REPORT

OF

THE PUNJAB BARANI COMMISSION

Government of the Punjab, Lahore

June 1976

I HAVE A VISION

I have a vision that one day the fields in our countryside will blossom with abundance, the rolling fields and orchards and village squares will ring with the song of happy children – children with the colour of blood in their cheeks and with books held under their arms.

We will build a society in which the old values of greed and advancement will be re-placed by a common concern for the welfare of the whole community. We will build over moments to our contemporary civilization – institutions of learning, factories and dams, atomic reactors and television censers these will be our Taj Mahals of the 20th century.

ZULFIKAR ALI BHUTTO

DAWN OF A BETTER DAY

It is only when the rural community is enabled to realize its potential and make to its rightful contribution, after receiving its due, to national progress and prosperity, that we can joyfully and with legitimate pride look forward to the dawn of a better day in Pakistan - a day whose sweetness and light are not confined to a few of us, but are the source of comfort, joy and pride for most, if not all, of us.

SADIQ HUSSAIN QURESHI

Date June 9, 1976

LETTER OF TRANSMITTAL

Dear Mr. Chief Minister,

I have the honour to transmit herewith the report of the Punjab Barani Commission constituted by the Government of the Punjab vide Notification No. S.O. G III-6-16/75, dated 20th January, 1975.

Respectfully,

(DR. Z.A. HASHMI)
Chairman,
Punjab Barani Commission.

Mr. Sadiq Hussain Qureshi,
Chief Minister,
Government of the Punjab,
LAHORE

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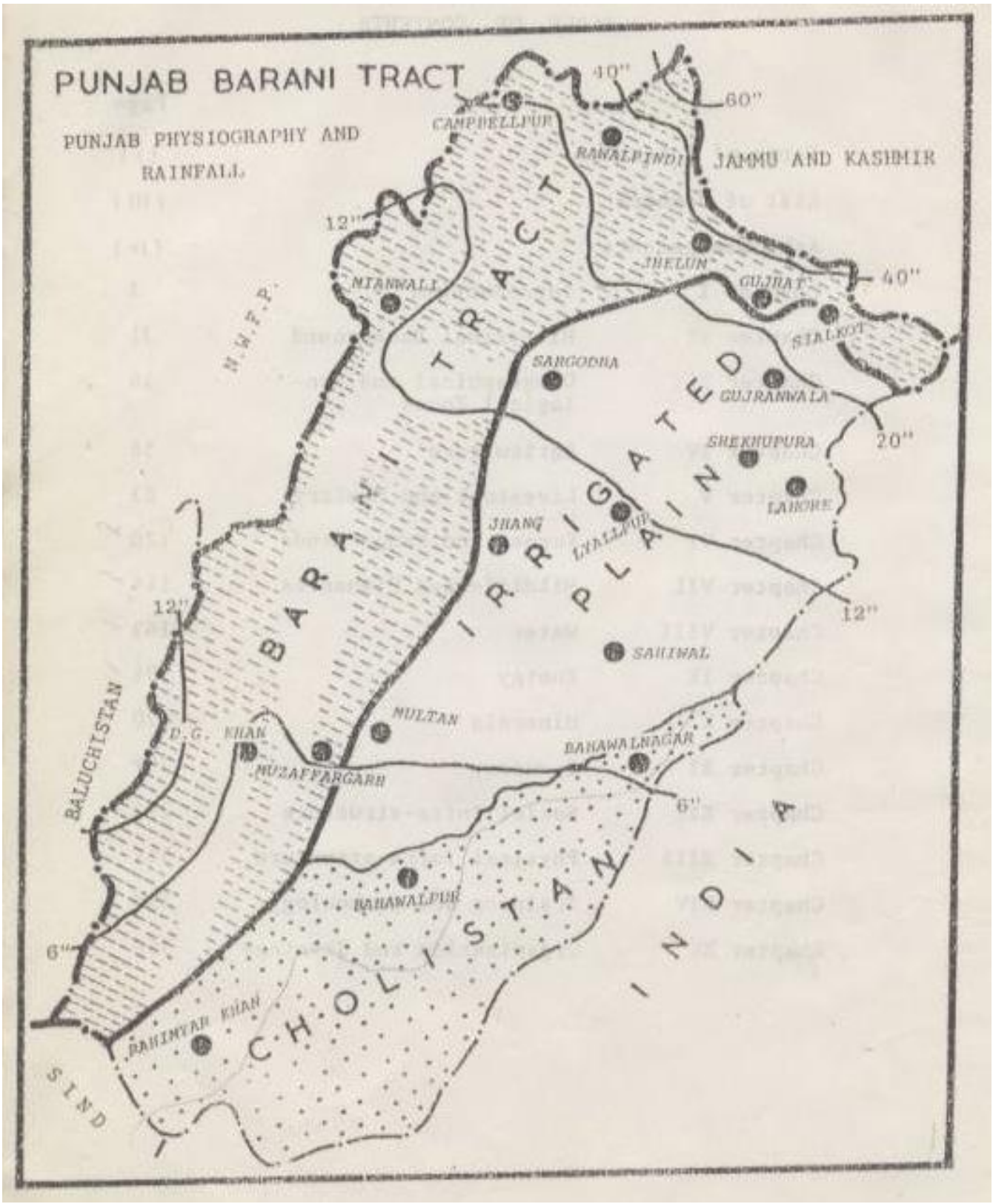
PUNJAB BARANI TRACT
PUNJAB PHYSIOGRAPHY AND RAINFALL
40"
60"
CAMPBELLPUR
RAWALPINDI
JAMMU AND KASHMIR
12"
JHELUM
MIANWALI
GUJRAT
40"
N.W.F.P.
SIALKOT
SARGODHA
GUJRANWALA
SHEKHUPURA
20"
LAHORE
BARANI TRACT
IRRIGATED PLAIN
JHANG
LYALLPUR
12"
12"
SAHIWAL
BALUCHISTAN
MULTAN
D. G. KHAN
MUZAFFARGARH
BAHAWALNAGAR
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BAHAWALPUR
CHOLISTAN
INDIA
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RAHIMYAR KHAN
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TERMS OF REFERENCE OF THE PUNJAB BARANI COMMISSION

The Governor of the Punjab was pleased to constitute the Punjab Barani Commission vide notification No. S.O. G. III-6-16/75, dated the 20th January, 1975 with the following term of reference:-

1) To identify Barani areas in the province and to survey their natural and human resources:
2) To examine the special problems, their nature and extent, faced by barani areas in various fields particularly in agriculture, soil conservation , water, small-scale industries, basic infrastructure etc:
3) To ascertain the development potential of barani areas and possibilities of technological and institutional improvement, with a view to indentifying investment / development programme in various sectors, with particular reference to sectors specified under (2) above:
4) To make concrete recommendations for the development of the Barani areas in various sectors including, inter-alia, the following :-
    a) For agricultural development, to recommend appropriate programs in the crops, animal husbandry, forestry, range management, fisheries and cooperatives sub-sectors and to advise regarding technology, cropping patterns, cultural practices, better seed use, fertilizer application, etc. and programmes for soil conservation, land and water development/ use most suited to the barani areas :
    b) For industrial development , to propose the types of industrial projects (particularly small-scale industries) which may be established in such areas so as to make the maximum use of local raw materials and minerals :
    c) For the development of physical infrastructure, to select appropriate sites for the construction of small dams, canals, road and bridges, and for power generation:

d) For the development of social infrastructure, to outline plans for improving technical education standards in the areas (with emphasis on establishment of skill- imparting industries) , and to make available increased health facilities :

5) To assess the financial requirements of the above recommendations in various sectors and suggest appropriate physical and financing phasing :

6) To consider the desirability or otherwise of establishing an independent or semi-autonomous organization / authority to plan, supervise and coordinate development activities in the Barani areas.

List of Members of the Punjab Barani Commission appointed by Government of the Punjab.

* * *

1.	Dr. Z. A. Hashmi, Chairman, Pakistan Science Foundation, Islamabad.	Chairman
2.	Col. Mumtaz Ali Khan, Resident of Thirchak, Tehsil Chakwal, District Jhelum.	Member
3.	Ch. Mohammad Aslam, MPA, Chakri, Tehsil and District Rawalpindi.	Member
4.	Malik Allah Yar Khan Khuda, Tehsil Fateh Jang, District Campbellpur.	Member
5.	Malik Mohammad Akram Awan, MPA Jauharabad, District Sargodha.	Member
6.	Mr. Farooq Ahmed Khan Laghari, Choti Zarin, District D. G. Khan.	Member
7.	Mr. Sultan Ahmed Cheema, MNA Tehsil Daska, District Sialkot.	Member
8.	Malik Muhammad Asad Khan, of Kalabagh, District Mianwali.	Member
9.	Chairman, Planning and Development Board, Punjab.	Member
10.	Secretary to Government, Punjab, Industries & Mineral Development Department.	Member
11.	Secretary to Government, Punjab. Agriculture Department.	Member
12.	Secretary to Government, Punjab. Forests and Wildlife Department.	Member
13.	Secretary to Government, Punjab. Livestock & Dairy Dev. Department	Member
14.	Secretary to Government, Punjab. Irrigation and Power Department	Member
15.	Mr. A. R. Khalid	Member/ Secretary

* * *

ACKNOWLEDGEMENTS

This Report is based on the communications received from various departments of the Government of Punjab and a large number of Specialists from the universities and the federal and provincial governments. It contains material collected by them from different sources including government documents. It is not possible to individually acknowledge their contributions. The Commission places on record its deep appreciation of the generous help and device received.

Amongst those who have given a great deal of their time are: Professor K. U. Kureshi. Dr. Maryam Ilahi and Dr. A. Rashid of the Department of Geography and Dr. F.A. Shams of the Geology Department of the Punjab University, Dr. Abdul Wahid Khan, Scientist Emeritus, University of Karachi, Dr. Abdul Hamid Khan and Agha Sajjad Haider of the university of Agriculture, Dr. Ahmad Hasan Dani, Dean , Faculty of Social Sciences, Quaid-i-Azam University, Dr. N. H. Azam, Secretary, National Science Council of Pakistan, Dr. Mohammad Aslam Khan, Department of Geography, Peshawar University, Mr. Abdul Qadir Khan and Dr. Mrs. Khurshid of the Meterology Department, Mr. Israrullah of the Geological Survey of Pakistan, Mr. Ilyas Dubash of the Department of Industries and Mineral Development, Mr. S. A. Rehman, Chief Engineer, WAPDA, Mr. S. M. Safdar, Project Director, Small Dams Organization. Mr. M. Nawaz, Chief Conservator, Forestry Department, Dr. S. A Qureshi, Punjab Agricultural Research Institute. Mr. Abdul Bari, Veterinary Disease Investigation Officer, Gilgit. Dr. A. Rehman Beg, Pakistan Forest Institute. Dr. Makhdoom Ali Shah, Director, Population Planning Council and Dr. Mrs. Nasera M. Shah, Senior Research Demographer, Institute of Development Economics.

Thanks are also due to the Member of the Commission; extremely busy people who took time out to tour the Tract discuss with the people and the official problems and remedies and made recommendations. Special mention must be made of the contribution made by Col. Mumtaz Ali Khan (Retd). He put in long hours of work in the organization of material for the report, and was constantly available for discussion.

Dr. S.M Qureshi Member Science, and Mr. Ejaz Ahmed . Member Finance. Pakistan Science Foundation are to be thanked for their mature advice on mumerous problems of approach and methodology that arose during the writing of the report .Mr M.Alim Mian ,Director, Soil survey of Pakistan took a great deal of intrest and provided a wealth of knowledge.

Thanks are due to Mr.M..N Sharif. Surveyor General of Pakistan and Mr. M.Abbas.Director. Map Publication . Survey of Pakistan .for their help in arranging the printing of the map and charts on a high priority basis and to Mr.Sameul Haq. Incharge of the Reprographic Section of the PASTIC and his staff for arranging the printing of the report in record time.

Mr. Mohammad Iqbal, Cartographer ,Pakistan Science Foundation worked with greater dedication on the preparation of as many as 37 maps and charts for the report. The typing work for the report was undertaken by M/s. Muhammasd Asharf, M.Gulistan.Ahmed Ali Shah. Asadullah. Mohammad Anis and Mehtab Hussain of the Pakistan Science Foundation and Mr. Abdul Aziz Khan of the National Science of Council who work cheerfully under great pressure.

In the end, I must thank the Secretary of the Commission Mr. A..K Khalid and his staff, as also the Secretary of the Pakistan Science Foundation. Mr.G.Murtaza Gilani and his staff for their unstinted cooperation and support. Mr. A Hameed, Deputy Secretary. Pakistan Science Foundation spent long hours in reading the proofs and generally talking care of a great deal of detailed organizational work

CHAPTER-I

INTRODUCTION

There is great concern in the world today that disparities in living standards and level of developments between the rich nations and the poor nations are increasing and that a few nations continue to appropriate the bulk of the earth's recourses. The people of the developing countries, inspite of political libration, are still relegated to role of producers of cheap raw materials for the industrialized and affluent nations. On the initiative of the third world countries, the United Nations have adopted the declaration of the establishment of a new International economical order' the second general conference of UINDO has similarly adopted the LIMA Declaration and Plan of Action', which covers abroad range of measure design to bridge the rap between the rich and the poor nations and the increase the share of the third world countries to atleast 25 per cent of world's industrial out-put by the end of the century. Within the developing nations, there is a similar demand from the people inhabiting the less favored region and those Belonging to the deprived section of society that they and their children should be given and equal right to development and access to the good thing of life.

National Commitment:

1.2. In Pakistan, the masses voted into power and today support a government which is totally committed to the reaction of new socio-economic order where in the benefits of development would be related to all the people including the people of backward regions and of the depressed strata of society. This commitment is enshrined in the 1973 construction of the Islamic republic of Pakistan. Article 37(a) (f) and (1), dealing with social justice makes the following three significant provisions ' The State shall : (1) promote with special care, the education and economic interests of backward classes or areas, (2) enable the people of different areas, through education, training, agricultural and industrial development and other methods to participate fully in all forms of national activities including employment in the service of Pakistan and (3) decentralize the government administration so as to facilitate expeditious disposal of its business to meet the convenience and requirements of the public. All public policies are being re-shaped to serve the common people rather than the city elites and the rural

feudal classes. A wide measure of reforms has been introduced in every sphere of national life. The appointment of the Punjab Barani Commission is a link in the chain of events which would hopefully transform life and living in the backward areas and is an earnest of the government's determination to evolve and implement well considered programmes to improve the quality of life of the mass of the people.

Development Perspective

1.3 The implementation of such policies and programmes is, however, no easy task as there has existed for centuries a stratified, unjust and exploitative socio-economic order. At the time of independence, the colonial rulers left behind a pattern of social organization characterized by a sharp dichotomy. There was : (i) the backward sector, comprising the mass of the people – the rural and the urban poor, with abysmally low levels of literacy and income, and (ii) the modernized sector, comprising about ten per cent of the population, which was educated or western lines, was comparatively affluent and had the out-look, habits and aspirations of the middle classes in advanced countries. This group has controlled the political and economical systems and has maintained, until recently, the same relation vis-à-vis the backward, mostly rural sector, which the colonialists had with the politically enslaved masses. The rural sector has been the source of cheap labour, cheap raw materials, and whatever capital that could be squeezed out of it. This sector has also provided the markets for the industrial goods manufactured by the modern sector. The modern sector, in fact, simply replaced the erstwhile colonial exploiters. The movement of resources, both human and material, has been from the rural to the urban areas. The functioning of the various sub-systems involved in the development and the pattern and processes of development have mainly served the interest of the modern sector.

1.4 The situation was further aggravated due to the style of development adopted after independence. Until recently, under the influence of the capitalistic world, a pattern of development was chosen which focused exclusively on economic aims and on maximizing the growth of the Gross National Product. The policy, adopted for the promotion of industrial development which was accorded high priority, consciously or unconsciously continued to be highly discriminatory against the poor people and the backward regions. Tax incentives, subsidies and protection resulted in the transfer of incomes to industrialists at the cost of the mass of the people. The exchange rate mechanism, the system, the operation of the banking system, the system of quotas, permits and licenses all operated to the disadvantage of the rural

areas and the poor. The results were disastrous. Agriculture and the rural areas were neglected which led to great income disparities and mal-distribution of wealth, rural unemployment as high as 45 per cent, and the exodus of rural poor to the cities. Slum formation in the cities, urban degradation and country-wide social and political unrest, were the aftermath of that short-sighted policy.

1.5 The record of the belated agricultural development was no better. The so-called green revolution caused income in-equalities, as only the larger farmers and the cultivators in the more favored regions could afford the risk of innovation and could command supplies of essential in-pute – the HYV seeds, fertilizers, tube-wells and tractors. It was highly selective : it helped the few rather than the many, because the majority of the small land-holders lacked resources and were institutionally precluded from taking advantage of the support measures provided by the State for the adoption of the new improved technology. Nearly 50 per cent of the rural population owned no land at all and worked as tenants, or tended livestock and worked as labourers : the majority operated farms of 1 to 5 acres per family. These rural poor had almost no access to the in-puts needed for the application of new technology.

1.6 The Barani Tract was entirely left out of the green revolution, on the ground that it was a high- risk area. The earlier push for industrial development had also by-passed the Barani Tract. This has caused an explosive widening of regional income disparities. It has been the poorer classes in the backward Barani areas who have suffered the greatest inequity in economic development. All this has given the people of the Barani Tract a deep sense of deprivation from the fruits of independence and progress. That there is sufficient reason for this feeling is borne out by a recent study of mass poverty in the nation conducted by the institute of Development Economics, based on house-hold income and expenditure survey data. The study has revealed that 80 per cent of the population lives below the annual expenditure level of Rs. 350 per person per annum and that this income level does not provide for even the minimum subsistence for a house-hold.

1.7 Pakistan is not the only country in the Third World which adopted such a style of development. Many countries were led to take this road and greatly suffered as a consequence. There is today a world-wide shift in emphasis from a strict economic growth approach towards the primacy of the social goals. But Pakistan has been perhaps the biggest sufferer because of the

enormous socio-political tensions created by unequal development in various parts of the country which was a natural consequence of the single-minded pursuit of purely economic goals. It contributed to the dismemberment of the country and has given rise to secessionist tendencies and negated hard-won economic gains. It is now recognised that the benefits of development must also be made available to the people in the depressed strata of society and those living in the backward areas, and not only to the people living in the more favoured part of the country, on the ground that there world be somewhat greater economic returns on developmental out-lays. This does not mean that economic development can be neglected: it has to be integrated with the ultimate objective of sustained improvement in the well being of all people.

1.8. There is thus a sound basis for special concern to develop the Punjab Barani tract and other under-developed parts of the country. It is necessary to improve productivity in such areas in order to:

(i) reduce the growing socio-economic disparity between the less developed and the more favoured regions,

(ii) enable these areas to contribute to, as well as benefits from national economic growth and development, and

(iii) Establish more stable form of land-use to overcome the detrimental effects of over-use caused by expanding populations and thus preserve and maintain the productive capacity of the land resources in these environments.

Potential of the Punjab Barani Tract:

1.9. The Punjab Barani tract, once the cradle of a great and flourishing civilization, the centre of a great empire which held sway for 2000 years, with rich cities manufacturing arms and implements from locally-mined and smelted iron, and with great seats of learning such as Taxila, has languished due to the vicissitudes of time, a highly exploitative use of resources and persistent neglect in development. This decline is long attending but the creation of the extensive system of canal irrigation at the turn of century in the Punjab plains, spelt the doom of the Barani tract, as the entire development effort in the province was thereafter diverted to build up the canal colony areas, leaving the poverty-ridden Barani areas as merely the recruiting ground for soldiers to fight battles for the british empire.

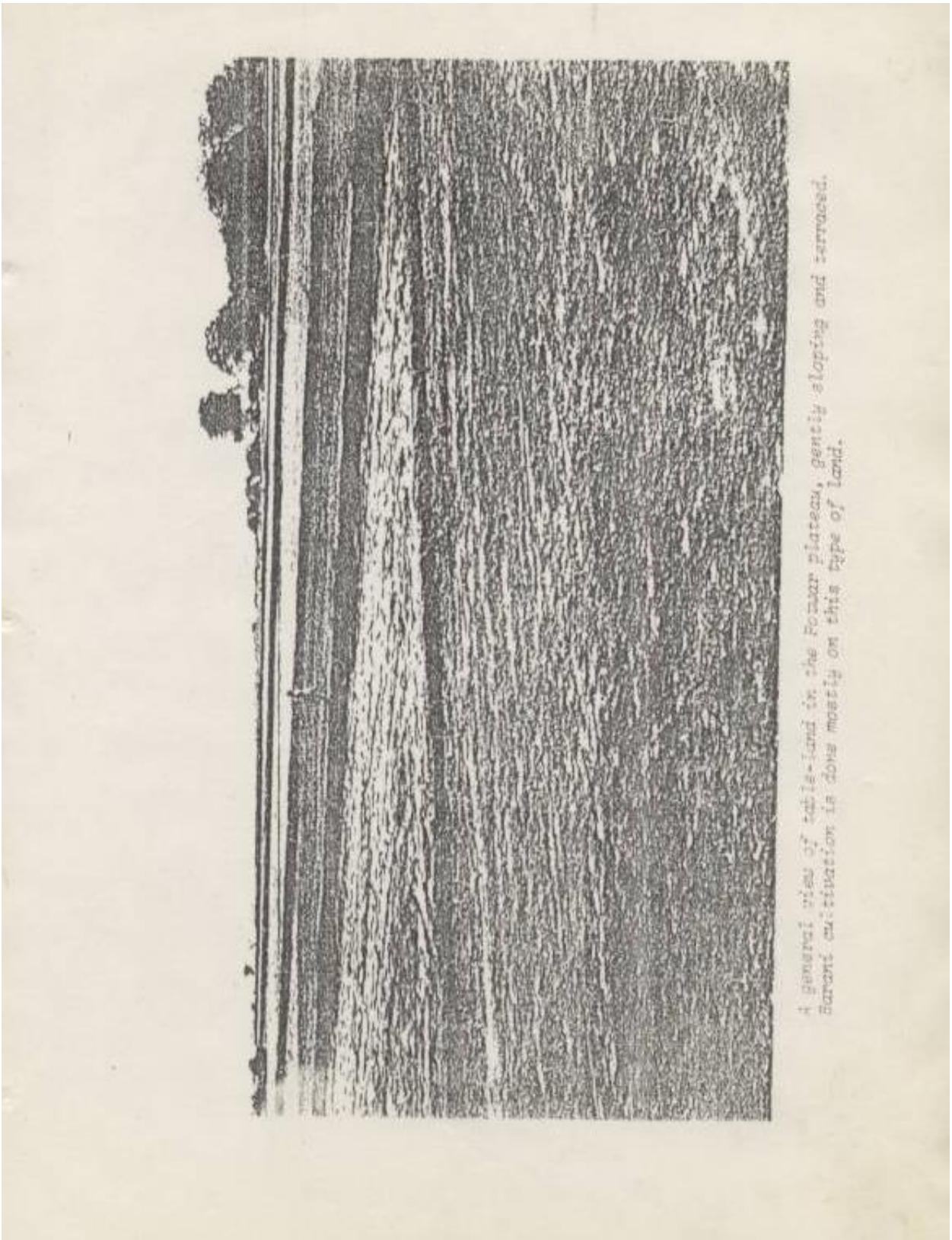
1.10. The potential of tract for development, however, is still very great. This is borne out from the fact that the tract has: (i) eighteen million acres of land and climate and rain-fall capable of supporting the entire population of the province if the present level of crop and animal production technology of demark, Holland or Japan is achieved,

(ii) about 90 per cent of the known reserves of minerals in the province, (iii) about 75 per cent of the forest wealth of provinces, (iv) ten million acres of one of the world's best-endowed range-lands which supports 9 million head of live stock and 4 million poultry , (v) 9.6 million people, one fourth of the total population of the province, with a higher education level, higher ratio of artisans, higher labour force participation rates for women, lower population growth and smaller ideal family size perception. As soldiering is the most favoured profession, there is a large number of ex-army people in every village community.

These men are disciplined and hard working, support modernization, and are highly motivated and capable of being quickly mobilized for development work, (vi) a considerable potential for energy resources : the Tract has wood-land, coal, natural gas and oil : and 600 M. W. nuclear power plant is to be built shortly and a complex of six such power plants is planned to be built by the end of the century. There are possibilities of radio-active materials and fuel in the tract.

1.11. The area is, at present, being managed at extremely primitive levels of technology and there are bright possibilities of securing manifold increases in agricultural production, in manufacturing and industries by the application of more productive appropriate technologies. It must be remembered that resources development is a function of technology and enterprise. Before the advent of modern technology, the Punjab was a semi-arid land traversed by five mighty snow-fed rivers. This tremendous resource was being greatly under-utilized and the rivers carried away bulk of the precious waters to the sea. Cultivation was, by and large, confined to narrow ribbons of land, a few miles wide, flanking both sides of the rivers. Between these cultivated ribbons lay stretches parched desert. The 19th century irrigation technology made it possible to build barrages and weirs across the rivers and divert their life-giving waters into a network of canals which converted large areas of barren land into blossoming crop fields, in such areas as Lyallpur, Sahiwal, Sargodha, Bahawalpur and Multan. With the canal system was created a complementary railway and road network to carry the produce to the sea ports and to link the newly opened-up areas with the rest of the country. What are today considered the

most developed parts of Pakistan were virtually deserts before the application of the 19th century technology.



A general view of table-land in the Potwar plateau, gently sloping and terraced. Barani cultivation is done mostly on this type of land.

1.12. It is not difficult to foresee and forecast that the 20th century scientific development and technology in such fields as genetic engineering, remote sensing, weather modification, space and nuclear technology would succeed, in the not too distant a future, in converting the Barani Tract also into a rich resource. Already, plans are well advance in creating vast new sources of energy in the area by the establishment of a complex of nuclear power plants beginning with a 600 M.W. nuclear power plant at Chashma in Mianwali. New breakthroughs in such fields as molecular biology and genetic engineering would no doubt bring about fundamental changes in the production patterns in agriculture and stock-husbandry. The HYV seed technology responsible for green revolutions all over the world is but only a beginning. It has already been demonstrated that the yields of wheat and maize can be easily increased two to four fold in the Barani Tract by using high-yielding varieties and chemical fertilizer.

Satellite-based remote sensing techniques have already identified huge copper deposits (over 300 million tons) in Pakistan and this and other newer techniques would no doubt be used for similar exploration in the Barani Tract. Remote sensing has many applications in fields such as agriculture, water development etc. There is already ample evidence that the Barani areas of the Punjab are rich in mineral resources. Even the known resources are being exploited at only about three per cent levels. There is little doubt that we have hardly scratched the surface in terms of exploring and exploiting our mineral and other resources.

1.13. While the beginning of development work in the Barani Tract may be in doubling crop yield through the mass scale application HYV seed technology, chemical fertilizers, and moisture conservation, the future of Barani Tract lies in the rapid development of its energy and mineral resources and the establishment of industries. In the agriculture sector the traditional farming system which was evolved for much lower population densities, a vastly different ecological configuration and for meeting the needs of isolated communities is no longer relevant. A fundamental reorientation of land-use practices and cropping patterns would have to be achieved to harmonise with the natural environment of the area. Such adjustments would be based on scientific studies and improved appropriate technologies. Water harvesting and moisture conservation, range-management and ley-farming, emphasizing livestock production and production of oil seeds and pulses would undoubtedly result not only in restoring soil fertility, conservation and improvement of environment and a much more highly productive

agriculture in the Tract but would also provide the nation with products that are in extremely short supply.

National Imperatives:

1.14. Apart from the obvious needs and opportunities to develop the Barani Tract, there are overall national imperatives which compel urgent attention to be given to the area. These include the following:

Water-resource development:

1.15. The life of Mangla and Tarbela, our large earth dams, is very short; in a few decades they are expected to silt up. There are not many more suitable sites for big dams. Before the reduction and cessation of the irrigation water supplies from the high earth dams, the nation must develop alternative means to counter the sharp decline in production which would follow the cutting off of these supplies. The harvesting and optimum utilization of the vast water resources of the Barani areas would provide a valuable alternative. Steps must be taken, without loss of time, to develop the capability for the full utilization of this resource and develop site-specific superior technologies for increasing agricultural and industrial production. The Barani Tract constitutes 36 per cent of the land-mass of the Punjab province and has in large parts enough precipitation to support balanced animal husbandry and crop-culture. The application of improved water harvesting technologies has already proved beyond any measure of doubt, in far harsher conditions than those in the Punjab Barani Tract, that highly productive crop and stock husbandry can be practiced.

Silting up of River beds:

1.16. Pakistan's river system constitutes its life-line. The system is threatened, amongst others, with: (i) the silting-up of the river beds and (ii) the increased salt content of the canal and river-water. The erosion in the piedmont, the Potwar and the Salt Range is directly aggravating both problems. Sediment production by the Soan, Kansi, Kahan and Bunhaf rivers of Potwar generally ranges from 5 to 7 acre feet (1700 cubic yard per sq. mile) in a year. Erosion in the

Barani Tract must, therefore, be reduced to the minimum not only to improve the local conditions but also for the continued prosperity of the nation as a whole.

Food-deficit:

1.17. The Barani Tract, due to lack of development and the explosive increase of population, has become a deficit area in terms of all supplies, particularly food-grains including coarse grains and pulses and is thus a great drain on national resources. It has an estimated deficit of 1.2 million tons of food-grains which has to be met by imports from outside (current production is 1.4 million as against the requirement of 2.6 million tons). The doubling of population by the end of the century will greatly increase the deficit. There is potential in the area not only to fill this gap but produce a sizable surplus. There is however no room for complacency and no time to waste.

1.18. The nation faces a difficult food situation which may grow much worse unless we proceed to harness every little resources to the maximum. The Barani tract is too big a resource to be ignored. The inter-censual rate of population growth between 1961-1972 is over three per cent but the growth rate in agriculture has touched on all-time low. It has averaged only 0.9 per cent per annum during recent years as compared with the growth potential of about five per cent per annum in the first nine months of the year 1974-75, imports of grains, pulses, flour and vegetable oil totaled Rs. 229 crore. Combined with higher costs of fuel oil and fertilizers etc. the balance of payment gap was an all- time record of $1335 million. Pakistan is thus on the list of the Most Seriously Affected Countries (MSA).

1.19. The Barani range-lands are the natural locale for raising livestock and are a major source of the supply of draft animals and foods of animal origin. Poor management of the range-lands has reduced their productivity to as low as 10 to 50 per cent of their potential, resulting in serious reduction of critical supplies of draft power and meat. Nearly 75 per cent of the draft power needed for farming is provided by the six million bullocks in the country. It has been authoritatively estimated that we have only about one half of the minimum draft power needed – 0.0 H. P. per acre as against 0.2 H. P per acre and the only sane way to get it is by doubling the draft power of the existing bullocks. The best draft bullocks in the country are produced by the Barani Tract. Improvements in their genetic quality would greatly help in meeting the deficit. Similarly, the consumption of meat in the country is as low as 8-10 lbs of meat per head per year.

The development of the Barani area Livestock Industry is also the answer to the problem of low supplies of meat as all over the world it is such dry-land areas which raise the slaughter stock.

Mass Migration:

1.20. There is continuous mass exodus of people from the Barani rural areas to the urban centre. Two major causes operate behind this exodus: (1) the population explosion and (2) rural poverty and under-development. It is estimated that the population in Pakistan would double within the next 25 year and that 50 per cent of the population will be living in the urban areas instead of the present 28 per cent. A disturbing feature of this migration is that migrant are moving into only a few major cities as the small towns are unable to provide employment . Major cities has thus become the refuge of the mass of poor people and are beset with insoluble problems of haphazard growth slums overcrowding inadequacy of services such as transport water supplies sewerage and unemployment. The solution to the problems of urban degradation does not lie in the cities, it lies in the eradication of rural poverty regional planning and the development of backward areas. It lies in increasing opportunities in the rural and backward areas through more intensive farming and small scale de-centralized industries, labour-intensive works programmes in the country-side to create better physical infra-structure, land development, and the development of rural towns in order to stagger concentration of people in the larger urban centres. While it is impossible to stop the migration totally it must be reduce and staggered in both time and space so that the problem become manageable.

Problems and constraints:

1.21. Some problems and constraints that effect progress in the Tract have been mentioned earlier in the preceding general discussion. There are many more which will be discussed in the chapters dealing with specific fields, such as, agriculture, industry mining, etc. It appears necessary, however, to briefly mention here a few problem areas which have a wide-ranging impact and determine the planning parameters and framework. These are broadly: (a) natural resource constraints, and (b) human and social problems. The natural resources constraints are: (a) erosion and low soil fertility, and (b) water losses. The human and social constraints are: (a) high population growth (b) unemployment and (c) lack of social institutions.

Erosion:

1.22. Wind and water erosion constitutes one of the major problems in the land. Estimates of losses of land from erosion vary from 12,000 acres to 30,000 acres going out of cultivation due to soil erosion every year. Wind erosion, has led to desertification of vast areas in the Thal and parts of Mianwali, Muzaffargarh and D. G. Khan districts where rainfall is low, summer temperatures are high and the soil is loose and sandy. Here, dust storms and shifting sands damage crops, choke up water ways, and the blowing away of the finer particles of soil leave behind infertile sandy wastes. Water erosion is severe in the northern and north –eastern parts of the Tract, in the districts of Jehlum, Gujrat, Rawalpindi, Camellpur and Sargodha. Millions of tons of fertile top-soil gets washed away to seas and silts up rivers and irrigation structures.

1.23. The Barani Tract presents such a stunning picture of sheet and gully erosion that people are over-whelmed by the sight of the colossal physical damage. They would like

to see the ugly scars disappear expeditiously and readily endorse expensive and often wasteful programmes for the leveling of such lands through heavy earth-moving machinery. It is not generally realized that the greater part of the badly cut up areas, particularly gully erosion, has been the result of geological erosion for which man is neither responsible nor can he reverse the course of natural pro-casses. Man has indeed aggravated the problem by deforestation, over-grazing, cultivation of slopes and marginal lands, and by adopting land use and cropping systems which leave soil bare and exposed to water and wind erosion thereby disturbing and damaging the delicately balanced eco-system. Such damage cannot, however, be arrested by land leveling or building anti-erosion structures. The basic problem is one of restoring the ecological balance and involves numerous adjustments which only an enlightened and informed approach would bring lands by mechanical means, without simultaneously implementing carefully worked-out land-use and water management plans. The gullied land in its natural state is more or less stable but when disturbed through land-leveling is subjected to active erosion.

Low Soil Fertility:

1.24. By far the most important problem of the Barani Tract is the extremely low level of soil fertility which is the direct immediate cause of low crop yield in the Tract, the food deficit and prevailing poverty. The soil Testing Laboratory, Rawalpindi has reported on the basis of tests on 8,000 samples that 95 per cent of samples show deficiencies of nitrogen, 75 per cent of phosphorus and 10 per cent of potassium. All soils are thus short of essential nutrients, particularly nitrogen. In areas where ground-out is cultivated a rapid depletion of phosphorus from the soil takes place and unless phosphatic fertilizers are used, crop yields drop very materially. The soils are low in organic matter because of deforestation, over- grazing, and the burning away of most of the manure as fuel. No part of a crop is returned to the soil as even the stubble is grazed by the livestock and an exhausting cropping pattern emphasizing cereals is practiced. Almost 50 per cent of the land is kept fallow and the lack of vegetative cover on the soil permits the leeching of the soil. The hard pan created by the continued use of the inefficient country-plough accelerates the run-off and results in low fertility levels. The proportion of leguminous crops in the crop rotations is very small, although the potential of the area for growing soya beans, pulses, ground-nuts and other soil-enriching leguminous crops is very great. The adoption of a more suitable cropping pattern which would include leguminous fodders, such as, the key-farming system practiced in Australia, could add annually 60-80 Kg of Nitrogen per

hectare per year, as legumes have in their root nodules microbial form which fixes in the soil the nitrogen of the air.

1.25. Most of the dung and droppings from livestock, which are an excellent source of soil nutrition are presently wasted, or brunt for fuel. The re-cycling of such manure and other organic matter could provide the major part of fertilizer needed in the area. Very cheap bio-gas plants have been successfully evolved, both farm-sized and village community size, for the fermentation and conversion of farm yard manure and other biological materials into methane gas and residual sludge which is an excellent fertilizer. The manure from livestock herd of nine million head of stock in the Punjab Barani Tract could supply much more energy than is obtained currently from burning the manure, as also the equivalent of 14 million tons of chemical fertilizer. Nearly 10,000 bio-gas plants are in operation in India and hundreds of thousands in China and the Philippines.

Water Losses:

1.26. Water Is one of the major constraints which limits agricultural production in the Tract and effective water management is perhaps the biggest challenge in producing rapid yield increases. Although total rain-fall in many areas is adequate for crop production, the seasonal pattern of precipitation often does not coincide with plant growth requirements. Great difficulties arise from the variability and irregularity of the rainy season causing uncertain and intermittent water supplies to crops. Periodic droughts result in the reduction of grazing and losses to livestock. Besides, much of the rainfall is lost through run-off which is estimated over large areas to be as much as 50 per cent. If the loss is taken at only 25 per cent of the average precipitation, when extended to all the Barani crop-land, it represents something of the order of three million acre feet of water i.e. nearly one-third of the usable capacity of Tarbela Dam. Extremely effective water harvesting techniques have been developed in Australia, the U.S and a number of other countries and such proven technology needs to be adapted to conditions in the various ecological zones in the Barani Tract.

1.27. During the rainy season, the water in the numerous streams, rivers and the hill torrents in the Tract becomes a bane for large areas, causing flash floods, devastation of crops and washing away of top soil. The water so lost could irrigate at least two million acres if this

resource is properly harnessed. Very crude methods are used at present for diverting flood water into cultivated areas. Hydrological surveys to identify possibilities of harvesting and tapping water resources both surface and underground through tubewells and wells need to be vigorously pursued. Systematic studies, surveys and planning should be under-taken for the construction of medium and small dams, ponds etc. It is necessary to re-orient the entire system of land-use, the cropping pattern, the leveling and terracing of lands and the tillage practices to the conservation and full utilization of the available moisture.

High population growth:

1.28. The very high population growth, currently over three per cent per annum and the consequential imbalance between population and resources is a factor contributing to all the major problems in the Tract. There are too many months to feed, clothe and house, and many more being added every year who would need and demand not only the basic necessities of life but all the good things of life that they would see people enjoying in the advanced countries. Combined with the primitive technology used in agriculture and the low yields, it is the direct cause of low per capita availability of food and widespread malnutrition.

1.29. The disturbance of the man-land ratio has resulted in extensive resource depletions and in very small uneconomic holdings e.g. 80 per cent of farms in Gujar Khan Tehsil are less than 2 acres in size and the owners of land are abandoning such holdings and migrating to urban areas. Most of the enterprising and the able-bodied persons are moving out of the area leaving behind the young and the old, the women and the least enterprising. There is thus paradoxically a shortage of labour in the Tract, in particular at the time of sowing and harvesting which cannot be staggered because these operations are dependent on rain-fall.

1.30. The tenant holdings (53 per cent) have little incentive to improve the resource base and generally follow the most exploitative system to gain immediate benefits. The owner-operated farms, because of their small and uneconomic size have no savings for re-investment in land improvement or for necessary in-puts such as fertilizer and high quality seed. The area under forests has decreased due to felling of trees for timber and fuel and to create farm-land marginal lands are being cultivated causing soil erosion, the range-lands have deteriorated due to over-stocking and un-controlled grazing. The disturbed man: land ratio is thus resulting in a stagnant,

unprogressive and exploitative system of land use, very low levels of soil fertility and environmental degradation.

1.31. It is possible to alter these trends and to establish a condition of ecological and economic stability that is sustainable for the future, provided a clear under- standing is achieved at various levels of decision making that a transition must take place from growth to equilibrium and ecological balance.

Unemployment:

1.32. Over three million persons, roughly 51 per cent of the males and 7.5 per cent of females above 10 years, are in the labour force in the Barani Tract. The growth in this huge labour force would be massive in the next ten years, between 30 to 40 per cent, due to increase in population and the likely increase in the participation of women in the labour force. Roughly 70 per cent of the labour force is engaged in agriculture, about 9 per cent in village and cottage level manufacturing and the rest in services. The economy of the Tract has been declining for many centuries and even after independence, the Tract has seen little growth, either in agriculture or in industry. Very few new job opportunities have been created but the growth in both population and the labour force has been very rapid during recent years and is now measuring at over three per cent per annum. The population employment equation has been, therefore, seriously disturbed and in the years to come will undoubtedly assume even greater importance than the population: food equation.

1.33. The population explosion has caused the area per person to dwindle and the holdings are fragmented. The farming system is archaic and the productivity and income levels have been falling. There is an increasing number of people willing to work who are unable to find jobs on which they can maintain an adequate living standard. The landless and the jobless are living without dignity and security. In fact, due to the unjust and exploitative world order and the style o development formerly adopted in the nation, there has been not only little change in the living standards of the people in the Barani areas, but they have ceased to have the capability of providing a living to their children. The urban drift of the under- employed and the unemployed has been a phenomenon unrelated to the adventure of breaking new ground, but a simple transfer of misery from the rural areas to the urban areas.

1.34. There is gross under-employment and much overt unemployment and consequently a mass exodus of the able bodied from the Tract, to work in the Army, in the large urban centres and in the more affluent countries. The Tract is thus not utilizing its considerable human resources. The efforts made to provide work so far have been on traditional lines i.e., through a variety of works programme. A recent report based on a study under the auspices of the Planning Commission makes disquieting reading as to the success of such an approach. Human resources cannot be effectively used by simplistic approaches to 'creating jobs' which tend to degenerate into doles and not infrequently corruption. What is needed is the growth of employment policies from an over-all strategy of resource utilization, by establishing appropriate labour intensive industry, by the modernization and diversification of agriculture, labour intensive farmer enterprises such as poultry keeping and livestock production and intensive and multiple cropping. Only an integrated approach linking employment with increased production and the overall development and utilization of resources would succeed.

1.35. Wealth must be generated within the Tract. Employment created through outside assistance, grants, loans and aid of one type or another, howsoever substantial, would not even begin to solve the problem. Employment for the sake of employment would increase the money supply, and the demand for food and other consumer goods. Unaccompanied by increased production it would inevitably lead to inflation. Employment-oriented programme should be linked with production and it is only when savings are generated and re-invested that a dynamic growth pattern would be established which can sustain full employment as well as the provision of basic needs. Ultimately, it is productivity per person which is measure of the prosperity of a people. Thus, rural employment, productivity and prosperity are all interdependent.

1.36. In order to generate production-linked full employment, a sizeable percentage of the rural labour force would have to be employed in the non-agricultural rural sector, mainly in cottage and small-scale industry and related services. Within the framework of our resources, agriculture and large-scale industry would not be able to ensure full employment to the people. Productivity increases must be accomplished so as to increase simultaneously employment opportunities and also ensure distributive justice. Maximization of net income on small holdings would imply greater employment of labour than does the maximization of profits on large mechanized holdings. Similarly, large industry may mean growth of national economy but

limited expansion of employment and such a growth which leaves substantial sections of the population little better off than before is a highly questionable objective to pursue.

1.37. The major sector offering employment, namely agriculture, has peculiar problems of its own in the Barani Tract. Due to the absence of controlled irrigation there can be little staggering of sowing/harvesting time. The dependence on rain requires the completion of operation, such as seed-bed preparation, sowing and harvesting, in a matter of few days and at such peak times labour availability become a very serious constraint, although during the rest of the year there is not much work for the peasants. Employment must thus be found in the village orbit in small-scale industry located in the rural areas so that a pool of labour exists in the country-side which can be drawn upon during peak labour season. Migration takes away the more enterprising and the more talented out of communities and the hiatus so created in leadership roles inevitably ideas to slow progress and absence of innovation and creative purposeful change.

Lack of Social Institutions:

1.38. The village community in the Barani Tract, like similar backward communities everywhere, is under relentless pressure from numerous forces of modernization and change. For centuries, it was a stratified but cohesive unit which was structured to preserve the oligarchy of the privileged classes and functioned on the basis of custom and usage. The evolution in communications has broken down its isolation, the market economy has taken away its self-sufficiency and the democratic political processes have altered its power structure. As almost every village community in the Tract has its members working in the large metropolitan areas, in the army and the services, and in foreign countries, there is continuous contact with the outside world. The people no longer look to the local community for securing their rights, for economic opportunity and work, for supplies, market and credit or even for their recreation. The unit integrity, and hierarchy in the village has disappeared and the old established socio-economic order has crumbled. The village community today stands destructured; every individual is on his own working for himself and his personal family.

1.39. Individual efforts, un-tempered by social concern and the welfare of the community as a whole, inevitably mean that the few, influential well connected and affluent

people appropriate the lion's share of the benefits from development, creating islands of wealth in a sea of poverty and the consequential tensions and conflicts. It also inevitably means unplanned and exploitative use of the natural resources of the area. The attack on poverty and under-development must be a collective endeavor, so that there is also distributive justice and benefits for all the people in the community. This requires restructuring of the village community to develop the base for the performance of organizational and managemental tasks.

1.40. A variety of new institutions have been experimented upon under various programmes of rural reconstruction - the Panchait, the village Aid, the Basic Democracies and the Integrated Rural Development Programme, but there has not been enough time for there to take root. Recently legislation has been enacted to establish local government institutions, namely the Deh Council, Halqa Council, the Tehsil Council and the People's District Council, with a wide range of responsibilities and powers. The entire country is to be covered by these institutions which would provide the base for the effective participation of the people in the management of their resources as also for liaison with the development activities of all government departments and agencies including integrated Rural Development Programme, the people's Works Programme, the Social Welfare Department and other nation building departments.

1.41. In view of the multiplicity of functions entrusted to the proposed local government institutions, it would require ancillary organizations for providing services and for resource management functions. There is general consensus that is institution with the greatest promise for the purpose is the cooperative society and a great deal of earnest thought is being given to the form and structure of the cooperative. The predominant type of the cooperative in the country – the cooperative credit society, has had a very chequered history and record. It is felt that the challenges and opportunities which face rural communities require a cooperative organization with an expanded scope. The Government of Pakistan have decided to launch in every province, on a pilot basis, farming cooperatives based on the pooling of land. There is also the Comilla/ Daud-Zai type of cooperative organization, which has a considerable record in performing production, marketing, service and developmental functions alongwith requisite emphasis on the education and training of the people.

1.42. The cooperative institutional structure to be created in the Barani Tract must be such that the organization can effectively assist in the management of resources, both material and human. Such an institution should be capable of making a determined bid to change the state of technology and modernize means of production. The situation in the Barani Tract is particularly favourable to the organization of cooperatives. The farm size has become so small that a large majority of the owners have left the Tract in search of jobs elsewhere. They would welcome initiatives for organizing cooperatives. The tenants have been given a wide range of protection under the land reforms. They would find it much easier to secure their new statutory rights if they dealt with an organization such as a cooperative instead of the owners of the land. It would, however, take a good deal of education and training of the people to act as good cooperators. Cooperation is indeed the highest activity of civilized man. Such training has been effectively imparted under the Comilla/ Daud Zai programme and this feature must be incorporated in whatever type of cooperative society is promoted and established in the Barani Tract.

Development Model:

1.43. All previous work in rural development has been based on the affluent country model of agriculture extension work. In this model a few progressive farmers are the target population, who are persuaded to pioneer in the adoption of innovations and improved technologies for increasing production. The results are then propagated, through the 'demonstration' method, to others in the rural community who see the advantages of the improved methods and means of production and have the resources to purchase the package of recommended inputs.

1.44. This method which places reliance on the perception and acumen of the individual, his initiative and financial capacity, inevitably reaches only o limited population of the more enterprising, educated and affluent farmers. They grasp the significance of modern improved method, have the contacts to obtain technical help from agricultural and other governmental agencies and possess the capital to purchase the recommended inputs. The 10 per cent or so of the farming population who become the beneficiaries of this system receive a variety of subsidies and price incentives for their surplus produce. These progressive farmers, because of their increasing income and savings, manage to buy up the lands of their poorer and

less progressive neighbours who keep drifting to the urban areas. Typical of this system is the case of the USA, where only about 3.5 per cent of the population now own all the farm-land in the nation. The mass of the rural people have had take up other work in industry, business and services. The system was, however, saved in the U.S by the rapid growth of urban economy which provided jobs for a safe proportion of the surplus farm people.

1.45. No such urban opportunities can be created in the foreseeable future in Pakistan. In fact the big cities are already face with numerous insoluatle problems because of the inability to provide minimum amenities in terms of housing, transport, employment, water supplies, sewerage etc. for the large number of rural people who keep migration into metropolitan centres. In Pakistan, therefore, only such approaches to agricultural modernization should be used which reach and benefit the mass of the rural people and do not lead to mass migration. The affluent country 'Extension' model, is not designed to achieve this objective and like-wise, our own extension services which have been organized on this pattern. Such services have reached only the upper ten per cent of the rural people and hence the early ceiling reached in the green revolution which, inspite of the technical potential of increasing yields fabulously, has neither wiped out the food deficits nor the object poverty of the farming people.

1.46. Our situation, therefore, requires that decision making at individual farmer's level is substituted by decision making at the community level. Even when convinced of the merit of the new technology, individual small farmers find it impossible to identify and obtain the inputs needed. Such resources can only be obtained collectively through a network of farmers cooperatives. Extension work, under our conditions, should aim at modifying the group behavior. The individual farmer's behavior would of course, be changed as the behavior of the group changes but the process involved would be group dynamics. The logic of the situation demands that the various departmental extension agencies should work through the farmer's cooperatives in the village and in the development area. The training of the individual and the modification of his behavior should be a function of the cooperative society and not that of the extension services.

1.47. The inputs recommended for development have been similarly based on the practices followed by the rich countries. These are mostly imported industrial products such as agricultural machinery, fuel, chemical fertilizers and pesticides. This pattern is a part of the

overall imitative life-style and style of development adopted by the nation for industrial and agricultural development in general. The funds have come from foreign loans and the forced savings of the rural masses but the benefits have gone to the rural elites. The mass of the people have only derived minor fringe benefits.

1.48. A more equitable self-reliant and self-sustaining style of development will have to be adopted based on the participation of the mass of the people, labour-intensive, low-capital, low-energy and austere use of locally available materials and resources and appropriate technology in order to generate resources required for growth. Such a style of development is desirable not only due to resource constraints but also because it is scientifically more sound. The modernization of agriculture in the affluent societies has been capital- intensive and based on high-energy inputs, as they managed to acquire oil at vey cheap prices. This style under the changed circumstances, is being seriously challenged today by the enlightened people of even rich societies as wasteful, costly and environmentally polluting. It is asserted that, in absolute terms, more energy is put in than is harvested from an acre under the capital-intensive system of farming.

1.49. The Third World is also no longer willing to sell oil and other raw materials at throw-away prices. Pakistan does not have the industrial base to produce to inputs needed under such a system more the capital to import enough of inputs. The import of farm machinery, fertilizers and pesticides is being paid for in scare foreign exchange and can meet the demand of only a small number of the richer farmers. If the benefits are to be provided to the mass of the people, then an entirely different system would have to be used, which must under our own conditions be a low-energy, low-capital system, in greater harmony with our resource base and stage of development. This will also mean a balanced eco-system and much less environmental pollution. The critical elements in this system are: (a) the recycling of waste materials e.g. bio-gas plants, composing etc: (b) balanced management of natural resources, utilizing nature's own recuperating mechanisms such as, the Australian Ley-Framing system. The expansion of acreage under leguminous crops such as ground-nuts, beans, pulses and fodder crops, which have in their root nodules nitrogen-fixing bacteria, would add nitrogen to the soil and restore soil fertility. A soil-enriching cropping pattern, emphasizing legumes instead of the existing high cereal soil-exhausting rotation and integration of crops with livestock production provides the key to sustained yield increases.

1.50. In the case of industry, the emphasis in the first phase should be on appropriate technology and rural industry small-scale, labour-intensive, high employment and based on locally available materials. In particular, input industries such as small production units for improved farm implements, small fertilizer plants, small pesticide plants, processed feed mills should receive a very high priority. Agro-based industries such as oil-mills and carpet manufacturing units, and mineral based industries would provide value-added products and increase both employment and income. A substantial share of the income of the rural communities should come from the small-scale and cottage industries to augment their agricultural income. For the development of energy resources, the first attention should be given to energy plantations, local coal for small thermal power plants and bio-gas plants.

1.51. Environments are unique to their location. Problems arising in them must be solved by local knowledge and institutions. There is no well-staffed, well-equipped research centre in the Barani Tract and very little data based on scientific surveys is available on which objective planning can be undertaken. The institutional structure and innovative activities which could identify opportunities and constraints and create site-specific technology or assure the integrated development of local resources are non-existent in the Barani Tract. All research and planning processes are conducted by provincial level institutions and organizations. In the past, there has been little coordination between economic and physical planning (area development) and this has resulted in inter-regional disparities and unbalanced growth in various parts of the province, the Barani Tract being a major sufferer.

1.52. Development programmes have arisen out of the initiatives of individual agencies have been essentially single-factor ventures. Various government departments, such as, Agriculture, Forestry, Animal husbandry and Industries, have been working without much coordination. Expensive development and conservation schemes have been launched to achieve one or two objectives falling within the purview of a single department. Without consideration of other inter-related purposes. Important elements in the development of a sound comprehensive approach have been ignored. An area approach, based on local surveys and studies to assess resources, needs and opportunities for each unit area or region, would alone make for balanced development.

1.53. All regions, however defined, represent human belief that they can be treated as, units. When assigned purposes related to resource development, they become operational planning and management units. The Barani Tract forms one large region but it is too big a unit for comprehensive planning or management. There is very little in common, for example, between the Murree Hill area and the Sulaiman Piedmont areas of D. G. Khan, although both fall within the Barani Tract. They have different resources, problems and opportunities. For purpose of management they would have to be demarcated into district and separate area units to be organized as Resource Management Areas (REMARS).

1.54. For efficient management, the size of the area unit (REMAR) and its focal point for development will have to be determined carefully and on the basis of scientific criteria, discussed later in the report. The distinctive aspect of REMARS would be: (i) the efficient management of the totalities of the resource base- agricultural, industrial, human and social, (ii) the participation and up-lift of all the people- the farmers, artisans, labourers and all others, organized for collective action on a unit area basis, so that every part of the Tract receive the benefit of improved management and on a self-reliant basis through increased production, savings and re-investment.

CHAPTER-II
HISTORICAL BACK-GROUND

2.1. The Punjab Barani areas slope from the foot of the Himalayas, commonly known as the Siwalik Hills. They include the north eastern parts of the Sialkot and Gujrat Districts, the Siwalik Piedmont plains, the northern hilly areas of Murree, the Potwar uplands, the Salt Range and the adjoining plain, the That and spread down along the bank of the Indus intro Mianwali, Muzaffargarh and D.G. Khan districts. The Salt Range swoops down from the heights of Mangla in a curved shape and, passing through the districts of Rawalpindi and Cambellpur, goes across the Indus over to Kohat and Bannu districts. To the north of the Salt Range lies the undulating Potwar Plateau, which is drained by hill streams like Soan and Harro, often deeply furrowed and tortuously meandering due to geologic formation. It was during the Pleistocene period that much of this area was filled with yellowish loess that rises in considerable heights at some places. The geologic warping has cut up the soil and left many gullies here and there. As a result, these could not form a long flat plain and hence no perennial rivers traverse this zone. Consequently, the whole of the area can be termed Barani.

2.2. The natural make-up of the area was not left un-marked by man. In fact, this is the zone where the activity of the earliest man has been evidenced in Pakistan. The Siwalik area is well know to the paleontologists for its rich fossils of mammals and primates. And it is here, in the different terraces of the loess cut up by the rivers Soan and Harro, that the so called Soan Valley cultural material has been found. So far, we have discovered the human fossils of this period but the stone tools, made of quartzite, are said to follow chopper-chopping tool tradition. Their affinity has been seen with the material found in the Chou-Kou-tien Cave near Peking in China.

2.3. With the retreat of the glaciers following the Pleistocene epoch, the zone was populated by hunter-bowmen, who chased the fast running animals with their newly invented stone-tipped arrows. But soon, man learnt the art of food production. The earliest method of food production known in this area was by the process of terrace cultivation. This system of terracing prevailed right through Kashmir. At the site of Harwan near Srinagar, the earliest pit dwellings of this food producing community have been found. And, here at Saraikala, near Taxila, the

oldest materials relate to this phase of history. But soon the whole complex of life was to change with the discovery of the knowledge of irrigation. The Bronze Age shifted the population towards the fertile soil of the five-river irrigated plains of the Punjab and the deltaic region of Sind. However, the sturdier population continued to live in the Barani area and maintained their supremacy by hard work and their martial spirit. Both these characteristics are writ large in the people of this area. And it is because of this feature that throughout history, people of this area have swelled the armies and always striven for empire building.

2.4. Their martial spirit found expression with the development of iron industry in the area. Both iron and coal were discovered embedded in the rocks in and around Campbellpur district, the deposits running down to Kalabagh. Between Chhoi and Pindigheb in Campbellpur the remains of a large number of human settlements have been discovered. At some places stone walls of the houses are still standing to height of six to seven feet. All over this area are scattered iron ores, iron slags and blow pipes by the side of furnaces. The iron-ore was extracted locally and this extraction has left tunnels in the hills, locally called Surag.

2.5. It is the discovery of iron that led to the rise of the city of Taxila and the empire building on the basis of this iron technology was attempted by the Greeks, Scythians, Parthians and Kushans. All over this region small industrial centres cropped up and they brough their finished product to the Indus for onward transmission to distant places. From Attock down to Kalabagh, the whole area was bubbling with industrial life. In the account of the Greek historian Herodotus, the warriors of this area are said to be much in demand for their skill in iron-tipped arrows.

2.6. On the walls of the Achaemenian palace at Persepolis, the tribute-bearers, who carried gold from the washings of the Indus, are graphically depicted with their loads hung at either end of the pole on shoulder and sturdy bulls of tribute driven in front. The humped bull of this region has been famous throughout history and it is again here that the Greeks learnt of the fierce animal – the elephant that served like a tank in the ancient battles.

2.7. Throughout the history of this period, Taxila has remained an important seat of Government. It was a connecting link between the Indus and the Oxus and between the hilly passage to the north and the Arabian Sea to the South. It is because of this strategic importance

that a royal road was built by Darius in 6th Century B.C. to connect Taxila with Persepolis. This road served as a dual way of transmission of ideas and trade between the east and the west. As a result, Taxila become an important seat of higher education and very soon the university at Taxila earned world renown. Basic to this development is the technology of iron that was improved to an unprecedented extent.

2.8. At the same time, two other technologies were introduced here. One was the arghatta or Persian wheel system which helped in drawing up water from deep wells for the purpose of irrigation. One deep well lined with ashlar stones can be seen in the vicinity of Nurpur (Islamabad) high up in the hill. This technique of well irrigation was highly developed at this time. The second was the search of natural water springs all over the hilly areas. This spring water was then channelized from one terraced field to another and all along food crops were produced. A large number of villages has been discovered in the vicinity of these springs. In fact, some of the important villages, like Saidpur, in the Islamabad area, grew up around natural springs. Here in these two sites archaeological remains go back to ancient history.

2.9. It was during the Kushan period, in the early centuries of the Christian era, that this Barani area witnessed the golden age of its development when road communication was developed, international trade along the famous Silk route was diverted along this passage, industrial crafts encouraged, minerals – both metal as well as precious stones were extracted. Smithy progressed because of the control of temperature in a closed furnace. Agriculture was given a new life by the introduction of the Persian wheel. The art of the stone-carving, as witnessed in the numerous specimens of Gandhara art flourished, urbanization increased and the peaceful religion of Budha was sung and practiced in thousandsof monasteries the ruins of which can be seen on every hill top and in the glens and valleys throughout the area. The Shahan-Shahis, as the rulers were called, have left a deep impress on the life pattern of this area.

2.10. This technological development became static thereafter but the invaders from Central Asia established a new military order in the 9th-10th Century A. D. when land was apportioned by military clans. The Gakkhars and Janjuas rose up to be feudal lords as also the Awans and the Khattars. With the loss of foreign trade and decline of industrial interest, dependence on land increased but the feudal lords usurped to themselves the right of collecting their share from the toiling agriculturists who had to choose between seeking refuge in slavery or

accepting military service. Agriculture declined, cities were abandoned, and villages fell into ruins. In their place were built numerous feudal forts on hill tops in order to preserve and protect the interests of the tribal lords. Such forts can still be seen all over the area.

2.11. Throughout the Muslim period, the area was overgrown with forest and became a battle ground of the war lords. It is through this area that Taimur and Babar passed and it is here that Sher Shah Suri fought several battles with the Gakkhars. Later, the Sikhs ravaged the area to establish their authority and realize their share from the feudal lords.

2.12. During the British rule, population increased rapidly and the exploitative use of the natural resources continued unabated. Forests were cut, marginal lands were brought under cultivation, and wide-spread erosion of lands occurred due to an inappropriate land-use pattern. The holdings fragmented, the ranges became bare due to over grazing and rural poverty touched its nadir. The British turned the area into a recruiting ground for their armies.

2.13. At the turn of the Century they introduced an unparalled irrigation system in the arid Punjab plains, between the great snow-fed perennial rivers, converting the parched desert land into green fields for producing cheap raw materials for their industries and established road and rail links with the ports on the Arabian Sea. This effectively snapped the connections of the Barani areas with West and all trade was diverted to the sea for onward shipment to Europe. There was little incentive left for the improvement of the Barani areas which fell to the mercy of nature and all its past glory lay concealed behind the ruins and monuments of old.

CHAPTER-III

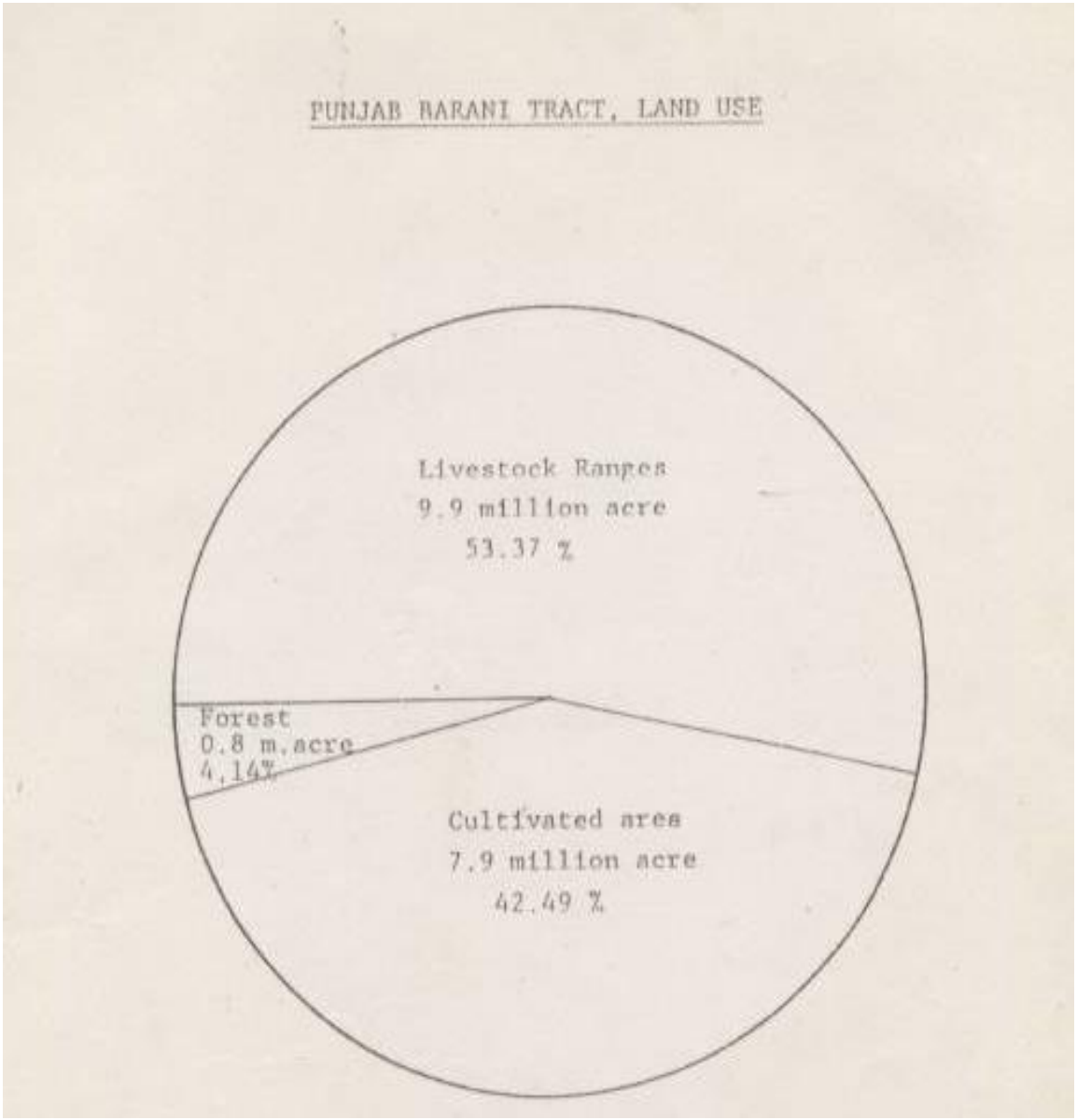
GEOGRAPHICAL AND ECOLOGICAL ZONES

Delineation of the Barani Tract:

3.1. It was decided at the first meeting of the Commission, presided over by the Chief Minister, that the Punjab Barani Tract, for the purposes of the Commission's jurisdiction, would comprise such contiguous areas in the province, as are not served by canal irrigation, excepting Cholistan for which a separate Authority had been constituted. The tract would include the riverain lands which get flood (inundation) water, as also the range-lands which provide grazing for livestock.

3.2. The total geographical area of the province of the Punjab is 51 million acres, of which nearly 23 million acres are irrigated. The remaining 28 million acres depend directly on rain water for crop production, grazing or forestry and constitute the rain-fed or Barani areas. These Barani areas do not, however, lie in one contiguous block. A considerable acreage lies dispersed in districts which are predominantly irrigated: these have been excluded from the Barani Tract. Cholistan, a large area covering about 8.3 million acres in the south west of the province, depends on rainfall but is also not included in the Barani Tract for purposes of the jurisdiction of this Commission, as its development is being treated separately. Of the total of 28 million acres of Barani lands in the province, only about 18 million acres are in a contiguous block: these have been taken to constitute the Punjab Barani Tract for purposes of the Commission's work. This Tract comprises the districts of Campbellpur, Rawalpindi and Jhelum, and parts of Sialkot, Gujrat, Sargodha, Jhang, Mianwali, Muzaffargarh and D. G. Khan. The revenue tehsil has been taken as the unit and such tehsils have been included which are mainly rainfed and contiguous with the Barani Tract.

PUNJAB BARANI TRACT, LAND USE



Total Geographical Area 18.6 million acres

3.3. In the Barani Tract so delineated, there are pockets which are irrigated through small dams, tube-wells, inundations, open wells, tube-wells and minor canals. Thus of a total cultivated areas of roughly 7 million acres in the Barani tract, only about 4.5 million acres are purely rain-fed, nearly 2.5 million acres have some additional and assured water supplies. Such irrigated pockets have been, however, included as part of the Barani Tract, since development processes in the Barani Tract would, in any case, provide for larger and larger areas to be brought under irrigation, through the construction of irrigation structures, and deployment of water-harvesting and water-spreading techniques.

3.6. The Department of Geography, University of the Punjab, was requested to undertake a study for the detailed delineation of the Punjab Barani Areas and to prepare a map of the tract showing its physiographic regions and land use. As a result of the study, the Barani Tract has been classified into the following five main physiographic regions and fifteen sub-regions:

I. Northern Hilly Region

II. Submontane Region:
   1. Kala Chitta Range and adjoin Northern area.
   2. Eastern Potwar
   3. Western Potwar
   4. Central Potwar (Soan Basin)

III. Mountain Ranges:
   1. Salt Range
   2. Sulaiman Range

IV. Piedmont:
   1. Siwalik Piedmont (Chaj Doab)
   2. Siwalik Piedmont (Rachna Doab)
   3. Salt Range Piedmont
   4. Sulaiman Range Piedmont

V. Plains:
   1. North Central Thal
   2. South Eastern Thal
   3. Active and Meander Flood Plain-Indus

4. Active Flood Jhelum-Chenab

3.5. The Tract has also been classified into 9 land-use categories on the basis of present land-use, as shown below:

I.	Dry Cropped	1. Dry Cropped
		2. Mainly dry cropped with some irrigation
		3. Mainly dry cropped with some grazing
II.	Rough Grazing	4. Mainly rough grazing with some unused land
		5. Rough grazing
III.	Forests	6. Open forests
IV.	Unused Land	7. Unused land
		8. Mainly unused land with some restricted cropping and grazing
V.	Irrigated	9. Irrigated

3.6. A detailed description of the physiographic regions of the Tract is given in Appendix I, and map I, prepared by the Punjab University which shows the physiographic and present land-use regions. A description of the climate of the Tract, which varies widely from area to area – from the mountainous and sub-humid areas of Murree to the desert type, low rain-fall areas of the district of D. G. Khan, is also appended (Appendix II). Twenty-one maps (Numbers III to XXIII), showing the climate conditions in the Tract, prepared on the basis of the data supplied by the Meteorological Department of the Government of Pakistan, are also appended.

3.7. Based on the above studies and considering the agricultural potential of the various regions the Tract has been classified into the following seven ecological zones as shown in Map II:

Ecological Zones:

1. Murree Hills
2. Potwar Upland
3. Salt Range and the Adjoining Plain
4. Siwalik Piedmont Plains
5. Thal

6. Sulaiman Range and the Adjoining Plain
7. Riverain Area

3.8. A brief description of the Tract based on the seven ecological zones is given in the following paragraphs.

3.9. The Punjab Barani Tract comprises areas with widely varying conditions of physiographic, climate, soils and agricultural potential. In the north-east of the province, a sizable area is occupied by the Murree Hills which are the continuation of the outer Himalayas with elevations ranging from 2000 to 7000 feet. The hills comprise steeply dipping alternate strata of sand-stones and shales. The hill-sides are covered with soil cover formed ‘ insitu’ . The soil depth varies from a few inches to five feet depending upon the altitude and the incidence of erosion.

3.10. The North-Central area comprising the major part of the tract is the Potwar plateau which ranges in elevation from about 2000 feet in the north-east to about 1500 feet in the south-west. It represents a structural depression filled to great depths with tertiary sedimentary rocks of shale alternating with sandstone. These rocks were folded, faulted and tilted to varying degrees. Subsequent weathering and erosion of the less resistant shale strata caused troughs between the more resistant sandstone ridges, leaving a striking “ridge and trough” topography over most of the Potwar plateau. Shales were weathered in place to form clayey soils. Sandstone has given rise to loamy soils mainly in the south-western part. Severe erosion at places has exposed the parent rock. Large parts of the Potwar were covered by wind deposited material (loess) and the river alluvium during the Pleistocene period. The thickness of these deposits varies from a few feet to more than 50 feet. Down-cutting of the Soan, Haro and Kanshi rivers during the subsequent periods has eroded away considerable part of these sediments creating an intricate pattern of gully systems. The tablelands representing the original un-eroded surface have deep silty, clayey and loamy soils which constitute the bulk of the dryland farming areas. With the stabilization of the river-beds in recent times, narrow strips of flat land have come into being along the rivers where the soils are deep and medium textured, and are partly irrigated.

3.11. At the base of the Potwar plateau lies the Salt Range, a continuous range of low, flat-topped hills extending over 150 miles in an approximately east-west direction from east of

Jhelum River westward across the Indus River. The southern edge of the Salt Range ends abruptly in a steep escarpment that exposes a nearly continuous section of rocks ranging in geologic age from the Cambrian to the Tertiary. The elevations vary from 2000 to 3500 ft. The main body of the Salt Range comprises sandstones alternating with shales with varying degrees of tilt. The flat tops and inter-mountain valleys were covered by loess and locally-derived alluvium during the last glacial age. Subsequent erosion transformed the sediments into gullied land in some parts, leaving sizable areas still intact. The soils in the erosion-free areas are silty and clayey, and their extent is limited. The Salt Range has predominantly rough topography with little or no soil cover.

3.12. There is a narrow foot-hill plain running all along the southern rim of the Salt Range. It is traversed by number of hill torrents originating in the Salt Range. The soils are coarse-textured and gravelly near the hills. The silty and loamy soils occupy lower positions away from the hills. The lowest aprons of the foot-hill plain at some places are occupied by deep clayey soils.

3.13. The north-eastern parts of Gujrat and Sialkot districts comprise outwash plains deposited by hill torrents originating in the adjoining Jammu and Kashmir hill ranges. The deposits range in age from Pleistocene to Sub-recent. The recent deposits are confined to narrow strips along the torrents. The soils are mainly loamy and silty. The land surface is very gently sloping towards southwest. Elevations vary from about 800 to 1000 feet. A small area comprising Pabbi hills in Gujrat district and the adjacent dissected narrow strip along the Jhelum River has rough topography where the soil cover is either absent or is too thin and patchy for crop production.

3.14. The Thal is an extensive Barani region in the Province. It is an integral part of the Indus Plain. The elevations range from about 500 ft. in the south to 700 ft. in the north. It is the old flood-plain of the Indus deposited during the last glacial period. The sediment being mainly sandy, when subjected to severe wind action, was transformed into huge dunes and inter-dunal valleys. Subsequent favourable climate conditions encouraged natural vegetation which stabilized the sand dunes. The soils on the dunes are sandy and in the inter-dunal valleys they are loamy.

3.15. The D. G. Khan district comprises the eastern facet of the Sulaiman Range and piedmont plains and terraces which lie east of the ranges to the Indus River. The Sulaiman Range runs from north to south comprising hills with elevations of a few hundred to about 5000 feet. The surface has a rough topography and the hills lack soil cover. The out-wash plain is typical of other piedmont plains with a general slope from west to east. Adjacent to the hills are sandy and loamy soils with somewhat uneven topography. Areas farther away from the hills and the lower part of the slopes comprise deep clayey soils and are flat.

Climate:

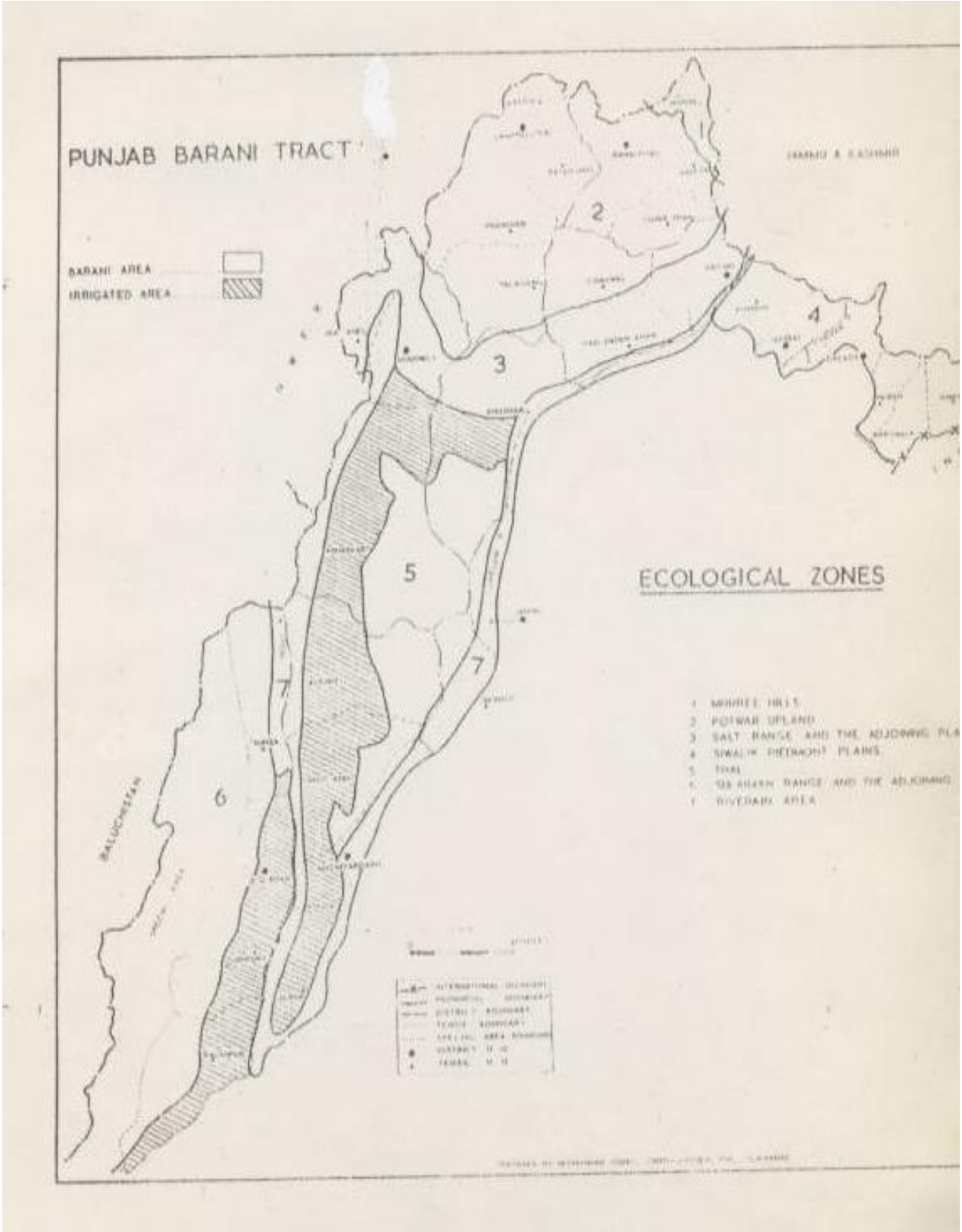
3.16. The climate of the Tract is suited to the production of many kinds of crops, grasses, and forests. In large parts low amounts of precipitation poor seasonal distribution of precipitation, however, are limiting. Rainfall is concentrated in either or both the monsoon (July-September) and winter (December-February) seasons. It ranges from about 50 inches per year in Murree Hills to about 6 inches in D.G. Khan. In most areas, rainfall from July to September accounts for the major part of winter precipitation in the Murree Hills, especially at elevations above 5000 ft.

3.17. The Tract experiences great extremes of temperature, both daily and seasonal. The winter is cold, particularly in the northern areas, and the summer is hot. Frosts occur frequently during January. Temperature are highest in June before the onset of monsoon season. The daily maximum temperature normally exceeds 40°C (104°f) and seldom, goes below 24°C (75°F).

3.18. Relative humidity is lowest during May and June and rises during the monsoon season. The number of months classed as humid varies from 8 to 9 months in Murree to about 3 months at Rawalpindi and to about 1 month around D. G. Khan. Because of high temperatures and low humidity, potential evapotranspiration is high. It is about 80 inches in D.G. Khan. The annual evapotranspiration in the Potwar upland ranges from 60 to 70 inches. Evapotranspiration is high in all areas from May through June accounting for about 25 per cent of the annual total.

Ecological Zones:

3.19. The Barani Tract exhibits a wide range of physical and climatic conditions. Based primarily on rainfall, topography and principal soil type, the area has been classified into seven main ecological zones. The ecological zones have been selected



as a baiss for discussing physical conditions: natural vegetation, agricultural, physical social and economic problems: and possible remedial measures. Distinguishing problems are indentified only in a general way and so also the suggested remedial measures stated in general terms in order mainly to bring out distinguishing characteristics of different zones. They may be somewhat similar for two or more zones. There are significant differences. The ecological zones are described as under:-

Location:

3.20. This zone includes the entire Murree tehsil and north-eastern hilly parts of Rawapindi and Kahuta tehsils. The hill ranges run from north-east to south-west. The eastern part of this zone drains into the River Jhelum, whereas the western part drains mainly into the River Soan.

Topography:

3.21. Relief in the northern hilly region consists largely of gently hilly to very steep mountain slopes of 15 to 100 per cent or still steeper. Elevations, i.e. below 3000 feet are generally gentler as compared to those at higher elevations.

Climate:

3.22. Climate ranges from subtropical subhumid in lower elevations to temperate in higher parts. Precipitation in southern and lower areas is 30 to 40 inches annually and most of it occurs during the monsoons. In the northern and higher areas the annual precipitation ranges from 40 to 50 inches. Most of the annual precipitation occurs during July- September. About one-third of the annual precipitation is received during winter. The growing season in the higher areas lasts from April to October whereas it is considerably longer in lower areas.

Soils:

3.23. Soils are developed in shales of purple colour whereas the interbedded sandstones have little contribution to the soils of this region. The soils are clayey and well-developed. The

soil depth ranges from five feet at elevations above 4000 feet to about one foot or so at lower elevations. The lower parts of hill slopes have also deep soils and are under cultivation. The soils at elevations above 5000 feet are non-calcareous and the surface soil is porous with fair amount of organic matter. On steeper and at lower elevations, the soil is not so well-developed. Bedrock is exposed in places, especially around the lower margins of the 'Chir' zone and in areas subject to landslides.

Natural Vegetation:

3.24. Vegetation types on forest land comprise a rich variety of plant associations dominated by woody plants. The Chir pine (Pinus longifolia) occupies a zone between 3000 and 5000 feet altitude whereas blue pine (Pinus excels) is the dominant tree species above 5000 feet altitude. Subordinate species include Oaks (Quercus sp.). Chestnut (Aezculus indica). Ash (Froxinus excelsior), and other deciduous trees.

3.25. In the rangeland and scrub forest areas below 3000 feet altitude, the most typical expression by plants of growing conditions is the benchargess which provides about 30 per cent density and the overstory of thorn bushes and scattered small trees of Acacia modesia, Olea cuspidate and Monotheca buxifolia.

Land Use:

3.26. The important land uses are forestry, grazing and cultivation of maize, wheat and apples. Murree is the nearest hill station to the plains and is a big tourist attraction. Tourisam and recreation are gaining importance.

Problems:

3.27. Due to heavy pressure of human and animal population natural vegetation his deteriorated as a result of which soil erosion has become the number one problem. Sizable areas are subject to landslide clearing of shallow soils on steep slopes for cultivation is aggravating the soil erosion problem.

3.28. Heavy grazing by all classes of animals set up an early trend towards invastion of low-value plant species on the range and scrub forest type. This has resulted in the dominance of low-value plants over the more desirable mixed association of grass, shrubs, and trees.

Remedial measures:

3.29. A well regulated programme of harvesting woody plants for use as timber and fuel and control through grazing by livestock (including goats) at the proper season of the year would very likely promote a better growth of fibrous rooted herbaceous plants. These plant reduce erosion and control run-off.

3.30. No new lands should be broken for cultivation. The bench terraces should be improved with water disposal structure Efforts should be made to replace maize with permanent vegetation including apple and other orchards.

2. **The Potwar Upland**

Location:

3.31. Potwar is a large plain area some 80 miles north, south by 120 miles east-west, lying north of the salt range and between the river Jhelum and the Indus. It is gently undulating plain cut up by an intricate drainage system of gullies and Bad Lands. Mot of the gully formation is the result of geologic erosion although this process has been activiated in recent times by the activites of man and his animals. About 60 per cent of land surface in Potwar has been eaten away by gullay erosion, leaving the rest a tableland. The tableland constitutes the main cultivated area.

3.32 The stream system has cut down to bedrock in many places. The streams are held up by sandstone ridges. The rivers soan and haro drain most of the Potwar uplan. The south eastern sector is dained by river Kanshi.

Climate:

3.33. Rainfall and temperatures vary considerably over the potwar. The average annual rainfall varies from nearly 35 inches in the northeast around Islamabad to some 30 inches at the

southeast cvorner and drops to 12 to 13 inches in the southwest. Monsoon rains are dominant in the east. The winter minimum temperatures drop below freezing a few times every year. The incidence of frost is not uniform everywhere, but is rather se4vere in isolated low-lying areas.

Soils:

3.34. The soil in the Potwar are mainly medium textured with a fair proportion of clayey soils. There is great variation in soil depth. Slope and susceptibility to erosion of a total area of 4.5 million acres, 1.5 million acres are cultivated. Whereas the remaining land is used for grazing. Abut two-third

of the cultivated areas is moderate agricultural land and the remaining one-third forms poor agricultural land. Low and erratic rainfall, erosion hazard and inadequate soil depth are the main limitations adversely affecting the potential of the cultivated soils. The limitations are severe in case of poor agricultural land as compared to those in moderate agricultural land. They are severer still in the uncultivated area (2.7 million acres) restricting its use of grazing.

Natural Vegetabtion:

3.35. Natural vegetation in the area is the mixed grass type. A considerable part is under crops such as wheat, sorghum, pulses, maize and millets. The uncultivated areas grow medium and tall buch grasses alongwith woody shurubs and trees such as Acacia Modesta. Zizyphus Jujuba, Zizyphus nurtmolaria, Dolbergia sissoo and Acacia Arabica.

Land Use:

3.36. Dryland farming is the main land use of the area about 60 per cent of the Potwar is used exclusively for grazing. The cultivated lands are also grazed when they are fallow especially during the monsoon season.

Problems:

3.37. The most serious problem is the disturbance of gullied land with the object of creating new agricultural land. The gullied land in its natural state is more or less stable, but when disturbed through land leveling is subjected to active erosion. The ully heads then start encroaching on the table-lands with a greater force. minerals conservation and its utilization is the most important problem in the cultivated area.

3.38. there is a great need to integrate production of crops with that of livestock. This requires improvement in forag production in uncultivated areas as well as a shift in the existing cropping patterns in favour of animal foods and fodder crops on cropland. Moisture conservation practices alongwith the use of fertilizers would greatly increase crop production, especially in the hig rainfall areas.

3. THE SAL RANGE AND THE ADJOINING PLAIN:

Locations:

3.39. This ecological zone includes the Salt Range and the piedmont plain all along its length from Azad Kashmir border to the trans-Indus area of Mianwali District.

Topography:

3.40. The area is dominated by the Salt Range and stream gorges. The main body of the Salt Range comprises sandstones alternating with shales with varying degrees of tilt. The elevations vary from 2000 to 3500 feet. The southern edge of the Salt Range ends abruptly in a steep escarpment over looking a gently sloping plain formed by deposits by hill torrents.

Climate:

3.41. The climate is characterized by a wide variation in precipitation, average ranging from over 33 inches near Mangla to about 13 inches in Mianwali. Temperatures are hot in summer and mild in winter. Frosts are common in the central parts of the intermountain valleys, but rare on the piedmont plain.

3.42. most of the land is mountainous and rocky. The hillsides have patchy and thin sil cover. The hill tops which are generally flat, and inter mountain valleys have alluvial or loesswic deposits. A considerable part of these depoistis has been severely eroded by deep gullies. The uneroded areas have deep soils which are mostly medium textured. The central part of the piedmont plain is strongly saline.

3.43. The slat range and the adjoining plain cover an area of about 3.4 million acres. About 9 million acres are used for cropping, on million acres are used for grazing and the remaining half million aces being mostly rock outcrop or saline flat are agriculturally unproductive.

3.44. about one third of the cultivated areas is irrigated and comprises deep silty and clayey soils. Another one third is moderate agricultural land dependent upon rain for crop production.

The remaining one third is poor agricultural land which is also dy farmed. The main limitations of the Barani cultivated land are low and erratic rainfall, erosion, inadequate soil depth or unfavourable soil texture.

Land Use and Vegetation:

3.45. most of this ecological zone is hilly and steep and is devoted mostly to grazing use. Only the deeper soils on gentle slopes are cultivated. Vegetative cover is of mixed grass-thornbush type.

Remedial Measures:

3.46. This ecological zone is so rough and broken, or arid, that it should be in grazing and woodland use. To bring it up to its potential for producing grass, much needs to be done. This includes renovation of large, hilly barren areas with adapted desirable species and better grzing management. Grass growth in this zone varies with wet and dry seasons. Developing a viable livestock economy will require that at least part of the limited cultivated land be used to produce fodder for supplemental feed during dry sasons. Use may also be made of synthetic urea and molasses.

3.47. Cropland requires moisture conservation and water harvesting techniques for increased production. The use of fertilizers would be beneficial especially in the high rainfall sector.

4. **SIWALIK PIEDMONT PLANS:**

Location:

3.48. this ecological zone includes the north eastern parts of Sialkot and gujrat districts. The Upper Jhelum Canal and the M.R Link mark the western boundary, whereas the Jhelum and Ravi rivers and the Jammu and Kashmir boundary mark the other limitsw of this zone.

Topography:

3.49. Most of the area has been desposited by a number of torrents rising from the adjoining Jammu and Kashmir hills. The area has a gentle slope of 1 to 3 percent. Area towards the Jammu hills is somewhat dissected with entrenched streams and some parts are subject to erosion. The main body of these plains is however nearly level and is free from erosion. A small area of Pabbi hills has rugged topography.

Climate:

3.50. The climate is hot in summer hand mild in winter. Forsts are rare. Rainfall varies from about 40 inches in the north east to about 25 inches in the south-east. About 70 per cent of the total annual rainfall is received during the monsoon season.

Soils:

3.51. Soils are deep, well drained and mostly loamy in texture. A Small proportion of clayey soils are encountered in the north western sector. Pabbi hills have thin and patchy soil cover which is subject to erosion. Almost the entire cultivated are has deep soils which under subj humid climate make this land as the best dry farmed cropland in the country.

Natural Vegetation:

3.52. Vegetation consists of scanty stands of grass and thorny trees ad shurbus in the uncultivated areas. The common trees and grasses are Acacia modesta, Acacia Arabica, Zizipphua Sp. Dolbergia sisoo, Morus Alba, Saccharum Munja, Saccharam Apontaneum, Tamarix Dioica, Eragrostis cynosuroiodos.

Problems:

3.53. The most important problems are moisture conservation and its optimal utilization and low soil fertility in areas under cultivation. Uncontrolled grazing is the main problem in the grazing areas.

Remedial measures:

3.54. Crop production is by far the most important land use. Use of fertilizers, inclusion of legumes in crop rotations and moisture conservation could help a great deal in agricultural production. Ground water investigation and its development would substantially improve the economy of this zone.

Location:

3.55. That is a vast tract of land between the Indus and the Jhelum and covers about 9000 square miles in the districts of Mainwali, Sargodha, Muzaffargarh and Jhang. The entire area is in the form of rolling sand dunes and inerdunal valleys. The size and shape of the dunes vary from one sector to the other as influenced by the main wind patterns.

Climate:

3.56. The climate is hot and windy in summer and mild in winter. A few forsty days are experienced each year. The incidence of frost varies from year to year. The annual rainfall ranges from 14 inches in the north to about 6 inches in the south.

Soils:

3.57. Almost the entire area consists of sand dunes and interdunal valleys. Soils on the dunes are sandy with low water holding capacity. They are also subject to wind erosion. The soils in the valleys are loamy in the north eastern sector and the proportion of fines decreases towards the south.

Natural Vegetation:

3.58. The vegetation includes shrubs and grasses providing thin cover. The important species are salvadora oleodides, calligenum polygonoiodos, eleuesine, comporessa, ponnisetum divisum, halozylon recurvm, proposls spicigera, cymbopogen jwardancusa, lasirac hirutus, zizipjus jujube.

Land Use:

3.59. The Thal environment has for centures, been a natural grazing for sheep goats and camels, grazing are still the most important land use in a major part of the zone. In the northern part of Thal, where annual rainfall is above 10 inches, some dry farming is practiced. Gram wheat, barley, sarson and tarmamira are the common crops. Water melons and guara are the summer crops.

Problems:

3.60. Low and erratic rainfall makes agriculture precarious. Areas sown to crops flucturates widely and so does crop production. Natural begetation has deteriorated as a result of heavy grazing. Sand dunes have become active, especially around villages and along roads.

Remedial Measures:

3.61. The arid and semi arid climate of this zone offers a limited grazing potential during certain parts of the year. There is a great need to regularize and improve the grazing sue. Groundwater investigations should help in the location of pockets of sweet water, which would be utilized for producing forage and feeds for livestock. The provision of supplemental feeds for livestock would be an important step in reducing pressure on natural vegetation. Grass reseeding has proved quite a success in the central part of this zone. This practice should be extended to large areas.

6. D.G Khan District:

Location:

3.62. The D.G Khan District lies west of the Indus and has a common boundary with Baluchistan. Topographically, the district comprises the eastern face of the sulaiman range, and piedmont plains which lie east of the ranges to the Indus river. The hilly part has a rugged topography with an average elevation of about 3000 feet. The piedmont plains have gentle slopes of 1 to 3 per cent.

Climate:

3.63. The District has arid sub-tripical continental climate. Annual rainfall varies from less than 4 inches in the plains to about 12 inches in the hilly areas of the sulaiman range. About 50 per cent of the annual total is received during July-September and the rest comes as light showers in January-March. The hill ranges from the estern limit of influence of summer monsoons. Summers are very hot and winters mild. Frosts are rare.

Soils:

3.64. The hill ranges are devoid of any soil cover. At places, the valleys have alluvial terraces with deep loamy soils. The piedmont plains have a gradation of sandy and loamy soils alongwith the foot hills to deep clayey soils in the ocentral and the eastern part. Shifting sand dunes occupy a considerable area near the foot of the hills.

Natural Vegetation:

3.65. The are is characterized by very aparse light vegetation. This may be partially due to over grazing as well as the extremely low eand variable rainfall. The most common plant species are capparis aphylla, acacia jacquemontill, saueda fruticoss, salvadora oleoides, tamarix articulate and mosquite. The common plants on sandy soils are saccharum munch, calatropis procera and eragrotis cynosuroides. The grass species are elonsine flagellifera and cynodon dactylong.

Land use:

3.66. Almost the entire area is devoted to poor grazing with large tracts lying unused. Patches of cultivated area are few and far between within the hill ranges. Whereas sizable area of plains is cultivated by means of torrent water. Cropped are indicates great fluctuations from year to year.

Problems:

3.67. low an extremely variable rainfall is the most important factor limiting agricultural production in the Barani area of te district. Dry cropping is possible only by means of diverting

and collecting torrent water in large fields. Crop failures are common and the element of uncertainty is over riding.

Remedial Measures:

3.68. Because of uncertain torrent water and low rainfall little benefit can be expected from introduction of a high level of management. Some increase in production can however be expected by improved control and distribution of torrent water with the help of earth moving machinery located at suitable sites.

7. Riverain Area:

Location:

3.69. The riverrain areas of sailaba occur as narrow belts all along the main rivers and cultivation on these lands depends on flood waters. Only those areas which fall within the Barani Tract are considered for this report. Included in this ecological zone are the upper reaches of activie flood plains of the Ravi, Chenab and Jhelum rivers and the active floodplain of the Indus from Kalabagh to Mithin Kot.

Topography:

3.70. The topographic features are well marked and the individual landform units i.e. sandy levees abandoned river channels and level areas stand out clearly. The area is subject to periodic flooding and sedimentation. Due to river bank erosion and shift in river course the landscape is subject to continuous change.

Climate:

3.71. Climate is hot in summer and mild in winter. Annual rainfall varies from 30 inches in Sialkot and Gujarat Districts to about 6 inches in DG Khan District.

Soils:

3.72. Sils comprise raw stratified alluvium. Sandy soils are situated at higher postions and are flooded less frequestly. Silty soils occupy early flat areas and the clayey soils are confined to depressions. Their relative proportion varies from area to area. Silty and clayey soils are used for cropping, mainly wheat on the residual moisture of the summer floods. The sandy soils provide poor grazing to cattle and sheep.

Natural vegetation:

3.73. Natural vegetation is mixed grass-type. Common shrubs and grasses are tamarix doicia. Populous euphratica, saccharum munja, saccharum spontaneum and ragrostis cynosuroides.

Problems:

3.74. Floods cause problems, both when they bring in too much water or too little, when floods are 100 heavy they cause damage to life and property over wide areas, when too little the production from sailaba flood water cultivation is greatly affected. Normal flooding in this ecological zone is thus helpful in that the winter crops are sown on residual flood moisture. It is however a great limitation as regards the cultivation of summer crops and making of improvements of permanent nature. Means of communication are lacking.

Remedial Measures:

3.75. ground water is fresh and shallow, it could be developed by installing tubewells at raised platforms for irrigation. Wheat crop receives a serious set-back in the later hald of the growing seson due to moisture deficiency. Tubewell irrigation in suitable areas would increase agricultural production and also help in introducing other winer crops.

CHAPTER IV

AGRICULTURE

4.1. Agricultural production in the Barani Tract is primarily dependent upon physical factors of climate and soil. These factors collectively determine the land potential, cropping pattersn and agricultural production. There are great differences in soil as well as climatic conditions in various parts of the Barani area. The climate varies over broad areas from sub-humid in the north-east through semi-arid in the south-west of the province. Whereas soil variation is rather important even in local areas.

4.2. the most important element of climate affecting land use is the total annual rainfall. Based on the annual rainfall, the Barani area can be divided into three main climatic zones, each zone having different potential, problems and possibilities for increasing agricultural production:

- Subhumid Zone: Areas having annual rainfall more than 500mm (20 inches)
- Semi arid zone areas having annual rainfall 300 to 500mm (12 to 20 inches)
- Arid Zone: Areas receiving annual rainfall less than 300mm (12 inches)

Crop Production in the Sub-Humid Zone:

4.3. The sub-humid zone covers the most important areas of the Barani Tract as far as crop production is concerned. The annual rainfall anges from 1200mm in the north east to 500 mm in the west which is considered adequate for production of a variety of crops with a reasonable degree of success. Murree hills, eastern hald of the Potwar and Salt Range as well as the eastern halves of Sialkot and Gujrat districts fall in this zone.

Cropping System:

4.4. The main cropping system which developed historically over a substantial part of the sub-humid zone relies on summer rainfall to establish winter sown crops. This system is known as Dofasli dosala" under which two crops are raised in two years on the same piece of land. The common crop rotation is wheat chari/bajra fallow fallow.

4.5. after harvesting wheat, the area is sown to chari (sorghum) or bajra (millet) in June/July with the onset of rainy season. Chari and bajra are grown in a larget part of the Barani area. Whereas, maize replaces these crops to a considerable extent in area having rainfall above 750 mm (30 inches). The summer crops depend entirely upon monsoon rainfall and reach maturity in september october when the rainy season comes to an end. The land is then kept fallow until the following october, when it is again sown to wheat. The lan is periodically ploughed after every rain in summer during the fallow period in order to conserve soil moisture by keeping down weeds and providing much at the soil surface. A year of fallowing improves natural fertility of the soil wheat is by farthe most important crop and occupies 50 to 60 per cent of the annually cropped area. Only about half of the wheat area is followed by te summer crops, whereas the rest remains idle during the sbusequent summer season, so in a part of the area the rotation wheat fallow wheat fallow is pratised.

4.6. these systems are not in harmony with the rainfall pattern. For sowing wheat, the crop requires well prepared seedbed and adeuatemoisture carried over from the summer rainfall. Inspite of the best efforts. Only a fraction of the summer rainfall can be utilized whereas, the rest runs off along with fertile top soil. The conserved soil moisture is used for sowing wheat. The soil moisture lasts till December when the winter rains must come to grow the crop successfully to maturity. It means that wheat crop relies heavily on rainfall of both the consecutive seasons. Wheat production is adversely affected when rainfall of either season falls or falls short of the crop requirements.

4.7 A much larger share of the annual rainfall is received is the form of high-intensity storms during monsoon when about60 to 70 percent of the fields are bare and subject to the bearing action of the raindrop resulting in the loss of precious rainwater, soil particles and nutrients.

Existing cropping patterns:

4.8 Wheat is the most important crop and occupies slightly more than half of the annually cropped area, Gram and lentils are the other minor winter crops. Millets occupy between 50 and 65 percent of the fields cropped in summer. The reason for small proportion of land being devoted to millets is that loss hardy crops can be raised; climate and soils being more favourable. Only in the areas bordering the mountains is maize an important summer crop.

4.9 In Sialkot and Gujrat districts, almost every acre that is not mountain land or stream bed is under the plough, wheat is the most important crop and accounts for about 60 percent of annual sowings. Gram is widely sown on coarse soils. Lentils are an important crop in Sialkot District, About4- percent of the annually cropped area is sown to Kharif crops, mainly millets, Kharifpulses are grown in about 20 percent of the fields cropped in summer. Maize is not grown in these districts.

Common crop rotations:

The present crop rotations are as under:

1. Wheat *- millet – fallow – fallow
2. Wheat – summer pulses – fallow – fallow
3. Wheat – fallow-wheat – fallow
4. Wheat – millets – lentil/gram** – fallow
5. Wheat ***– millets – wheat – millets
6. Groundnut – fallow – millets – fallow

4.10 The crop rotations which are efficient in utilizing the land and climatic resources are listed as under:-

1. Groundnut – fallow – groundnut – fallow
2. Groundnut – fallow – groundnut – fallow – millets – fallow
3. Maize – fallow –groundnut – fallow
4. Summer pulses – fallow – millet – fallow
5. Wheat (summer) fodder legume

Changing emphasis from Rabi to Kharif crops:

4.11 Many of the changes which could be made in this direction are possible with the existing technical knowledge. However, such changes would involve a re-orientation away from the traditional, subsistence wheat cultivation and are thus not likely to occur very rapidly. The rationale for a change in emphasis from Rabi to Kharif cereal and oilseed crops is to place the cropping system in harmony with the rainfall pattern. The lack of harmony in the present system is historical rather than technical. To accommodate his change, the staple food-grain, wheat, would need to be imported into these areas. As a matter of fact, a major part of wheat

requirements of the dryland areas is already being met by imports from outside. If the full requirements of wheat are met from outside on assured basis, these areas could be encouraged to grow summer cereals,fodders oilseeds which are the best utilizers of the summer rainfall. By growing groundnut the Barani areas are in a position to relieve the irrigated areas from the responsibility of growing winter oilseeds directly competing with wheat production in those areas. The oilseed industries can be based on local raw materials which would produce abundant oilseed cakes around which livesock industry in the Barani areas can be built up.

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* Millets are partly replaced by maize in areas having rainfall above 30 inceas.

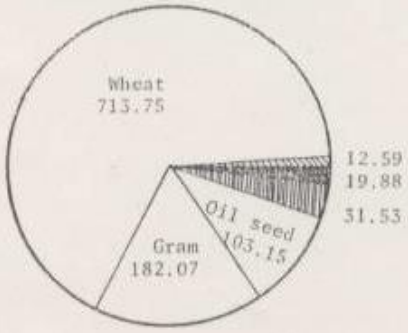
** Lentils/gram are sown in a year when some rain is received in late September – October.

*** This rotation is fallowed in “Lapara” lands i.e. the lands situated near villages.

PUNJAB BARANI TRACT CROP VALUES 1971-72.

TOTAL RS.1284.4 MILLION

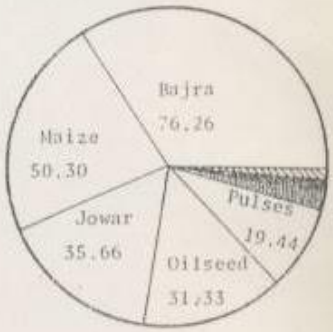
RABI CROP VALUES 1971-72.



Barley
Tobacco
Pulses

TOTAL RS.1062.97 MILLION

KHARIF CROP VALUES 1971-72.



Rice
Cotton
Sugar-cane

TOTAL RS.221.53 MILLION

4.12 The rainfall pattern demands a drastic change in the existing cropping systems so as to include mainly summer crops such as chari, bajra, groundnut, pulses, etc. which would not only protect the soil against the beating action of the raindrop, but would also make the best utilization of the rainfall resource. An actively growing summer crop utilized soil moisture at a fast rate, thereby enabling the soil to absorb and conserve rainwater of the coming rain.

4.13 The winter rains are received as gentle showers over prolonged period and, therefore, there is hardly a run-off even from the fallow fields. This is very important from the stand point of controlling soil erosion. The rainwater is absorbed in the sol which can be profitably utilized for sowing early Kharif crop. The loss of soil-moisture through evaporation is also loss during winter months.

4.14 Kharif crops do not require as good a seed be preparation as wheat does. In view of the acute shortage of bullock power in the Barani Tract, a witch-over from wheat to Kharif crops would greatly ease this situation.

4.15 The cost of wheat production under rainfed conditions is much higher than under irrigated conditions, making it increasingly difficult for the drylands farmer to compete with his counterpart in the irrigated areas. Wheat cultivation requires the use of nitrogen and phosphate fertilizers whereas a cropping system with suitable proportion of leguminous crops (groundnut, summer pulses, winter pulses) can greatly reduce the need of using expensive nitrogenous fertilizers.

Tillage and moisture conservation:

4.16 The key to success in dry-land farming is the proper moisture conservation. Regardless of which crops are grown, placing land in fallow is the principal means of conserving soil moisture. It is normal for these fallows to be ploughed a number of times. With only limited facilities at his disposal, the farmer appears to consider the number of tillage operations, rather than the effectiveness of individual tillage, to be the most important factor in conserving soil moisture.

4.17 The main objectives of the tillage operations are to (a) facilitate intake and penetration of rainwater. (b) keep down the losses of soil moisture by creating mulch i.e. a thin layers of loose soil at the surface and (c) kill weeds. The farmer tries to accomplish all these objectives by

ploughing the land frequently with the existing wooden plough. This implement is very inefficient as it (a) penetrates to a depth of only about 3inches and does not go deeper to break the dense plough-pan which is about two to three inches thick and has formed at a depth of four inches as a result of ploughing at the same depth over several centuries (b) opens and exposes moist soil to the air, resulting in considerable loss of moisture from the upper soil layer to the detriment of germination and early growth of a crop (c) does not kill weeds effectively.

4.18 Three different types of implements have been developed and are widely used in the rainfedregions of the world, each type meant for a specific purpose. Chisel ploughs are used for breaking plough-pan and deep penetration. Scarifiers and harrows are meant for very shallow cultivation to create mulch at the surface and seep plough are used for killing weeds. The scarifiers and sweeps are light implements and require much loss power than the wooden plough and do not expose the moist soil to the air. The cultivation with the chisel plough is needed only very occasionally i.e. once a year.

4.19 At present, land is ploughed many times and frequently with the country wooden plough for each crop. Each cultivation means an added cost in production. Costs of tillage operations must be kept low. The aim should be minimum but effective tillage.

Soil fertility:

4.20 As the cultivated land has been used for crop production for centuries without adding adequate amounts of manures or fertilizers, the soil fertility has been depleted is a very low level, especially with respect to phosphate and nitrogen. The usual practice of keeping the land fallow and the growth of leguminous weeds do help in maintaining the fertility status of the soil but at a low level and high cost. It is estimated that keeping the land fallow for one year and cultivating it frequently and nitrogen to the soil equivalent to about 40 lbs of urea (Rs. 25) per acre. As far as phosphate is concerned that practices is even less effective. There is a great scope of using fertilizers for increasing agricultural production in the sub-humid area. For wheat and millets, nitrogen and phosphate in equal proportion should be used. For groundnuts and pulses only phosphate fertilizers are needed.It may be mentioned that phosphate has been depleted in such a low level that it is now the main cause of poor yields of legumes like groundnuts and pulses.

The results of fertilizer experiments conducted in the sub-humid area have shown that crop yields can be doubled or even trebled by using proper doses of balanced fertilizers.

Use of Improved need:

4.21 It is estimated that more than 80 percent of the area under wheat, the most important crop in the sub-humid Barani area, is still occupied by un-improved indigenous types. The situation as regards either crops is even worse. The high yielding varieties in combination with other inputs and appropriate cultural practices have given astonishing results in the Barani Areas. The recorded yield of 45 moundsper acre has been obtained near Rawalpindi and Jhelum in good years of 150 – 200 mm winter rainfall and about 23 mounds in low rainfall of years with 50 mm winter rain.

4.22 High yielding varieties of some crops are already available and there is a need to evolve suitable ones in case of other crops for this area. There is a constant need to convince the dryland famer to take up the cultivationof improved varietieswhich are better adapted to Barani conditions and have high capacity to utilize the fertilizers use of tractors.

4.23 Because green fodder is available only during a few months of the year, it is very difficult to maintain working animals in good condition. Insufficient bullock power is a great constraints in timely cultivation of land throughout the Barani area. Chisel ploughing in essential for conserving soil moisture. Similarly, listing or contour ridging is a very good cultural practice for retaining rainwater where it falls. These cultural operations cannot be easily done by bullocks. Tillage operations have in to performed within a very short period for summer crops and for conserving moisture for growing wheat. Similarly, sowing operations also need to be carried out in a much shorter period as compared to the irrigated areas. With the present bullock power and existing implements, only a small fraction of the cultivated area can be handled at the proper time while the remaining are loses the precious soil moisture waiting for its turn. Chari, Bajra, Maize and summer pulses have to be sown soon after the first monsoon rain. The subsequent rains follow so closely that the farmer is unable to completethe planned sowings with the result that a large area remains un-utilized for lack of farm power.

4.24 There is a great need to introduce tractors augmenting bullock powerrequired for land preparation and timely sowing of crops, particularlyKharif crops. As the need for timely land preparation and sowing of crops is peculiar to the dryland areas, the introduction of tractors on a large scale through cooperatives or government operated tractor centers could bring about greatly increased production in the Barani areas. If the tractors cultivation on individual enterprise basis leads to predateriness by the tractor farm and the small farmers are bought out and start emigrating to towns, the social cost of tractors may become much greater than the economic benefits. This will also enable the small farmer to benefit from mechanized farming.

Cropping intensities:

4.25 Cropping intensities in the order of 60 – 70 percent are often referred to for Barani areas. This "average" figure appears to be an average of intensities of 90 – 100 percent in the higher rainfall areas and intensities of around 50 percent in the lower rainfall areas.

4.26 Particularly, in areas with annual rainfall above 25 inches, there is no reason why changes in cropping patterns alongwith the use of fertilizers, could not place areas now fallow throughout much of the year. In more productive use by increasing the cropping intensities. This possibility is evident from the fact that cropping intensities upto 200 percent are being achieved in "Lepara" lands surrounding the villages where soil fertility is not a limiting factor in crop production. In areas away from the villages having the same rainfall, low soil fertility imposes a serious constraints upon cropping intensities.

Soil Erosion:

4.27 To a common man as well as to many agricultural scientists, soil erosion appears to be the main problem of the Barani areas, especially the Potwar upland. It is believed that all the devastation caused by soil erosion has taken place within the recent times. The fact is that soil erosion is neither the main problem affecting agriculture, nor it is of recent occurrence.

4.28 The greater part of the bbadlycut-up areas (gullied land) is the result of geologic erosion which started about 20,000 years ago, simultaneously in many parts of the world as a result of a major climatic change. The process was most active upto about 10,000 years before present. Then the land was more or less stabilizedby natural vegetation due to favourable change in

climate on world-wide basis. The second cycle of erosion started when the natural vegetation deteriorated as a result of climatic change about 6,000 years before present. Thus, most of the gullied or badly dissected land came into being by the work of nature much before the man came to influence the process of erosion in his own way.

4.29 The erosion process has been accelerated by the action of man only during the recent times, as a result of the destructionof nature; vegetation byover-cutting and over-grazing as well as disturbance of gullied land in pursuit of creating new fields, Faulty methods of cultivation, unsuitable cropping patterns, low soil fertility and a host of other cultural, social and economic factors have caused and are still causing the loss of precious rainwater and valuable top soil in the cultivated area.

4.30 No doubt the man has accelerated the process of soil erosion but his influence has no relationship to the magnitude of the devastation that people now in the form of gullied land. Man's influence has been responsible mainly to induce sheet erosion in the gulled areas and the sloping parts of the cultivated land. The process of soil erosion can be retarded only to the extent the man has accelerated it. This is possible by improvement of natural vegetation in the gullied land and by covering the cultivated land by crops during the monsoon season. It may be mentioned that the process of gully erosion in the Potwar cannot be completely stopped because it is a natural process; only the rate of soil erosion can be retarded to certain limits by proper land use and soil management.

4.31 Proper understanding of the erosion process which has been active in the long past as well as at present, is extremely important for preparing realistic plans and priorities for the development of the rainfed areas.

Reclamation of "CulturableWaste" Land:

4.32 Land utilization statistics in the country refer to certain parts of land as "culturable waste". The term is understood to have originated in the irrigated areas and is meant to describe uncultivated land within a canal command area. In Barani areas it appears that this term has erroneously been extended to include land that is not presently cultivated as for example, some of the severely eroded lands in the Potwar upland. It is commonly believed that such lands can

be brought under cultivation after levelling by means of heavy bulldozers. This inference is based on the assumption that the soil material of the gullied lands is soft and could be as productive that of the cultivated lands. As a matter of fact, this material is inert, unstable and unproductive and lacks the usual characteristics of the cultivated soils.

4.33 In the past, great emphasis has been placed on the reclamation of the gullied land and construction of brick or stone drop structures, cults often at the cost of neglecting the cultivated land, a great natural resource product as a result of soil forming process over several thousand years. The past approach neither brought any significant increase in agricultural production because the area added to the cultivated acreage is very small, nor has it helped to control soil erosion. The newly created fields by reclamation of gullied land are usually unstable and prone to washing away by rain water running down from the adjacent higher areas. Besides, the reclamation of gullied land is a very expensive undertaking and its economics is doubtful.

4.34 The gullied land has a reasonable potential for grazing and locally for growing trees such as shisham, Kikar, and Phulahi. It is suggested that its proper use may be optimized by systematic management. Efforts of increasing crop production may be concentrated on the area already under cultivation.

Crop Production in the Murree Hills:

4.35 Crop production and cropping systems in the Murree Hills are different from the rest of the sub-humid area. The annual rainfall ranges from 900 to 1200 mm. Cold winters restrict crop choice and the growing season. The cultivated lands have steeps which are bench-terraced.Maize is the important crop and occupies the largest areas. Locally vegetable and potatoses occupy important positions. At altitudes below 4000 feet, wheat and oaksrare grown after harvesting maize. Crop yields are miserably low due mainly to low soil fertility.

4.36. The climate and soilsare well suited for fruit treeessuch as appple, pear, plum and appricot. In recent years Murree hills have developed as an mportant apple growing area with the guidance and assistance provided by the Forest and Agriculture Department.s there is still a great need and scope to epand the are under apples. Major constraints affecting expansion of the area under horticultural crops are the insect pest and the marketing problems.

4.37. on account of torrential rains and steep slopes. The cultivated lands are subjet to severe erosion. Maize cultivation should be replaced by permanent vegetation such as fruit orchards which would also minimize the need for frequent cultivation. This would heldp in controlling

soil erosion on the one hand and would minimise the need for keeping bulklocks for cultivation on the other hand.

4.38 growing maize the farmer in the murree hills area is not taking full advantage of the favourable climate during summer e.g. this area is capable of growing such vegetable crops that cannot be grrwoing in the plains during summer. An organized effort is required to assist the farmers in switching over from tradtional subsistance farming to highly ecnomic but more sophisticated farming of iorticultural crops.

4.39. Among the field crops potato is the most important. It should be grown under high productivity apprreach using proper fertilizer levels more seed alongwith other cultural practices. Conditions are favourable for producing disease free seed. If suitable projects for provision of deases free seed are undertaken the desired results can be achieved.

4.40 A variety of summer beans is also grown in the Murree Hill area, but the acerage under these crops is limited. The production is mostly meant for local consumption. The soil and climatic conditions are extremely favourablefor the production of summer beans. By assuring the wheat/maize supply to this area, the farmers can be persuaded to take up the cultivation of beans on a large scale. Due to fast growing and spreading nature of this crop, the soil gets protected against the beating of rain drop during the monsoon season.

4.41 The area under natural forests is diminishing. The privately owned forest lands known as "Guzara Lands" are particularly in a deteriorated condition. The forest land is bing converted into cultivated land, making a very serious threat to the stability of this entire area. These lands are very steep and have only a thin soil cover, once cleared they lose the thin soil quickly and turn into poor grazing land or bare rock, prone to landslides. The breaking of new land needs to be stopped by all means.

Crop production in semi-arid zones:

4.42 The semi-arid zones having annual rainfall from 500 mm (20 inches) in the east to about 300 mm (12 inches) in the west, covers the western half of the Potwar upland and the Salt Range. The limits of rainfall for secure cropping vary slightly according to the nature of the soils. In the

case of deep loamy soil the limit is at about 450 mm whereas the limit is at 500 mm in areas of silty and at 550 mm in the case of clayey soils.

4.43 The cropping is hazardous and on the average a poor crop of wheat is grown. The extent of the area sown and the areas harvested fluctuates greatly from year to year and crop statistics for any single year cannot indicate what may be expected in the next. The proportion of the area of failed crops to the area sown is the highest in the west and south. In both seasons as compared to the eastern part of this zone.

4.44 In all parts of this zone, winter Barani crop is greater than that of the winter. Actually rabi sowings account for 70 to 80 percent of the annual sowings in the PindiGheb tehsil whereas in Chakwal and Fatehjang tehsils the comparable figure is 50 to 60 percent.

4.45 Climate and soils account for this local variation in cropping. Loamy soils predominate over the drier western parts. In these it is the usual practice to conserve the moisture of the summer rain for rabi sowings. In this way, the farmer tries to use the rainfall of both the seasons for the rabi crop alone. Finer textured soils in the western part cannot be used in this way. The water runs rapidly off the surface and must be used when and where it falls. As most, of the rain falls in summer, the Kharif crop is all important, however, the summer rainfall is not always sufficient to mature the crop and some method of water concentration (rain harvesting) is necessary. This is often done by linking fields by means of ditches.

4.46 Further east, the area of heavier and more reliable rains, in combination with fine-textured, more fertile soils, make possible a more secure cultivation of wheat and a fair proportion of summer crops.

4.47 Systematic crop rotations are rarely followed and the practice is to sow crops year after year in the same fields. If the summer rains are adequate and timely, the area under Kharif crops increases. The farmers adjust their crops with the time and amount of summer rain.

4.48 About 80 percent of land cropped to winter, is sown to where Gram and Taramira each occupies about 10 percent of land cropped in winter. Millets account for 90 percent of the area

sown in summer. The pulses i.e. mash, mung and moth, occupy the reminder and are usually grown mixed with bajra.

4.49 To increase the yields of wheat and millets in this zone is more difficult than the subhumidareas. It is probable, however, that improved cultural practices could result in significant yield increases in case of gram and groundnuts. Such improved cultural practices would involve retaining virtually all rainfall where it falls, using moderate amounts of phosphatic fertilizer, planting good-quality seed etc.

4.50 There are sizable tracts of loamy soils in the eastern parts of this zone. They are particularly suited for growing groundnuts. As a matter of fact,in the areas around Chakwal and Talagang, groundnut cultivation has already assumed great importance and started changing the agricultural economy. This trend needs to be encouraged in the adjoining areas through proper incentives and education of the farmers.

4.51 Gram is more important in this zone as compared to the subhumid zone. By virtue of its deep root system, low water requirement and betterdrought tolerance, gram is well-suited to the conditions of the semi-arid zone. The use of small dose of 15-20lbs per acre)nitrogen as a starter necessary for rapid development of roots and root modules and full dose of about 30 lbs. of phosphorous per acre cold bring about greater increase in the yield of gram.

4.52 Taramira, which is a winter oilseed crop, is particularly suited for drier parts of this zone. It is also a good crop for less productive soils. As such, the cultivation of taramira has a great potential.

Crop Production in Arid Zones:

4.53 As annual rainfall decreases below 100mm(12 inches), rainfed agriculture is replaced by torrent watered sailabaagriculture. The torrent watered sailaba area located in the foot-hills plains, adjoining the Salt Range in Sargodha and Mianwali districts and similar areas in D.G. Khan district. The rainfall is not adequate for crop production, Cultivation, therefore, depends on the collection of run-off from the hill torrents. The fields are usually large sized and

embanked. In case of minor flood only small areas are benefitted whereas high floods are very difficult to control and pass away leaving the fields dry.

5.54 Most of the rain falls during summer and more than three-quarters of the cropping on torrent-watered lands takes place in the season. Millets are the only crops grown as they are more drought resistant than any other summer crop grown as they are more drought rersistant than any other summer crop.

CROP PRODUCTION THROUGH BETTER MANAGEMENT OF FLOOD-WATER.

4.56 Just after rains in the hilly catchments, the torrents collect run-off and bring flash floods. Very little time is available during which the flood-water is to be diverted into fields, and a great effort is required to irrigate as many fields as possible. The farmer can be helped in improving the management of flood-water by deploying a number of bulldozers at the important sites during the rainy season.

4.57 The soil fertility is not any significant constraint in the increased crop production. The flood-water brings with it a lot of sediment as well as plant food nutrients. As the production from these lands is low and uncertain, the use of fertilizer is not expected to give economic returns.

Crop Production in Thal:

4.58 Rainfed cropping in the zone is confined mainly to the areas receiving annual rainfall above 250mm (10 inches). Such areas are located in the northern half of Thal. By far the largest area has been used for grazing for centuries. Crops production with low rainfall has been possible due to the reason that the soils are predominantly sandy which absorb all the rain water and keep it available for use by the crops.

4.59 Gram is the most important crop which is sown in as manyas three-quarters of the fields cropped in winter. It is sown on the conserved summer rain moisture. The deep and fast growing root system makes this crop the best suited to the local conditions. Gram has been grown in Thal from times immemorial. The low soil fertility on account of past use without

fertilizers and sany nature of soil, is a limiting factor for increasing gram production. Small doses of phosphate could increase crop yields to a considerable extent.

4.60 Wheat and barley are the other two crops which are grown in the northern part of Thalwhenever there is late summer rain. The extent of the area sownis not much and also shows great yearly fluctuations. Not much improvement is expected as far as these crops are concerned. A summer crop is rarely attempted, and only a few acres of bajra, fodder, pulses and water-melons are grown.

4.61 Parts of Thal are subject to severe wind erosion as a result of destruction of the native vegetation. This region has a reasonable scope for use as improved range-land.

Strategy for increasing agricultural production:

4.62 The strategy aimed at increasing agricultural production in the Barani area must be formulated against a background in which:

a. There already exists a considerable store of technical information capable of producing substantial increases in crop yields, and yet
b. The main problem in the transfer of the available technology to thousands of small farmers.

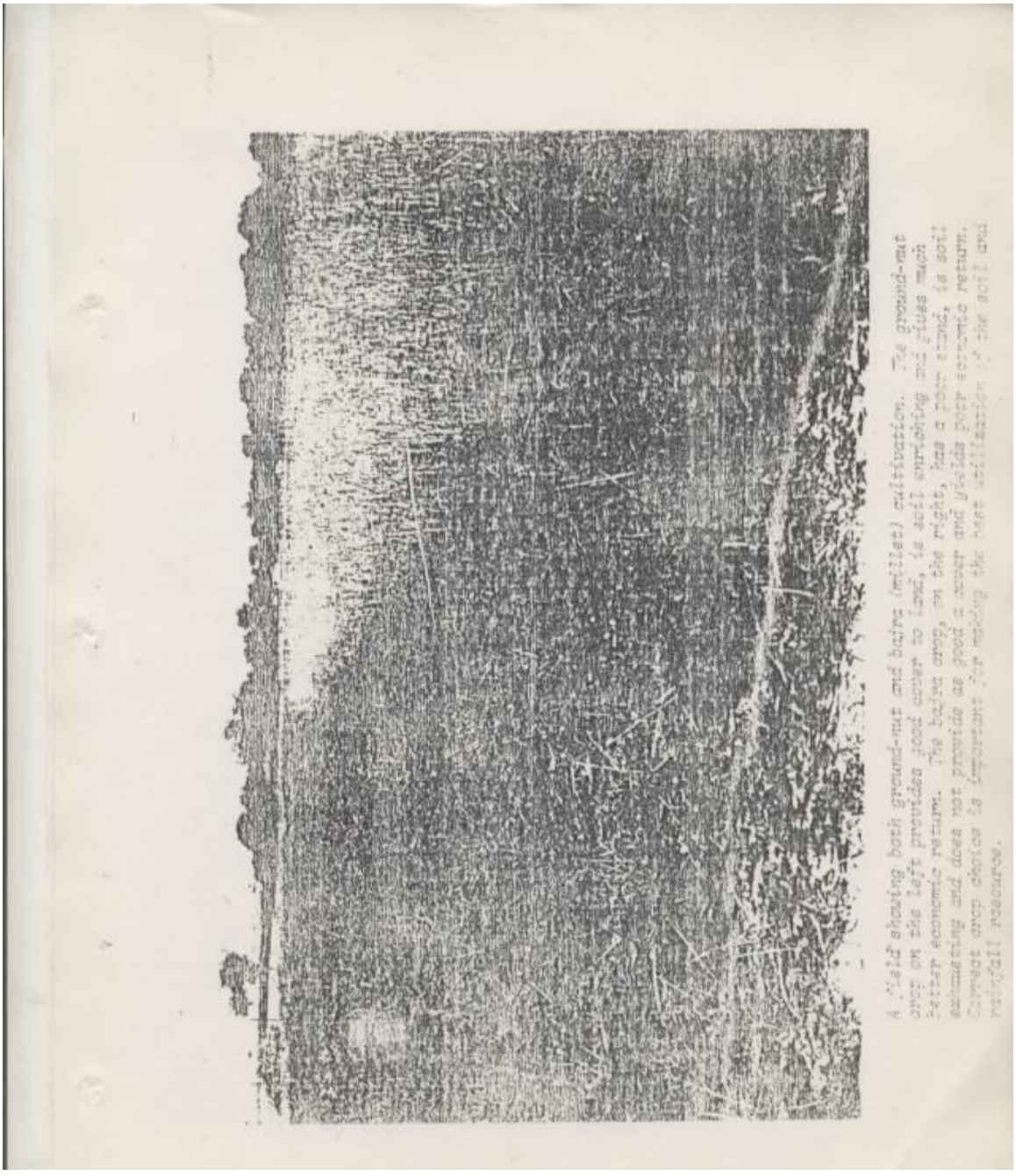
Package of Technology:

4.63 It has been established that increases of 2 to 4 times the yields normally obtained with traditional methods, can be obtained in case of wheat, groundnuts, pulses, maize and other crops by adopting a “package” of technology, including (a) better and timely cultivation for moisture conservation; (b) better varieties of crops adapted to the rainfed conditions;and (c) the use of balanced fertilizers to correct the extremely low levels of soil fertility. The cultural practices included in this package are simple and within the practical reach of the farmer. The subhumidzone of the Barani area has a good potential. As regards the semi—arid zone, more sophisticated agronomic as well as agricultural engineering practices are needed which would aim at moisture conservation by special techniques, and also a shift in cropping pattern is needed in order to bring about a significant improvement in agricultural production.

The Farmer – a key factor in production:

4.64 The most important factor in the process of agricultural development is the farmer himself. Throughout the world, vast areas of land were cleared and cultivated long before the advent of research and extension services. The amount of physical labour gone into transforming the Barani areas is gigantic. The Barani farmer is, and will continue to be a key factor in an agricultural revolution.

4.65 A widely observable characteristic of farmers is that their production response mechanism normally works best when trigerred by Financial incentive. The extent to which the



desired agricultural revolution occurs will be proportional to the degree of cncntive given to the farmers to make necessary adjustments and changes. Financial ncetnives of a premium on production rather than as subsidies on inputs, are regarded as a key element in desinging strategies aimed at a rapid increase in prodcution from the barani areas.

Tillage Implements:

4.66. although government sponsored input services have provided a good cover to the irrigated areas, the barani area is still largely without adequate supply of essential inputs such as fertilizers and seeds. One particular aspect needing attention is the provison and supply of implements desinged for barani farming. The government should set up a factory to develop and manufature such farm implements which are needed for moisture conservation, drilling of seeds and fertilizers, interculture and harvesting of crops. This factory should work more or less on the lines of roti plants established in big cities. The experience of other dryland regions of the world in developing farm inplements desinged for barani cultivation could be utilized by importing such implements in limited numbers. The prime need is the development testing and introduction of the following implements:

- Single-tined bullock drawn chisel ploughs
- Small steel ploughs instead of wooden ones
- Duch foot sewwps
- One row planter for sorghum, maize groundnut etc
- Implements for placing fertilizers beside plant rows.
- Groundnut diggers

Extension and farmer's traning:

4.67. although it is the decision of the farmer that controls the rate at which new ideas and technology are adopted an active and copetent extension service is necessary to demonsrate and dissemnate new ideas amongst farmers as widely as possible. The agricutlral extension service needs to be revitalised by taking on new purpose and by being given proper direction. Facilitites and equipment to do the job. In the barani areas, it is essential that this service reaches the remote villge and farm level, and that agricultural extension workers become involved in the hopes and aspirations of the farming community.

4.68. there is an increasing shift of emphasis to the training and education of farmers to assume responsibilities for better management of his resources. A number of programmes involving such training the commila/daud zia approach, the chiinese system of training peasants and workers, provide successful models. The results in this approach are long lasting and the developmental processes are dynamic.

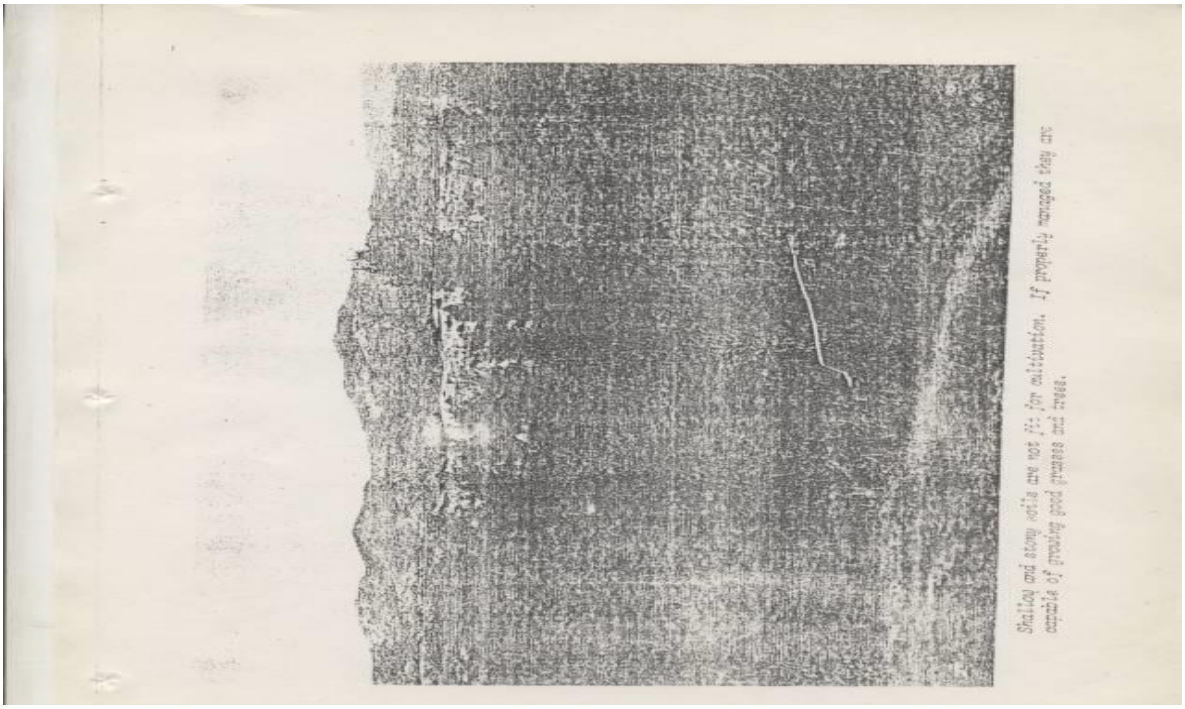
Agriculture Research:

4.69. the research services have never been adequate for the rainfed areas. There is an urgent need to establish agricultural experiment stations at representative sites in the variou ecological zones to evolve site specific proven technolgies and undertake adaptive research. There is a vast array of projects requiring study, for example:

(a). Agronomic problems relating to existing as well as new cops. Crop varieties cropping patterns rotations fertilizers, moisture conservation seed control etc.

(b). Erosion control and soil conservation, the need and opportunites for integrated land use involving rainfed agricutlure improvement and proper management of assocaited rangelands, reafforeal action in serverley eroded areas and watershed management.

(c). Socialogical studies to obtain better data for planning in relation to development of infrastructure, mechnaistation programmes, transference of labour from farming to livestock industry, forestry programmes and other fields.



d. The complex question of selective from mechanization as a means of improving tillage practices and increasing crop yields vis-à-vis the displacement of tenant farmers.

Integration of crop production and livestock production:

4.70 The Barani area of the province comprises a variety of landscapes. Slightly less than half of the area is used for cropping, the rest is not suited for crop production due to the limitations imposed by soil, rough topography and climate. Such areas have rough topography with shallow and stony soils or the annual rainfall is too low to allow secure crop production. The main land use in such areas is grazing.

4.71 The crop land and grazing land occur in close association in almost all parts of the Barani areas proportion of each varies locally. The cropping and livestock rearing have been practiced in the Barani areas from the times immemorial. As the pressure of population increased, emphasis gradually shifted to cereal production at the cost of livestock industry. Even as the conditions are at present, the Barani area still is the most important region from the standpoint of livestock production.

4.72 There are two distinct periods when the grazing lands produce forage at ta fast rate i.e. from March to April and July to September. The length of the periods varies with the climate. In the sub-humid zone the periods are longer than in the semi-arid zone. The intervening periods are dry and the forage availability gets very much limited during the dry periods the livestock have to live on land palatable forage or on browsing of scrub. The livestock owners are forced to sell a part of their animals at unfavourable prices in order to pass through the dry period.

4.73 The livestock owners, who own cultivated land, grow millets for stall-feeding of their animals both in the green form and in the form of hay. This helps them to some extent in tiding over the dry periods, but this arrangement is not satisfactory due to the lack of feeds for use with hay and dry stalks of millets.

4.74 The monsoon season, with adequate rainfall, favourable humidity and temperatures, is ideally suited for growing fodder crops as the rate of vegetation growth is at its maximum during

this period. The summer fodder crops (chari, bajra, moth and soyabeans) produce large amounts of fodder per unit area. Similarly, natural grasses which have been reduced to mere stubbles as a result of over-grazing recover remarkably and put up abundant growth during the favourable period.

4.75 A very strong base for livestock industry exists in the Barani area of the province. There is a large capacity of the rangelands for producing natural vegetation and a high potential of the cultivated land to produce forage and feeds. The increased feed and forage production could provide a firm foundation to sustain large numbers of livestock population. A larger part of the rain-fed area in highly suitable for growing groundnuts the importance of which cannot be over-emphasized as a soil-building and cover crop and as a source of vegetable oil and oil cake to be used as feed for the local livestock during the dry periods. Green fodder forms an essential part of the feed for the animals. Its regular supply during lean periods can be ensured if an adequate proportion of the cultivated land is devoted to grow perennial grasses such as Sudan grass, elephant grass etc. etc.

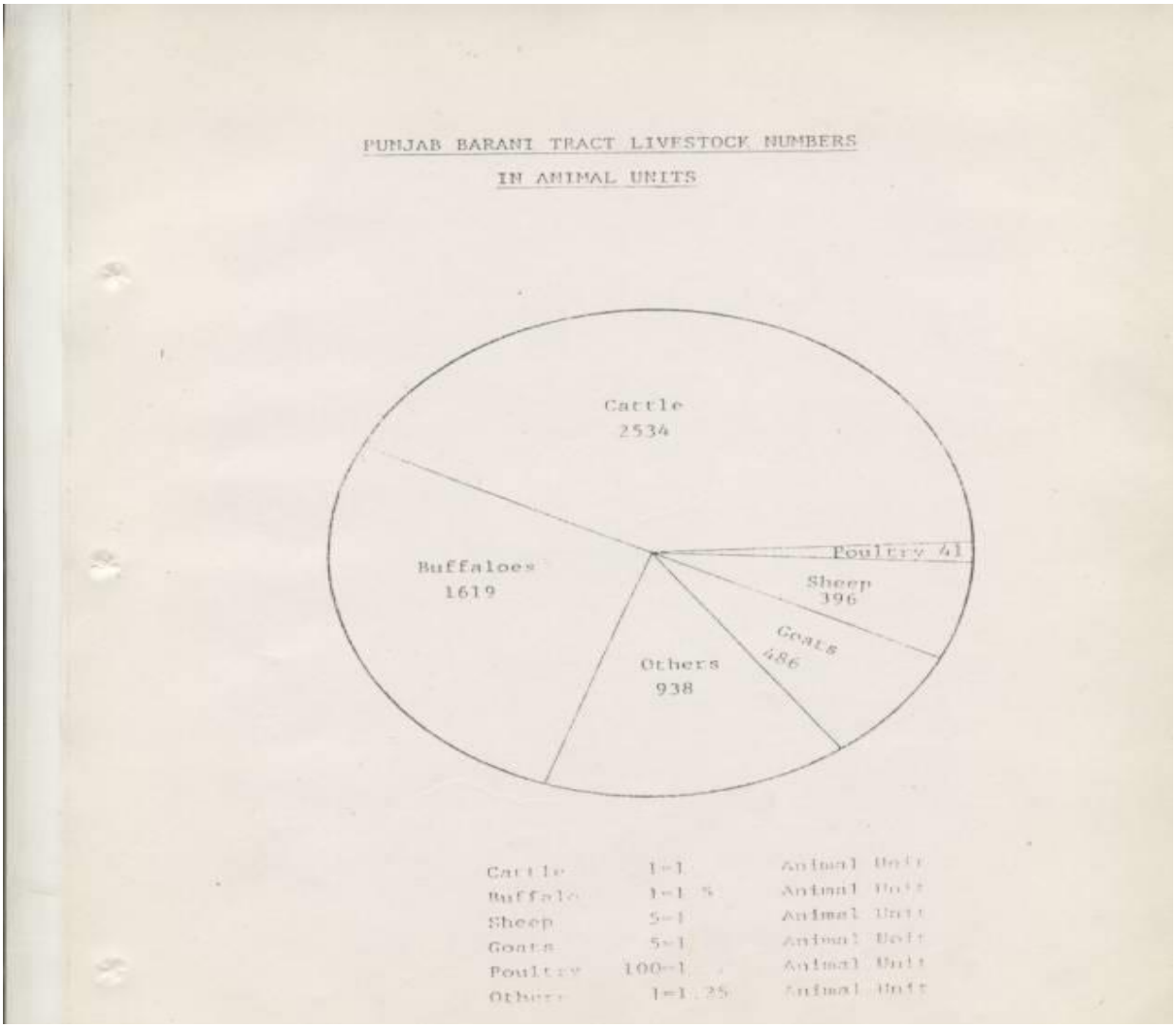
4.76 Since grazing land forms a sizeable proportion of the Barani area, the cropping patterns of the cultivated land should be such that forage crops are produced to provide supplementary feed for livestock, so that crop production and livestock production become complementary to each other. The vegetation in the range lands is in poor conditions at present due to over-grazing, but it can be improved if grazing is regulated. As all livestock in the Barani area largely depends on grazing in deteriorated range-land, the production per animal is very low. By production of forage on crop-land the pressure on grazing lands can be decreased and grazing can be regulated, which is so necessary for the rehabilitation of the grazing lands.

4.77 As long as wheat cultivation occupies the dominant position in the cropping systems and the Barani farmer is obliged to grow his own cereals for domestic consumption, full potential of the livestock industry cannot be realized. By sticking to the subsistence type of farming the precious rainfall resource is grossly under-utilized which results in soil erosion.

4.78 The integration of livestock rearing and crop production in the Barani area requires action on two main fronts. On the one hand wheat production should be given a big push in the irrigated area. This is possible increase of the increased irrigation supplies from tubewells and

Tarbela and the increased use of fertilizer. The increased wheat production in the irrigated areas would greatly ease the burden of the Barani farmer in growing his own wheat. On the other hand, livestock industry should be developed on modern lines by rehabilitation and proper management of range lands and forage as well as feed production in a part of the cultivated area. The organized marketing of the livestock producers, especially for export to the neighboring Middle East countries, could go a long way in establishing the ideal land use of the Barani area.

4.79 The Barani area of the Punjab occupies a unique position in the sense that cropland and range-land exist almost in each village in favourable proportion to other regions, the area are either mainly irrigated i.e. Indus plains on predominantly range-lands as in sandy desert and hills in Sind, Baluchistan and N.W.F.P. The integration of crop production and livestock production has thus great prospects in the Barani area. The required integration could be brought about but only through a long-term programme conceived on sound lines.



Chapter V

Livestock and Poultry

I. Introduction

5.1 Nearly 54 percent of the Punjab Barani Tract, totaling over ten million acres, is unfit for an agronomic or forestry crop, due to unfavourable soil or climatic conditions. These ten million acres produce grass and bush and livestock alone are capable of utilizing this extensive and renewable natural resource which would otherwise go waste. Animal husbandry thus occupies a vital place in the economy of the Barani area.

5.2 The Tract supports nearly 9 million head of livestock and 4 million poultry. In terms of the percentage of the various species of livestock in the Punjab Province, the Barani areas have 31 percent of the province's cattle. 14 percent of buffaloes, 46 percent of goats, 35 percent of sheep, 40 percent of poultry and 43 percent of other livestock, such as, camel, horses and donkeys. Their produce is valued at over one hundred crores of rupees annually, about 45 percent of the total produce from Agriculture.

5.3 With the increase in population there is mounting pressure on theirrigated lands in the country to put large acreage under food and cash crops. The area under fodder crops is bound to be reduced or diverted to dairy cows/buffaloes for milk production. The raising of draft bullocks, sheep, goats, camels etc, would be increasingly emphasized in the Barani Tract, where vast range lands exist. In countries like the Australia and Argentina where ecological conditions on the range lands are not very different from Pakistan successful animal industries have been established by efficient management of the range resources.

5.4 At the national level livestock and poultry are amongst the major contributors to agricultural production, the estimates vary from 28 percent* to 45 percent* of the GDP

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* Report of the Agricultural Enquiry committee, Government of Pakistan, Ministry of Food and Agriculture, 1975.

* Report of the Committee on Animal Health and Production, Government of Pakistan. Ministry of Food and Agriculture and U. areas, Feb, 1972.

from Agriculture – the lower estimates are mainly due to non-inclusion of animal draft power, dung etc. Curiously, however, the share of livestock in the plan allocation has been only about 5 percent of the total developmental expenditure for agriculture. The growth rate in the livestock sector consequently has been only a fraction of the human population growth rate, thus adding directly to under development, of the Barani Tract, where a major occupation of the people is animal husbandry.

5.5 It has also caused a lack of draft power is from bullock. The current availability of draft power for agricultural purposes is only about 0.1 HP per acre as against a recommended minimum of 0.2 HP. There is thus a major deficiency in draft power which is a critical reason for poor tillage and the low productivity of agriculture. It has also contributed to the poor nutritional status of our people. The per head consumption of meat and eggs, for example, is only about 8-10 Lbs of meat and 7 eggs in a whole year. Inspite of the fact that we have one of the largest sheep population in the world, we produce no fine wool and all of our 26 woolen factories depend exclusively on the import of fine wool. Our wool yields are so low (only about 1 Lbs of coarse wool per sheep per year) that the coarse wool that we do produce is inadequate ever for local industries. The export of wool has dropped from 23.7 million Lbs in 1965-66 to 6.6 million Lbs in 1973-74. This is partly explained by increase in manufactured goods, such as carpets, but the production of wool is still much below potential considering the large sheep population. The case of hides and skins is similar, the export of hides and skins has sharply dropped and we have started Importing leather and leather substitutes for our leather goods industries.

5.6 Of infinitely greater importance however, is our un-realized potential for the export of such livestock products as meat, which we do not at the moment export at all. It has been estimated that about 1.4 million male buffalo calves are slaughtered at a few months of age primarily because domestic beef prices are being kept too low and export is not permitted. About one million lambs are similarly killed off at birth due to low incentives for meat production. If these animals were to be reared for meat production, the incremental production for beef alone would be 987 million Lbs of beef. At current prices it would mean an additional income of 2,961 million rupees annually. If one fourth of this meat i.e., prime cuts only, in exported, it would fetch 3,952 million rupees (at about Rs.16 per Lb) in foreign exchange. No

other country in the world, except India – which is not likely to enter the beef trade in a big way, has the livestock population and the current wastage levels to permit spectacular increases in meat production through salvage alone.

5.7 The neglect of the animal husbandry sector and the inability to perceive opportunities for development are due to complex social, cultural and economic reasons, but basically it is due to the chronic difficulties in producing enough food-grains and hence the priority accorded to production of cereals. There is also a great deal of faulty reasoning based on the promise that we could substitute tractors in place of bullocks and eat pulses instead of meat and can, therefore, afford to let animal husbandry remain backward and neglected.

5.8 What is not taken into account is the fact that it costs about Rs.100,000 in foreign exchange to buy a tractor and accessories and that even if the number of new tractor units is increased by a steady 10,000 units per year, at a cost of 10,000 million rupees annually, it would take 40 years to replace the existing 6 million bullocks, if the present draft-power deficit (which is currently estimated at 100 percent) is also taken into account it would take some 80 years and if the need of new lands which would undoubtedly be brought under cultivation, because of the doubling of population by the end of the century, is taken into account, we would need a still longer period for the replacement of bullocks. In respect of pulses it may be mentioned that there has been a marked decline in the availability and consumption of pulses since independence, from 71 to 22 gms per capita daily. Which, therefore, as many tractors may be imported as resources permit and as much increase as possible secured in increased production of pulses, there is no possibility of their substituting draft bullocks or meat in the foreseeable future.

5.9 Simplistic single factor calculations of tractor versus bullock cultivation without a comprehensive understanding of the socio-economic realities can lead to very fallacious reasoning with disastrous consequences to the welfare of the people. A recent study of the impact of the introduction of the medium/big tractors in Pakistan has, for example, high-lighted the heavy social costs of tract organization. There was undoubtedly economic gain for the affluent farmer, who obtained a substantial Government subsidy to purchase the foreign manufactured medium/big tractor. The tractor farm, however, became predatory and bought additional land in its surroundings, thus dispossessing many small farmers leading to the exodus

of numerous farm families to the cities. Such dispossessed people cost enormous amounts to be rehabilitated in cities and suffer endless misery when they swell the ranks of the landless unemployed labourers.

5.10 It is also not appreciated that a bullock does not need imported fuel and spare parts paid through precious foreign exchange. In a wondrous symbiotic relationship with microbes in its rumen the bullock is able to convert rough grazing, crop waste and stubble into energy. When it can no longer do work in the fields it is not junk but is turned into meat, hide and other useful products.

5.11 This does not mean that the tractor has no place in the scheme of things, it could indeed be a very valuable facility used by a cooperative society for performing certain tasks which cannot be undertaken by bullocks. It is obviously unwise to subsidized its purchase by predatory farms so as to create landless labourers and tenants and thereby negate the land reforms which have been launched with the objective of establishing small owner-farms in the country.

5.12 There is also an inadequate understanding of the vital role of livestock in our economy, ecology and culture, Livestock provide the weave and web of the culture of Punjab. Traditionally, the people have beengraziers and their rich poetry, music and romances are woven around the life buffalo borders like Ranjah and Mahinwal. Herds and flocks are the source of prestige in society and the measure of a man's wealth, they are also used ceremonially and have aesthetic value. Domestic livestock and poultry supply food items that are highly valued in our culture – milk, meat, ghee, butter-milk and eggs, things which a farmer, like every one else, would strive and labour for to provide to his children. Above all they supply 75 percent of the draft power, power for which we do not import fueld, machines and spare parts. They provide many products used in the household economy-wool, hair, hides, skins, feathers, horns, hooves and bones. They also supply dung which is the main cooking fuel, they plaster of people's houses and the fertilizer for their crops.

5.13 Sometimes the un-informed criticism and prejudice against livestock originates from foreigners un-familiar with our conditions. Our livestock subsists mainly on the vegetation on range-lands which are unfit for arable cultivation, grass on the pathways and road-sides crop residues and stubble after harvesting and the by-products of sugar, grain edible oil milling

industries. They utilize resources that are not human food and would otherwise go waste. Every ruminant is in fact a singularly efficient and economical single-cell protein factory converting waste cellulose, through the activity of micro-flora in its rumen, into valuable proteins of high biological value. It is also by the same token a highly efficient fertilizer plant which recycles, through bacterial and enzyme action, low quality waste materials into valuable fertilizers.

5.14 The prospects of developing a lucrative trade in livestock products have been greatly brightened during recent years, both internal trade as well as export trade. Basically, Pakistan has a tremendous advantage over most other competitors in this field. We possess one of the largest livestock populations in the world and thus do not have to take decades to build a large enough population base. All that is needed is to save losses from death and disease and use the new feed technology, such as, the use of amino-acids. Urea and molasses as feed supplements to meet the nutritional deficiencies in livestock. We have highly developed resources in land and water. The rapid urbanization in the nation and the ever-increasing purchasing power of a larger and larger section of the urban people and the rural rich have resulted in a greatly increased demand for livestock products within the country. There has also been a sharp uprising of world demand for high protein foods which is reflected in e.g. the prices of beef in the world markets which have been touching the price of cheese. The phenomenal affluence of the neighboring oil-rich countries has similarly created a vast new demand for quality products and opportunity to export large quantities of meat, milk and eggs at exceedingly attractive prices.

5.15 In the meat exporting countries, such as Australia, the cost of producing beef and transporting it over long distances has also sharply increased due to the high cost of fuel and the energy intensive systems of farming they utilize. They would increasingly find I more and more difficult to be competitive with nations such as Pakistan where a low energy, low feed-grain and low labour cost farming system is practiced. Pakistan‘s nearness to the rapidly expanding middle-east markets, also provides it an edge. The Barani areas of the Punjab are exceptionally well endowed for rapidly building up livestock populations and the adjacent irrigated areas could develop feed-lots, abattoirs and the export markets. The opportunity should be utilized to enter the world trade for beef.

II. Technological break-through:

5.16 There have been in addition notable technological break-through in livestock and poultry management and nutrition during recent years, which have put it within our reach to rapidly increase and modernize our production of livestock. These advances have been achieved in all fields-nutrition, disease prevention, breeding and management. Some of these are mentioned below to bring out the new possibilities and their likely impact on the prospects of developing livestock industries.

5.17 The basic constraint in developing the livestock industry in the country has been the great shortage of livestock feed. The daily availability of the green and dry fodder per head of stock has been estimated at 13.2 pounds of green fodder and 4.2 pounds of dry fodder as against 24 and 8 Lbs respectively required for maintenance. A member of new developments have recently taken place which would help very greatly in segmenting supplies of livestock feed and fodder without additional demand on land for growing fodders (1) It has been demonstrated that feed and fodder crops, in particular newly evolved hybrid short duration sorghums, can be grown as catch crops on land at present allowed to remain fallow which could add many millions of tons of feed and fodder to the existing supplies. (2) key-farming, system combining wheat and leguminous fodder fodders for raising livestock have been evolved and are being practiced in Australia and a number of other countries which have proved highly successful in increasing soil fertility by fixing the nitrogen from the air by microbes in the root nodules of legumes, thus increasing wheat yields, as well as, providing large quantities of luxuriant green fodder for livestock (3) More productive fodder types have come available such as the Bajra-Napier hybrid, fodder type sorghums (Jawar) hybrid. And SUDEX or Sadadahar Sorghum/Sudan-grass hybrid (4)A coarse grain revolution is occurring, all over the world through the development of very high yielding varieties of sorghums and millets-particularly hybrid sorghums leading to much higher yields per acre. (5) Molasses has emerged as a highly useful substitute for grain feeding in livestock rations. We have a surplus of about 200, 00 tons of molasses annually which could be used with great advantage in livestock feeding. (6) Non-protein nitrogen-urea and bi-urates, have been successfully utilized as extremely in-expensive substitutes for proteins in livestock feeding (nearly 600,000 tone feed grade urea is being fed to livestock in the U.S.A. alone). (7) Single cell protein for livestock feeding has been produced cheaply by growing yeasts and other microbes on petroleum wastes of natural gas and as a by-product of bio-gas production from livestock manure. (8) Cheap synthetic essential amino acids, which balance poor quality

proteins in rations are being extensively used in processed feeds to get higher weight gains and production. (9) The establishment of a livestock processed feed industry in the nation has made it possible to utilize the newer advances in nutrition on a commercial scale.

Disease Control:

5.18 A poly-valent vaccine has been successfully prepared in the country against Foot and Mouth disease. Apart from the widespread losses that epidemics of this disease cause, especially its crippling effect on draft animals at the time of sowing and harvesting, advanced countries do not permit import of meat from areas where Foot and Mount disease is known to exist. Protective vaccination against Foot and Mouth disease (and its eradication ultimately) is thus a pre-requisite to the development of and export market. There is in the country a comparatively favourable situation due to (1) the availability of a wide-range of Biological for preventive immunization of livestock and poultry against epizootics. (2) availability of broad spectrum parasitcides; for mass scale use, such as dosing with phenothiazine and nilverm, which are effective against more than 20 internal parasites, dipping in long acting insecticides solutions such as gammexane which is effective against mange mites and most other ecto-parasites of livestock, and (3) the availability a flow-cost antibiotics and growth promoting substances, critical for the achievement of the low morbidity in successful calf-rearing.

Breeding

5.19 Recent developments in the country include (1) the use of frozen-semen and liquid nitrogen to replace liquid-semen stored under ordinary refrigeration, thereby increasing storage life of semen from a few day to many years, (2) the perfection of a successful technology for artificial insemination in the water-buffaloes, (3) the availability of frozen semen of high-yielding exotic breads, (4) the availability of nucleus stock of a number of superior exotic sheep and goats, and (5) the evolution of Lyallpur Silver-Black, an improved Poultry type for village poultry keeping.

Management:

5.20 The introduction of intensive management systems and the successful adaptation of superior technology for commercialized poultry farming. The development is underway of a modern sector in the Dairy/meat industries.

III. Development of Animal Husbandry:

5.21 The basic steps needed to develop animal husbandry would include the following: (1) policy, favourable to livestock production and incentives, (2) restoration of feed-livestock balance, (3) genetic improvement in the quality of livestock, and (4) provision of adequate animal husbandry/veterinary services.

Policy:

5.22 The current level of support to Animal Husbandry is minimal. The expenditure on Animal Husbandry in the annual development programme budget for 1973-74 is typical, in the Punjab it was 4.9 percent of the total spent on Agriculture. By contrast the crop sector in allocated over 90 percent of the developmental expenditure on agriculture and is heavily subsidized – seeds, fertilizer, water tractors, and major crops are protected through price-support measures. In the case of livestock, there has been virtually no price-support, subsidy or developmental out-lay. On the contrary, the sector has been discriminated against and kept depressed by forcing prices of livestock products at below cost of production levels and by the imposition of heavy duties on export items and out-right bara on the export of most livestock products.

5.23 This has resulted in numerous anomalies and a marked skewing of the functioning of the sector. For example, as the export of livestock and their products, such as meat is banned and the prices in the neighbouring countries are much higher, an estimated 600,00 head of cattle, buffaloes, sheep and goats are smuggled out of the country. Similarly, about one half of the total production of wool is smuggled out since an advalorem duty of 40 percent has been imposed on wool, raw hides and skins. This means low prices paid to producers by the traders, since there is no reason to expect that they would accept for themselves any significant reduction in marketing margins. This encourages large scale smuggling by the anti-social elements in society. About 13 million lbsof wool and several hundred thousand lbs of raw hides and skins are known to be smuggled out of the country. Although a highlylucrative world market for meat exists, because of the ban on the export of meat nearly 2 million buffalo/cattle calves are killed off a few months after birth and nearly one million (100,000) lambs are slaughtered at birth and their pelts exported at colossal losses to the meat, milk wool and manure production in the country. On the

other hand, imports of livestock products such as milk and dried milk, including products gifted by various aid agencies is freely allowed; which is used mainly to depress the price of milk.

5.24 The traditionally low prices of livestock and poultry products were associated with the scavenger status of livestock and poultry and the primitive style of this enterprise. Livestock have existed on free ranges, and on the free labour of women, children and unemployed dependents. The limits to this type of husbandry have reached and future expansion and increased production of livestock and poultry would be dependent on purchased feed and hence on reasonable prices. It is only when the current price policies permit the necessary margins that organized modern marketing services would also be established and the processing, storage and quality production facilities would be developed. The highly arbitrary pricing policies currently in vogue, would only promote illicit exports and primitive levels of husbandry, collection, processing and marketing practices.

5.25 The easy availability of institutional credit is another basic requirement for the development of the sector which has received little attention. The Agricultural Development Bank has only given about 4 percent of total credit to the animal husbandry sector. The commercial banks have given only 10 percent of their credit to the farm sector, of which less than 1 percent has gone to the livestock sector. The total credit is estimated to be of the order of Rs. 8 million during 1972-73. It is necessary for such institutions as the Agricultural Development Bank to develop the necessary competence in helping a sector which contributes as much as 45 percent of the total contribution of GDP from Agriculture. At least 30 percent of its staff should comprise animal husbandry graduates specially trained to assist the stock-breeders as the feasibility of most of the projects supported through such credits is doubtful.

Restoration or Feed: Livestock Balance:

5.26 Concurrent with the explosive increase in the human population there has been an increase in the number of animals. With every new family unit added to a village, a minimum livestock unit also gets established. There has been however, no corresponding increase in the feed supply. The livestock numbers cannot be permitted to increase beyond the feed supply and should be reduced to restore the feed; animal balance and prevent damage to range lands from

over grazing. This can only be done by improving the quality of the livestock so that fewer animals would provide the existing production.

5.27 Recent advances in animal and poultry breeding and the extremely high yields from animals in environments similar to the Punjab Barani areas hold out the promise for the success of carefully planned measures aimed at (a) improving yield potentials through genetic improvement, (b) increasing fertility of livestock, (c) reducing morbidity and mortality so that fewer breeder animals are required to produce the requisite number of off-springs, and (d) increasing off-takes from the ranges for slaughter. The basic need, however, is to improve the feed-supply as 90 percent of the livestock are subsisting on starvation levels, rather than for production.

Range-Lands:

5.28 The natural grazing on the vast range-lands provides about 20 percent of the nutritional requirements of cattle and 60 percent of sheep and goats. The flocks and the herds of the land-less subsist almost entirely on the range-lands. The range-lands have been badly over-grazed; the palatable species of grasses have perished and have been replaced by vegetation livestock does not relish. Soil erosion has affected a large proportion of these lands. The carrying capacity has been greatly reduced: their yield is hardly 10 to 50 percent of their potential. Since the range-lands often cover extensive water-sheds, erosion and accelerated run-off during short periods of heavy rainfall lead to serious problems.

5.29 It is estimated that the number of animals grazed is 3 – 4 times the carrying capacity of the range-lands causing not only a very poor state of the health and production of livestock but also widespread denudation and damage to land from water and wind erosion. This situation is aggravated due to the seasonal migration of large numbers of animals belonging tonomadic graziers, such as,the Bakarwala fromKaghan who spend the winter in the Pothwar and slat-range grass lands and the nomadic tribes from Baluchistan and even Afghanistan in the D.G. Khan piedmont areas. They are expert graziers and generally keep good intelligence about the availability of grazing. They are, however, interested mainly in the exploitative use of grazing and contribute little to the conservation and sustained utilization or improvement of the rang-land.

5.30 The remedies to stem the deterioration of the range-lands are well known and are discussed more fully in the chapter on forests and range-land.

5.31 Because of a variety of reasons, the annual off-take rates of livestock from the ranges are low: they are estimated at 10 percent, 20 percent, 40 percent and 50 percent for cattle, buffaloes, sheep and goats respectively. Higher off-takes would mean greater availability of livestock products to the consumer, major income to the producer and lesser burden on the range-lands and hence better conservation of soil and water. The major bottle-neck is due to poor marketing arrangements but greater reproductive efficiency of the stock and effective disease control measures would provide a high enough level of survival that the stock-breeder would be willing to consider a market orientation to his enterprise. There must be a sustained drive to ensure that all surpluses are marketed in time.

5.32 A major means of achieving higher off-taken is the stratification of the livestock industry i.e. the establishment of a chain of feed-lots in the irrigated areas adjoining the range lands to provide for the regular lifting of the produce of the range and to ensure adequate returns. Here stock-yards, abbattoirs, and facilities for the storage and marketing of meat etc. could also be arranged for. This will create an important market for immature or store animals, giving the producers out-lets for their young stock. This will offer opportunities to reduce pressure on the over-stocked range-lands, at the same time substantially increasing beef and mutton production. It has been estimated that in time, as the effect of this stratification is extended over the entire industry, mutton production alone would be increased by about 33 percent without even the change in the composition and productivity of the flocks. Without the feed lot/marketing facilities the ranges will continue to maintain the existing low off-take levels, carry livestock greater than the carrying capacity of the land and cause progressive deterioration of range.

Fodder Crops:

5.33 Natural pastures provide adequate forage only at irregular intervals as the growth of self-sown herbage is linked with seasonal rainfall. Supplementary fed has thus to be provided to the stock, in particular during periods of drought and scarcity. The lack of such supplementary

feeding is a major reason for the emaciated hungry look of the animals, their low rates of reproduction and growth and their poor yields. A system of mixed farming is practiced throughout the tract with crop and livestock husbandry very intimately integrated. This is also reflected in the cropping pattern. While generally separate areas of land are not set aside for fodder crops, there is often an ad-mixture of crops with a view to obtaining some fodder for the supplemental feeding of livestock. In large parts of the Barani areas (the Potwar tract and the salt range) during Rabi the wheat and barley crops have an admixture of rapeseed grams, and berseem. The Kharif crops have admistures of maize, millets, sorghum and guars. Some part of every crop is fed to livestock. This also; (a) makes it possible for nutrients from soil to be derived from two levels due to differing depth of the root system, (b) increases soil fertility by combining with cereals, leguminous crops that have the ability to fix air nitrogen in soil through the microbes in their root system, (c) avoids total crop failure in case rains fail because of the generally lower water requirements of the crops from which fodder is obtained.

5.34 One or two cuttings are often taken from wheat etc. also for fodder. There is opportunity here to use wheat varieties which have heavy tillering or instead of wheat use. Triticale (wheat and rye hybrid which has now been cultivated on millions of acres all over the world and has such attributes as higher protein content and tolerance to drought) which tillers very heavily and would provide much higher yields of fodder as a rotation crop.

5.35 This cropping patern has, however, been evolved to meet the food, feed and market requiremens in a traditional setting. With the rapid changes taking place in agriculture at the national scene, the canal irrigated areas would hopefully produce all the wheat needed by the country. The existing cropping pattern emphasizing Rabi over Kharif and of wheat over other crops with long fallow periods in the Barani is then likely to change dramatically. The ecological situation with extensive soil erosion and low soil fertility would demand a cropping patter which provides crop cover on land during the monsoon season.

5.36 At present clean fallowing is practiced in most parts of the Barani tract to control weeds and conserve soil moisture. In Australia the same practice was followed but has no been replaced by another systemwhich has brought in the green revolution of Australia in terms of production and conservation. This involves self-regenerating forage legumes (media etc.) alternating with wheat. This rotation has been successfully tried in a number of other countries such as Cuba and Algeria, and experts believe that the has particular relevance to the Potwar

tract of the Punjab Barani areas. It has the advantage that it not only eliminates the expenses on mechanical operations during fallow but provides nutritions' forage legumes for the livestock, improved soil fertility and thus increases wheat yields. The forage enables livestock husbandry which stabilizes the farmer's income at a higher level. Greatly increased soil fertility without the use of nitrogenous chemical fertilizers has under this cropping system made possible very lucrative livestock industries to be established. A similar revolution is indicated for the Punjab Barani areas.

5.37 There are two distinct dry or lean periods during each year i.e. May to June and October to February when the range lands provide small amount of forage of low nutrient value, with the result that the animals loss weight and vitality. The stock-breeders are, therefore, forced to sell a part of their stock at un-economic prices. This could be avoided if some gross fodder is made available during the lean periods. This would be possible if perennial grasses, such as, Sudan grass, Bajra-Napier hybrid, sorghum hybrid, sadabahar etc. are grown on a part of the cultivated land. Green fodder from those grasses should be cut only during the dry periods in order to help tide over the lean period. The cultivation of these perennial bunch grasses is especially helpful in the areas having rainfall about 20 inches. Taramira and Sarson can provide green forage during January and February even in drier areas.

5.38 There is a great opportunity to increase the cultivated area during Kharif especially in parts with fair rainfall. Some of this increased acreage should go to cultivated fodder. the Bajra-Napier hybrid, the Sudan grass, Sorghum hybrid, sadabahar and the fodder type sorghum are all very good prospects and can be cultivated depending upon the needs and conditions in a particular locality. The successful accomplishment of the change to a more desirable cropping pattern and higher yielding varieties would depend upon the certain locally of forage experiment stations in each ecological zones to generate tested technologies and genetic materials.

Coarse-Grain Revolution:

5.39 As part of the provision for supplemental feed, the coarse-grains play in important role in creating successful livestock industries. So far, the green revolution in the country has been confined mainly to wheat and rice, and the coarse-grains have received little serious attention. In the Barani Tract, maize, sorghum and millets and important crops and unless a break-through

similar to wheat and rice is achieved in their case Barani area would not receive the full benefits from the spectacular developments in agricultural science. The development of high yielding varieties of wheat and rice were a contribution of world science and a similar initiative in now affect in the case of millet4s and sorghum. For example nearly 8,000 varieties of sorghum are under study at the International Group Research |Institute for the Semi-Arid Tropics (ICRISAT) in India which is an International centre similar to CYMIT in Maxico and IRRI in the Philippines. High yielding varieties are also available from the USA, Australia and other countries. It would, however, require considerable effort at the national level to utilize the advance achieved at the international level and to make appropriate selections from the improved germ plasma available from world sources so that all parts of the country could benefit. The revolution in coarse-grain production would provide the much needed cushion in creating food-grain reserves, as well as the base for developing animal industries, in particular poultry keeping . Coarse grains have also a large international market and the surplus if nay could be exported. More than anything else such a revolution would increase the productivity of vast areas in the Barani Tract now producing at abysmally low levels, thereby, improving the income of the people. Having up the favoured parts of the county. The government of Pakistan have already taken a decision to establish a national institute for research in coarse-grains under the Agricultural Research Council in order to give the requisite impetus to this neglected field. This decision needs to be implemented without further delay.

Fodder Trees

5.40 It is the experience of range-lands all over the world that feed scarcities occur periodically and alternative source of feed must always be provided. Traditionally a number of trees have provided fodder for livestock but selling of trees and inattention to grow replacements have reduced this source of nutriment. the importance of trees for animal feeding purposes, is generally under-estimated. There are a great many species that could be increased or at least protected for rational use. Protective measures and systematic planning of fodder trees should be undertaken to provide nutritive fodder reserves for the dry seasons. A systematic policy to encourage fodder producing trees should be the keystone of land use management programmes. for the Barani Tract it would be not only a solution to the problem of reserve fodder for the end of the dry season, but would make also possible other use of land around watering places which is abandoned most of the year for lack of grazing. A list of the fodder trees of the area is enclosed. (Appendix-I).

Porcessal-Feed

5.41. The corner-stone for developing sound livestock and poultry industries is the establishment of feed-mills to produce processed-feed. there are numerous by-products of various industries such as oil-cakes, fish meal, bran and rice husk, bone-meal, blood meal, molasses, baggase etc. which can be mixed with substances such as coarse-grains, urea, dried clovers, minerals, amino-acids and growth promoting substances to prepare processed feed for the supplemental feeding of livestock. In periods of great scarcity when the protein content of the feed goes down, even as small a supplement as 2 ounces of such feed per sheep would provide the nutrition for microbes in the human which in turn would digest the cellulose in the rough feed available and enable the animal to survive. High production and growth rates require such supplements. Already a number of feed-mills have been established but more need to be established forthwith and given the name priority as is given to fertilizer factories. A programme for subsidizing the use of processed livestock and poultry feed is indicated in order to promote the wider use of this essential ingredient of successful livestock enterprises.

5.42 The availability of processed feeds would enable the stock-breeders to tide over critical periods. Growth of claves and lambs is, for example, restricted and losses are increased because much of the milk is taken for human consumption; supplemental feeding of milking cows and ewes would increase milk yields and thus allow young stock to receive a larger share. The period after weaning is a critical one; supplemental feeding is especially needed at this time since the young animal can never fully recover from shortage of good quality pasture at this period. Similarly higher plane of nutrition shortly before service will increase conception rates and can, therefore, increase the calf and the lamb crop and be of help towards adjusting parturition dates to coincide with the most favourable time of the year.

5.43 During the dry season the quality of the available pasture rather than quantity is often the limiting factor and is insufficient for maintenance. Small quantities of protein-rich supplements in the form of processed feed or protein-rich oil seed cakes, alfalfa hay or a mixture of urea and molasses will enable stock to maintain condition which otherwise they would suffer loss in weight. Mineral supplements especially of phosphate are also needed.

5.44 The rice lands of Sialkot, Gujranwala, Sheikhupura and Gujrat districts, lying adjacent to the Barani Tract, offer a great potential for supplying supplemental protein-rich processed feed for feed-lots that could be established right within the tract. At present all the rice lands are put under wheat during winter. As both the crops are exhaustive and shallow rooted, the subsoil remains under-utilized. Physical condition of the soil is progressively deteriorating under the Rice-Wheat system. Heavy use of the expensive fertilizers is also needed to get reasonable crop yields.

5.45 This cropping pattern needs to be replaced by the rice-berseem system so that a deep rooted leguminous crop could be added to the crop rotation. The berseem crop would open up the subsoil and add adequate amounts of nitrogen for use by the rice crop thereby eliminating the need for nitrogen fertilizers which are so necessary under wheat - rice system. By putting the entire rice-area under berseem tremendous amounts of green fodder could be grown which could be dried and processed into pellets with the help of small units of drying and pelleting plants. This protein-rich feed could be supplied to the Barani Tract for fattening of cattle and for optimum utilization of the range lands. The pelleted berseems and Lucerne has an unlimited market in the middle east where the price is around $268 a ton.

5.46 A recent development of great interest is the feeding of non-protein nitrogen in the form of feed-grade urea or biuret to cattle and other ruminants to replace proteins from grains and other expensive food-stuffs in livestock rations. The bacteria and protozoa in their rumen can synthesize high quality protein from non-protein nitrogen. Fertilization of field crops. Already 600,000 tons of urea is used per year in the USA in livestock feeding corresponding to a saving of about 5 million acres of soya beans. Single-cell protein from microbial growth on sub-strata such as molasses, bagasse, manure, petroleum waste etc. could also be incorporated with advantage.

5.47 Molasses is another by-product which is not fully utilized in livestock feeding. The energy and protein deficiencies of stock which are universal in animals reared on range-lands can thus be easily be giving small quantities of processed fees containing such cheaper ingredients as "Urea", single cell protein and molasses. Urea and molasses mixtures are being fed to ruminants successfully to provide energy and proteins, replacing as much as fifty percent and more of the total requirements of energy as well as proteins.

5.48 It is not generally recognized that reserves of feed are equally necessary for livestock populations as for humans. all over the world the absence of such reserves results in periodic losses of millions of livestock on range-lands. Although the Punjab Barani range-lands are infinitely better endowed that, for example, the grazing areas in neighbouring Afghanistan, where every few years couple of millions of animals die of feed shortages, nevertheless like other range-lands periodic feed scarcities are the rule rather than the exception. The fat-tailed sheep, the humped cattle and the humped camel are nature's adaptation to counter periodic feed scarcities. The fat is the reserve carried by the animal to tide over periods of scarcity. This is, however, quite wasteful. It can be easily imagined how much of food energy is expended by sheep carrying up and down hill sides an additional weight of 10 - 20 lbs of fat in their tail. the fat-tail is also an obvious impediment to high fertility levels and causes extensive economic loss. Studies of cross-breeding for tailed with thin tailed sheep at Bochal Kalan in the Tract and the University of Agriculture, indicate that the breeding, efficiency of cross-breeds has been increased (80 percent lamb crop instead of 50 percent) both weights and weaning weights of cross-bred lambs are significantly better and the mutton quality has improved. The lambs are fetching much higher prices as compared to fat tailed lambs, and breeders are taking to cross-breeding. It would be much more economical to build feed reserves on the ground rather than in the tail of sheep. Storage of fodder as hay, silage, dried stalks of sorghum and the availability of processed feed containing cheap ingredients such as urea and molasses should all be systematically encouraged through community action. such programmes should be pursued as earnestly as programmes for the supply of fertilizers to increase crop yields.

5.49 Fortunately, experience is being gained in may countries as to how such problems can be tackled. One example may be quoted from Syria, where a national revolving fund for feed reserves now totaling $ 2 million has been set up with World Food Programme assistance; feed stores have been set up by the government and by grazing cooperatives now established on 700,000 ha of range-lands. Successful cooperative programmes have also been set up for feed-lot fattening and for fattening sheep on fodder crops on the agricultural land. Similar programmes must be developed for the survival and productive efficiency of livestock on the Punjab Barani lands.

Genetic Improvement:

5.50 The livestock types found in the Punjab Barani Tract are hardy and well adapted to the peculiar conditions prevailing in the area and some of these have high merit such as the Channi and Dajal cattle as superior draft animals. inspite of doubt expressed to the contrary, world-wide experience shows that livestock, raised under hard ecological conditions where ability to survive is the first consideration can still respond well to improved feeding when brought into feed lots or on to improved pastures. Feed lot fitting has long been commercially profitable with annual sheep in Syria, and successful feed lot operations with cattle brought in from the semi-arid areas are reported from Kenya and the Sudan.

5.51 There is, however, no doubt that may of the existing livestock types have evolved primarily for survival and have a low production ceiling. the stock-breeder would be willing to invest in purchased feed and other in-puts only if the yield increases are significant to warrant the additional expense and care. With improved feeding and management there must be such high yielding livestock which can give adequate returns on additional feed and care. This can be achieved by (a) selective breeding from amongst the local animals, (b) cross-breeding with superior types, Initial selective animals, (b) cross-breeding with superior types, Initial selective culling could lead to quite rapid improvement in the hers. Such improved herds can be the source of improved bulls for up-grading the local stock. Cross breeding will the right breeds would result in very rapid improvement in yields. Artificial insemination could be deployed on a large scale for cross-breeding programmes with exotic breeds where-ever such programmes are considered advantageous and feasible.

Livestock Types:

5.52 Unlike the crop-world, the number of domesticated species of economic importance is very limited and their distribution is determined by the availability of feed. In the Punjab Barani Tract, the least favoured arid deserts have camels, arid areas which have brush and bush have goats, semi-arid range -lands with grass have sheep, grass-lands with some cultivation of millets and sorghum carry cattle and the sub-humid areas carry milch buffaloes. although in terms of animal units the Barani Tract has 28 percent of the livestock population of the Punjab, it has more than 40 percent of the goat and the poultry population of the province. Special attention should, therefore, be given to these two species.

5.53 The tract is the home of two of the best draught type cattle breeds in the country, the Dhanni in Potwar and Dajal in DeraChazi Khan. There are three outstanding breeds of goays in the tract; the beetle in the Sialkot/Gujrat Districts which is about the best tropical milck goat, the Dera Din Panah goat in Mazaffargarh which is a hardier milchtype animal and the "Teddy" goat in Jhelum – a rapidly spreading new introduction from Banga-Desh, which is very prolific, is small-sized and has the best skin of any goat breed. The sheep breeds include (1) a fat-tail sheep, the Potwari, (2) the Thaili, and (3) an off-shoot of Lohi. The best indigenous horses, the Baluchi horses are found in the D.G. Khan district. The buffaloes are, like other Punjab buffaloes, outstanding milk producers. All these animal types are very well adapted to the severe climatic conditions prevailing in the area and can subsist on very rough feed.

5.54 The genetic improvement of livestock has nto received due attention. A judicious set of policies would have to be evolved; (1) for up-grading the genetic quality of the superior livestock breeds in their home tracts e.g. Dhanni and the Dajal cattle, the Beetal, Der Din Panah and the Teddy goats, the Baluchi horses and the Thaili sheep. This would require the establishment of livestock breeding farms in various parts of the tract and the organization of 'Key-area Livesock Improvement Projects' on the lines of the old Dhanni Cattle Breeding Scheme which successfully rehabilitated the breed in its home tract earlier during this century, (2) cross-breeding with more productive exotic superior breeds in carefully selected areas where the feed and hygienic situation warrants the introduction of higher yielding types. This would require the establishment of the experimental station livestock breeding farms in the area for evaluating their performance under local conditions, and the selection for propagation of those which prove best adapted. The cross-breeding work will have to be introduced in a phased manner, in selected zones. The exotic breeds should be introduced not in the form of a single in-put but as part of a package which would include improvements in the feed, hygienic situation, disease control and better marketing of produce.

5.55 The exotic breeds suggested for cross-breeding include; the Jerseyand Illawarashort-horns for the higher rain-fall areas of about 20" rain-fall, the CorriedaleLincoinand the Cotswold sheep for Potwar and the Awassi sheep for the salt range, the Angora goat for mohair, and the Toggen-burg goat for milk. The Lyallpur Silver Black, a synthetic breed, evolved at the University of Agriculture should be propogated in the rural areas. The best available superior high yielding strains (fr both eggs and broiler production) from world sources (which are being

continuously evolved at great expense in commercial poultry breeding enterprizers)should be used in the organized commercial poultry farms.

Cattel and Buffaloes:

5.56 In common with similar areas in the sub-continent, the semi-arid areas, which constitute the major part of the Punjab Barani tract are the home of outstanding draft breeds of cattle. Prior to independence the canal colony areas were mainly dependent for their draft bullock supplies on the extensive dry-land cattle breeding areas of the Hisar-Haryana tract of East Punjab and only secondarily on the North Western dry land cattle breeding tracts. Cut off from the Hisar-Haryana tract, the Punjab farmer is now dependent on the Barani areas of Dajal and Rohjan in the Dera Ghazi KhanDistirct and the Dhanni and Potowar Tract.

5.57 In view, however, of the large demand, the neglected state of the range-lands, the inadequacy of arrangements for growing supplementary food and fodder, and the high cost of processed feed, the Barani stock-breeder disposes of his draft cattle male calves at about the age of one year. People in the canal colonies buy these one year old male-calves from the Barani areas and rear these up on their own lands. It is very uneconomical to raise bullocks on cultivated fodder in the canal colonies. This pattern is not entirely satisfactory as with better management of resources the Barani staock-breeder could raise the bullocks to maturity as he used to do before independence and get a much higher price. A good Dhanni or Dajal bullock would fetch around 4 to 5 thousand rupeesand the demand is almost unlimited. It is more profitable to produce buffalomilk and meat instead, in irrigated tracts. Considering the vastness of the Barani resources, the re-habilitation of the range-land and the better management and breeding of cattle in the area would make it possible to fully capture the market for bullocks in the province to the mutual advantage of the irrigated as well as the Barani Areas.

5.58 There are three distinct cattle breeds found in the Punjab Barani area, the Dhanni, the Bajaland the Rohjan. Only a few animals of these breeds are being kept in Government Livestock Breeding Farms as there is a popular belief that breeding draught type animals, under farm conditions would result in breed deterioration. It is argued that their environment should be harsh and they should be naturally selected for hardiness. This is not based on any scientific defensible premise and has been practically countered by the fact that about the best draft type animal in the sub-continent, the Hisar breeds, has been bred on a livestock farm. It is urgently

necessary to establish, in the breeding tract of the three breeds, Breeding Farms which should engage in the genetic improvement of the three draft type cattle breeds on sound scientific lines.

5.59 Meanwhile the best bulls available in the breeding tracts of the three breeds should be purchased and concentrated in key breeding areas under schemes modelled on the lines of the old Dhanni cattle breeding scheme. This approach would give a flying start to the up-grading of these superior types.

5.60 In areas which fall outside of the selected zones for the propagation of the three indigenous breeds, cross breeding work should be initiated mainly throughartificial insemination, to begin with, on a pilot scale basis in carefully selected circumscribed areas. Theresults of such work in the pilot areas should be carefully watched before cross-breeding is done on a mass scale. In the colder areas such as the Murree Tehsil where the present cattle are only of a non-descript type, artificial insemination could be undertaken using exotic breed semen, such as, of Jersey or Brown Swiss, as he cross breeds would not have to contend with the high heat and aridity of the plains. This should, however, be simultaneous with a strong push to cultivate leguminous fodders, such as, lucern under the orchards and the supply of processed feed ad other essential inputs, such as, disease prevention.

5.61 Almost 14 percent of the animal units in the tract are water-buffaloes. The water-buffalo has emerged in the country as the major producer of milk and is in great demand for city milk supplies. As the technology for artificial insemination of buffalo has been more or less perfected, a determined effort should now be made to up-grade the genetic quality of the water-buffalo in the Barani tract. The Barani area buffaloes are somewhat inferior to the water-buffaloes in the Riverain Punjab and it would be very rewarding to upgrade this stock.

Poultry:

5.62 There is great scope for poultry production in the Barani areas. The poultry numbers in the Barani areas at 40 percent of the total poultry in the province. The climatic conditions in the Murree Tehsil and in the climatically more moderate parts around Rawalpindi, Gujrat and Sialkot are particularly suitable for the establishment of organized poultry forms and commercial hatcheries etc. Special efforts should be made to development organized poultry farming in these areas. For the village type birds the supreme test is survival and the ability to convert into eggs,

meat whatever can be picked up by the birds on free range. The Lyallpur Silver-Black is the only improved type in the county which is claimed to possess hardiness alongwith superior meat and egg production potential. It is necessary to pursue vigorously the work for the evolution of such types which can be kept on free range basis in the villages more or less as scavenger birds.

Goats:

5.63 There has been some-what un-informed prejudice against the goat. While this animal could cause considerable damage to trees and tree plantation in certain locations and situations, there are vast areas in which the goat performs a positive and highly useful role. Most of the antagonism to the goat is subjective and very little experimental evidence exists to prove that it is any more destructive of trees than other animals including man.

5.64 In Tanzania, Africa, the results of extended trials with a number of animal species have indicated that the goat is no more destructive of forest than other animals. The only place in the world where a determined attempt to eradicate the goat was made is Venezuela but the results were disappointing. As a result of the eradication of the goat the thorny bush and shrubs became so over-grown that cattle cold not even get into the grazing areas and the goat had to be re-introduced in order to maintain afavourable ecological balance. The scientific evidence available so far and the informed conclusion has been that it is over-grazing and uncontrolled grazing and not grazing by a particular animal that causes damage.

5.65 In Pakistan, inspite of the legislative measures against the goa the recent livestock census indicates that in the country as a whole the goat has increased by almost 50 percent between 1960 and 1972 while sheep have increased by only 20 percent. The total number of goats in the Barani Tract is 24,36,000 as against 19,82,000 sheep.

5.66 Two goat breeds in the Barani Tract have a high potential of milk. Beetal Goat is found abundantly in the Sialkot and Gujrat Districts and the Dera Din Panah goats in Muzaffargarh district. Selective Breeding work with these types to evolve high yielding milch goats should be taken up in earnest.

5.67 In selected areas cross-breeding experiments should be initiated with exotic high yielding goat breeds. The American Record for the Toggenburn breed of gotats has now touched 5,750

pounds of milk in 305 days. This is about 19 lbs of milk per day for an animal weighing as little as 100 – 120 ls and requiring only modest feeding space and care for maintenance.

5.68 It should be remembered that the price of a milk buffalo is today about 4 to 5 thousand and it has become impossible for a poor famer to either purchase an animal at such a high price or to feed it. In the Barani Tract where the number of milk buffaloes and cows is in any case small, there is a tendency to keep goats as dairy animal. As the prices of large livestock go up further dependence on the goat is likely to increase and there would be opportunity to keep goats not on ranges but on stall feeding so that damage to trees would be minimized.

5.69 A new goat introduction to the Barani area, is the Teddy goat which is spreading, fast, specially in the Jhelum District, because of its high prolificacy, its small size and consequently very modest food needs. This goat is siad to have been introduced from Bangla Desh and can live on very little grazing. It is primarily a meat animal but the skin is an important by-product which is in great demand for its superior texture and grain.

5.70 The goat is not a seasonal breeder like sheep and hence types, such as, the Teddy goat would almost give a 200 percent kid crop while in the case of range sheep the lamb crop dos not exceed 40-60 percent. Secondly if we try to increase number of lambs by inducing twinning in sheep, the low level of milk production in the local sheep does not permit nursing of more than one lamb, the second lamb thus generally dies. This goat, on the other hand, can easily rear 2 to 3 kids. One of the major challenges facing the nation is to increase the number of meat and milk animals in proportion to the exploding population. Poultry and goat alone are capable of quick increase. There has been also a sharp increase in the demand for hides and skins for leather industry necessitating new imports of hides and skins while formerly we used to export large number of hides and skins. Before 1971 the best skins used to be produced by East Pakistan. The Teddy goat, an introduction from Bangla Deshinto the Barani area, is quickly gaining ground and would soon fill the gap in the production of high quality goat skins.

5.71 Compared with the sheep the goat is more resistant to diseases, it is hardier and can face exposure to inclement weather, particularly rain, better than sheep. The prejudice against the animal should not be permitted to stand in the way of necessary research and development work

to obtain the maximum benefit from this animal and to reduce damage, if any, to the environment.

Sheep:

5.72 A number of sheep breeds exist in the area. The natural selection processes have fovoured genetic types which can survive and subsist on a low nutritional place in an unfavourbleenvironment rather than highly productive types. A dynamic change has to be brought about firstly in the feed situation and then in the genetic improvement of the animals for increased productivity. There is need for; (1) better wool yield and quality, (2) more milk and bigger carcase,(3)higher twinning percentage so as to get a larger lamb crop, and (4) quicker growth rates and early maturity.

5.73 The first push should be to improve wool yieldand quality. Wool is used extensively for producing a variety of household goods at the cottage industry level; the most important being carpets. Pakistan has emerged during the past decade as a leading producer and exporter of carpets. There are 125,000 of carpet looms, 60 percent of those being in Punjab. The carpet export earnings have increased five-fold during the past five years, from Rupees 12 crore in 1970 to Rs.60 crore in 1975; in the next five years we are likely to double the existing export levels. The industry is labour intensive and already employs 5000,000 people directly and about 2 million people in supporting activities. It is best organized as a village occupation and could draw on the family labour which is otherwise under-utilized.

5.74 A major limiting factor is the availability of good carpet wool in sufficient quantity and hence the need for a crash programme to support sheep breeding and improve the quantity and quality of wool produced. There is already a clamour on the part of the industry to permit import of carpet type wool, a commodity which needs to be imported on only one premise, the complete neglect of sheep husbandry in the country.

5.75 The sheep in the Punjab Barani tract all produce carpet wool but their quality is not as good as that of the Harnal and Bakhshani sheep in Baluchistan or the Cholistanibreed in Bahawalpur. Selective breeding and up-grading with superior varieties to produce better carpet wool should be undertaken withoutany delay. The average annual wool clip per sheep is only about 3 lbs which could be increased to at least six lbs. Fibre quality should approximate the

ideal carpet wool as the carpet quality depends on the quality of wool and yarn which should possess durability, flexibility and shine. The ideal type for carpet wool sheep should thus be carefully and objectively defined and selective breeding and up-grading work undertaken to produce sheep with requisite attributes in terms of true wool fibre, keep and heterotypecomposition, fineness, crimpiness and length of fibre etc.

5.76 The base for good carpet wool production already exists and there should be no cross-breeding with imported fine wool type sheep except in carefully circumscribed zones. Indigenous superior types from other parts of Pakistan such as the Harnal, Rakhshani and imported carpet wool types such as the Lincoin, the Cotswold and the Awasalsheep from Lebanon should, however, be judicious introduced in order to increase meat, milk and wool quality and quantity. This would require a net-work of experiment stations in the various ecological zones to evolve suitable types adapted to local conditions.

5.77 Another urgent need is to produce the fine apparel wool required for our 27 woolen mills which are dependent at present entirely on imported wool. It would be worthwhile to attempt to produce this type of wool in a few selected parts of the Punjab Barani tract. There should, however, be no question of mass-scale and indiscriminate crossing with fine-wool sheep as;(i) the present breeds are well adapted to the prevailing rigorous conditions, (ii) the prices of good carpet wool are quite competitive and (iii) there is internal un-met and expanding need for good carpet type wool.

Animal Husbandry/Veterinary Services:

5.78 Animal husbandry/veterinary services for livestock have so far been based on the government veterinary hospitals. This has been due to the clinical and curative orientation of the British veterinary surgeons who pioneered the establishment of our veterinary services. These institutions have, however, little relevance to our conditions and needs. In the U.K. epizootics and parasitism have long since been controlled and the stock-breeders are amongst the most progressive in the world. United Kingdom remained the stud-farm of the world for a long time and the standards of veterinary hygiene have been very high. Such conditions do not exist in Pakistan and a hospital based clinical service has little relevance to our conditions. The emphasis in our case can not be on the cure of individual sich animals, it has to be on controlling herd infections and effective control of contagious, infectious and parasitic disease through mas vaccination, dosing and dipping of livestock. Stock-breeding in Pakistan similarly has not been

the function of a lucrative export industry as was the case with Britain. It is practiced by very poor subsistence farmers who have little surplus to invest in the necessary in-puts for modern livestock industry. The State must come to the rescue of the livestock owners and assist in the improvement of livestock on ranges through mass artificial insemination services. Provision of site-specific technologies and improved practices in animal nutrition, management etc.

Animal husbandry, veterinary services:

5.79 The existing Government services in respect of animal health and production are quite thinly spread in the Punjab Barani tract. In the entire Barani Area, 36 percent of the province of the Punjab, there are no properly equipped disease investigation laboratories and only a few field station type livestock breeding centres. Most of the attention of the Department of Veterinary Animal Husbandry Punjab (Now styled as the "Department of Livestock and Dairy Development) is devoted to the more developed irrigated areas. All the teaching/research institutions as well as large Breeding Farms are located outside of the Barani Tract. Similarly the work of the Punjab Livestock and Poultry Development Board which was established in 1973 (with the Charter to secure finances, establish companies, engage in production, processing and trade, including export, undertake commercial type projects and provide services for the livestock industries in production, processing and marketing) is mainly concentrated in the moredeveloped parts of the Province. The possibility is remote that the Barani Tract would be able to secure the attention of the province level organizations and institutions. It would be necessary to work through agencies set up exclusively for Barani Tract work and their organizational base should be relevant to the local conditions.

Livestock Centres:

5.80 The Government veterinary hospitals are hardly suitable locals for the purpose. Hey should be replace by "Livestock Centres" which should be equipped to provide both animal health and animal production services. The physical base of a "Livestock Centre" should preferably be an experimental livestock farm and veterinary disease centre/investigation laboratory so that developmental activities could be supported not from a text-book base but from a base of scientific observation and experimental work under the local conditions of each area.

Trained Man-power:

5.81 The major constraint in the provision of an adequate veterinary cover and the provision of essential animal husbandry services would be trained manpower. The present approach emphasizing only professional level training will have to be substituted by a down to earth policy involving the tracing of the people themselves.

5.82 The provision of animal health and animal production services have been conceived so far, as the exclusive preserve of the Government Animal Husbandry Department and agencies and the initiative of the stock breeders has not been encouraged to develop their own competence or to help themselves. The effective reach of the existing veterinarians under ideal conditions is hardly about 10 percent of the animals. Under the real life situation prevailing this restricts the services to the more affluent farmers and stock-breeders. A high level of parasitic infestation and debilitating disease as well as of recurring epizootics inflict huge losses, estimated at 20 to 30 percent of the herds and flocks. The farmers and stock-breeders consider this as a part of their destiny in the same manner as they are reconciled to losing many of their children. An average infestation with, say, the stomach worm Haemonchuscontortus causes a daily loss of about 2oz's of blood from an animal. the resulting damage to health can be readily imagined. Such losses can only be checked if the stock-breeders themselves undertake the vaccination, dosing and dipping of their own stock.

5.83 The losses in stock breeding are equally staggering. The loss of milk and the calf crop due to one factor-low fertility in the milk buffaloes – has been calculated to be of the order of nine billion rupees annually in the country as a whole. Instead of depending on government functionaries whose reach is hardly 5 – 10 percent of the stock, veterinary/animal husbandry auxiliaries must be trained in every village. Since there are nearly 9,000 villages in the tract he number of men to be trained at this level would be of the order of about 10,000 during the next five years. A month's training given to any stock-breeder, preferably literate but not necessarily so, in just there operations namely; (1) vaccination against major infectious diseases endemic in the area, (2) dosing against internal practices, and (3) dipping to protect livestock from eco-practices, such as mange-mites, would suffice as beginning level training. These men could be trained at the nearest "Livestock Centre" or the Veterinary Hospital and could receive supplies of biological and parasiticides there from once in a month. On the auxiliary's monthly visits to the Veterinary Hospitals/Centres, Further training and topical advice could also be given to him on

various aspects of livestock industries. Arrangements could similarly be made for progressive training in a variety of animal husbandry operations.

Professional and Intermediate Level Workers:

5.84 The training of university-level professional personnel in the field of animal husbandry and veterinary medicine is both time-consuming and expensive. There is a world-wide demand for such highly trained men and to deploy them for sub-professional level wok, as is customary in Pakistan, it is not possible as these men do not perceive this as their proper function. This is considered as simple waste of their talent and leads to dereliction from duty and brain-drain. While the strength of professional level persons may, therefore, be increased steadily to about 200 professionally trained persons for the Tract, they should be used at properly equipped animal husbandry or veterinary centres/Laboratories and for supervisory duties to implement developmental programmes. The big push in the next five years should be in the training of the inter-mediate level workers. Each professional level person should be provided with about 10intermediate/technician level men to assist him by performing specific tasks, such as, disease control work, artificial insemination etc. They should be given training for one to three years after high school. Training institutions for this level of workers should be established within the area. The number of intermediate level workers to be trained during the next five years would be around 2,000.

Chapter – VI

Forest and Range Land

Introduction

6.1 The bulk of the valuable commercial forests in Punjab are situated in high rainfall areas in the Barani Tract, particularly in northern hills. A large part of the Tract is ideally suited for the raising of forests and for utilization as grasslands. Only about a 100 years back the western extension of the Himalayas i.e. Murree and Kahuta hills, salt range and Kala Chitta hill were covered with dense forests. The rivers and streams draining the Barani Tract also supported extensive forests along their banks.

6.2 These forests, however, gradually disappeared with increase in human population and the ensuing extension of agriculture till the process was regulated through the settlements carried out in the last two decades of the 19thcentury. Substantial areas of natural forests situated away from habitations were constituted into reserve forests both in the high-hills as wellas in the foot-hills and the plains. Another class of forests know as protected forests was constituted next to reserve forests wherein numerous rights of timber and grazing were admitted. The rest of the natural forests were given to village communities in the form of shamlats/guzaras or individual wood-lots.

6.3 Most of the tree growth from private wood lots as well as guzaras has disappeared during the past 50 to 60 years. They are now potential range-lands. These are also subjected to heavy grazing pressure and are progressively deteriorating. Protected forests as a result of excessive burden of rights have also deteriorated considerably in their stocking and soil potentials. The reserve forests though comparatively in good condition are also subject to heavy biotic pressure.

6.4.1 The areas covered by state owned and private forests in the Tract aggregate to 642.000 areas about 117.88.000 areas rangeland. The distribution of these areas by districts is given below:-

Sr. #	Name of District	Geographical area.	Cultivated Area	Forest Areas	Range Lands.	
1	Rawalpindi	1306	236	217	01	352
2	Campbellpur	2419	1073	113	111	1122
3	Jhelum	1774	715	152	74	833
4	Sargodha	1056	2378	28	62	588
5	Gujrat	1449	1095	16	19	299
6	Sialkot	1323	1073	24	-	226
7	Mianwali	3458	1834	44	78	1502
8	D.G. Khan	5990	1664	38	74	4216
9	Muzaffargarh	3593	1369	11	93	2120
Total:-		74368	11917	643	532	11236

Vegetation type:-

a) Forest Type.

6.5 The forests can be classified into five brand types namely, high hill forests, Sub monstrance serub forests, Riverain Forests, Riverian Forests, Potowar rangelands and Thall rangelands.

(i) High Hill Forests (Northern Hilly Regions)

6.6. These coniferous forests occur naturally in the waster hills between 2300, elevation and with an annual rainfall of 10” to 50”. The principal tree species in these forests are the blue-pine or kall (…….) and Chirpine of chir (P. roxburhgt) for (Abires pindorw) and space (Picea morinda) occur over small areas on Murree and patreata Peaks. In their normal state these forests are two

storeyed. The above mentioned coniferous trees occurring in the upper and the broad leaf species like Oaka, Chearnute, acers, etc. In the lower story, these high hills forests which are the most important source of timber and resin in the Province are under sewere pressure of grazing and wood cutting they cover on area of 1,24,000 acres.

6.7. These forest occurring on low hills upto an elevation of 3500' consist mainly of slow growing small sized trees of phulai (areas modeste) and Kao (……) They at present, yield only firwood and small sized timber for tool handles and agricultural implements. Their main function is the protection of site. The total area covered by this type of forests is 6,39,000 acres.

6.8. The riverain forests occur along the banks of all the Punjab rivers. They grow with the immdation water and water available in the sub-soils and consist mainly of shisham (…….) Kikar (acacia Arabia), fresh ……. Is aphytta and some obhan I (populus euphratiea). The total areas under those forests is about 27,000 acres, but a considerable part of this areas is unproductive. Some areas if those forests are now being converted into poplar plantation with the help of Tubewells.

(B) RANGE TYPE

6.9. This type is found in Northern Hilly Region falling in Rawalpinidi district. The vegetation is complied of following grass species in addition to the tree species given under Part-A.

Grasses

Poa annua, eleusine, flagellifera, pannicum antidotaie, cenchurus ciliaris, eulaliopsss binata and cymbopogon jawarancusa etc

6.10. The grazing incidence is very high. It is not limited that there are about three to four times the number of Livestock than their carrying capacity. The ranges are therefore, in a poor state Over-grazing is therefore, on major cause of poor watersheds causing Soil Erosion, alteration and flash floods down in the plains.

Sub Tropical Sem Arid type (Sub Montane Region)

6.11. The vegetation complies of following main grass species:-

Aristida, epressa, botheriochoba pertusa, digitaria bicornis, cymbopogon jawarancusa, elusine flageliifera, elionurus hirsutus, iteteropogon controtus, cenchurs, chyroysophogon montanus, chrysopogon aucheri etc.

The incidence of grazing in this type is about two times the present carrying capacity. The ranges are therefore not producing what they are capable of and are in a depleted state

Tropical Plains non sandy (piedmont and mountain ranges)

6.12 This type is found in mountain ranges at the Suleman Hills and Suleman ……. Falling in D.G.Khan District and (b) parts of Sialkot and Gujrat piedmont. The vegetation in Suleman Piedmont comprise the following spices:-

Acacia modesta, prosopis spicigera, prosopis, fuliflora, zizyphus nummilaria and tamarix articullate etc

Among the grasses the main species are:-

(Chrysopogon montanus, cymbopogon jawarancusa, pennisetum lanatum, cynodon dactylon, saccharum spontaneum and stipa sp. Elusine flagellifera an elionurus hirsutus etc.)

The grazing pressure in these areas is extremely high. The major cause of over-grazing is the huge nomadic flocks emigrating from adjoining districts as well as from Afghanistan. The estimated pressure is 5-6 times the carrying capacity

6.13 The vegetation of piedmont zone falling in Sialkot and Gujrat districts is as under:-

Acacia modesta, prosopis spicigera, prosopis, fuliflora, zizyphus nummilaria and tamarix articullate etc

Among the grasses the main species are:-

(Chrysopogon montanus, cymbopogon jawarancusa, pennisetum lanatum, cynodon dactylon, saccharum spontaneum and stipa sp. Elusine flagellifera an elionurus hirsutus etc.)

(iv) Tropical plains (sandy types)

6.14 The vegetation of the area I grouped under tow major sub-types as under:-

(a) Sond dunos
(savadora oleoides, acacia jacuimontii, calligonum polygonndes, pennisetum sp. Aristida depressa and sueda fruticoa etc)

(b) Flats

(c) Prosopies spiigara, tamrix articulatea elusine flagerllifeara cymbopogon jawancusa cenchrus ciliraris silonurus hirsutus and sueda fruiticosa etc

The grazing incidence in this type is very high, it is estimated that number of livestock is more than three times the carrying capacity of the range. As a result of low rainfall the potential is low and the ranges in poor state of production.

CURRENT PRODUCTION :

A Forest Areas.

6.15 The coniferous forests of Murree, Kahuta Tehils yield substantial quantities of construction timer and pine resin. The scrub forests in the sub-montane tracts as well as salt range serve largely the function of protecting the watersheds. They, however also yield small quantities of firewood and small sized timber. The

present production in the state owned forests in Barani Tract is estimated as under:-

Fig. Field Major Forest Products (1971-72)

Name of District	Timber (Cft)	Firwood (Cft)	Charcbal (Cft)	Resi (nds)
Campbellpur	-	105600	-	-
Rawalpindi	1021912	91202	676	50000
Jhelum	796	134200	-	-
Gujrat	5000	10000	-	-
Mianwali	-	-	-	-
Sialkot	-	6841	-	-
Total	1027313	347843	676	50000

B. Range Arcas.

6.16 The current level of production of private ranges is very low. On the average about 100 ths grass (dry weight) is produced per acre. The carrying capacity, therefore comes to 140 acres per animal unit. In state owned ranges where grazing is some what regulated the average production is 860 Ibs/acres with the carrying capacity of 174 acres per A.U. In areas where range improvement manures are undertaken along with grazing management, the production is as high as 2700 Lbs/acre with the carrying capacity of 3 ½ acres A.U. This wide range of production is minly due to better rainfall and high potential of the range, if managed properly.

6.17 This type falls in low rainfall zone and mainly sandy soils. The relative potential of production is low,. The production in private ranaes is between 20-30 Lbs/acre with a carrying capacity of 245 acres per animal unit. In state owned rangelands where only some grazing is regulated, the production is about 290 Lbs/acre with a carrying capacity of about 24 ½ acres per A.U. Whereas in areas where ranges have been improved, the average production is about 650 Lbs/acre and a carrying capacity of about 11 acre A.U.

CURRENT PRODUCTION:

6.18 (i) High hill forests

Name of product	1970-71	1971-72	1972-73	1973-74
Timber (in thousand cft)	928	1342	1168	517
Pesin (in thousand cft)	68	52	66	44
Charcoal (in maunds)	745	676	685	438
Grass (in thousand Rs)	14	17	14	02
Grazing (in thousand Rs)	01	04	-	18

6.19 Sub montance scrub Forests:-

Name of product	1970-71	1971-72	1972-73	1973-74
Timber (in thousand cft)	52	81	-	36
Firewood (in thousand cft)	612	583	404	259

6.20 Riverain Forests.

Name of product	1970-71	1971-72	1972-73	1973-74
Timber (in thousand cft)	41	27	16	11
Firewood (in thousand cft)	76	01	184	241
Charcoal (in maunds)	02	02	01	01

6.21 Range Area.

Sr #	Name of District	Areas of Range Land		Total forage production		Total animal units	
		State owned	Private`	State owned	Private`	State owned	Private`
		Thousand of acres		Thousands of mds			

				dry weight			
1	Rawalpindi	1.6	151.6	31.5	1316	150	14620
2	Campbellpur	-	1122	-	2804	-	31200
3	Jhelum	74	811	1295	2082	14400	23020
4	Sargodha	-	588	-	1470	-	16400
5	Sialkot/Gujrat	39	475	682	1485	1600	13000
6	Mianwali	78	1554	585	1162	6500	12980
7	D.G. Khan	74	2734	560	1676	6100	18600
8	Muzaffargarh	93	2120	465	975	6170	21700
	Total						171520

ORGANIZATION AND ITS FUNCTIONS :

6.22 For purpose of management of State forests and for extension activities in other areas the Forest Department has responsibility for both the forests and ranges in the tract. It is organized on the standard pattern of beats, blocks, ranges divisions and circules. There are 9 territorial Forest Divisions namely Campbelpur, Rawalpindi South, Rawalpindi North. Murree Hills, Jhelum, Gujrat Sialkot, Mianwali and Bhakkar and one circule namely Rawalpindi which operates wholly or partly in Barani Areas. The forest service apart from managing the state forests promotions afforestation on private lands and carries out watershed management and soil conservation. In order to undertake improvement work in the range areas. There is one Range Management Circule. Its two Divisions at Chakwal and Bhakkar are located in the Barani Tract..

(i) Management of State Forests.

6.23 Forest Department is charged with the responsibility of managing the existing state-owned forests to ensure the maximum sustained out-put of timber, firewood and other products as well as preserving the soil in site qualities. The major forests i.e. Murree Kahuta Hills forests Rawalpindi scrub forests, Kala Chitta and other forests in Campbellpur districts, forests of Jhelum district are all managed under regular working plans as approved by the Government. Afforestation, regeneration tending, thinnings and followings in these forests are carried out under the programmes contained in these plans.

(ii) Watershed Management

6.24 Management of province's watersheds particularly those in high hills is also the responsibility of Forest Department Scientific use of lands in hills in accordance with their capability is promoted through suitable incentives and demonstration, Cultivated lands are terraned cultivation of fruit trees is encouraged in preference to grain and other crops, steep and unstable hill sides are planted with trees and graness. On esuch product covering about 10 sq miles has been completed around Bhurban. Another project around Ghoragalli is under implementation while the their one in Lehtrar Vally has been taken up recently.

(iv) Promotion of Private Forests.

6.25 Private lands owned individually or communally are afforested with the cooperation of the farmers. The lands are closed under Section 38 of Forest Act and thereafter converted into timber, fuel and fodder reserves. These woll lots serve as models to the rest of the villagers. Afforestation is also promoted in the form of farm stead plantations shelters belts, wind breaks and belts along ravines.

(v) Range Management.

6.27 Lands which are not suitable for growing of commercial tree crops are used for raising grasses for livestock, potwar Piatau of fors same very good lands for this purpose, Sandy lands is that tract have also been coverted into rangelands. After the improvement stage the ranges are used by private livestock owners under a rotational grazing system on payment of confessional trees.

PROBLEMS OF BARANI AREAS.

A Forest Areas.

6.28 Forestry and forests in Barani Tract are faced with a large number of serious problems. Their immediate solution is necessary for preservation of existing forests for creation of new forest resources and for restoring the ecological balance in these areas.

(i) Burden of rights.

6.29 Coniferous forests of Murree and Khuta Tehsiles are burdened with rights of timber, firewood, grazing and fodder. These rights have multiplled with the growth in population and their exercise is posing danger to the very existence of the forests large areas of protected forests have been denuded of tree growth due to exercise of these rights. It is very necessary to stabilize and ultimately extinguish these rights

(ii) Commercial and Private Forests.

6.30 Private forests have virtually dispended and the land under them has been brought under cultivation disregarding its capability. After clearing the forests the soil was washed was leaving behind stony wases, it is necessary to demarcat the communal forests and to place their management on scientifc footing. Cooperative societies may be created for their management under the supervision and guidance of the Forest Deparment.

(iii) Adverse biotic pressure .

6.31 The pressure of human dnad cattle population in high hills is mounting rapidly. It is causing a rapid denudation of vegetation and consequent accelerated erosion and deterioration of the locality factors. This trend should be arrested by limiting the number of animals and providing alternative means livelihood to hills people. This can be done by setting up small industries.

(iv) Forest thefts.

6.32 Since land holdings in Barani Areas in general and high hills in particular are small people depend for fuel, timber and firewood entirely upon the forests. They resort to forest thefts on a large scale. In order to save the forests alternate means i.e. fuel gas. I.P.G. kersoing oil, electricity etc. may be supplied to these areas if possibl at subsidies rates. Forest thefts are be dealt with more strictly than hithertofore.

(v) Scientific

6.33 The present land use is not in keeping with capability of the lands, Buld of the hill area in Kahuta and Muirree Tehsils is suitable only for growing forests excepting some valleys and easy slopes where fruit trees could be grown. The present practice of using these lands for growing grain crops etc, which could easly be grown in the plains should be given up. Similar planned use has to be extended to rest of the areas in Barni Tract as well. This may be done by providing suitable incentives.

PROBLEMS OF BARANI RANGES :

6.36

(i) The main problems pertaining to rangelands are as under:-

(a) **Over grazing**

The stock holders tend to have large number of animals than the ranges can support. The number of livestock in the tract is roughly three times the carrying capacity the vegetation is therefore deteriorating progressively since times immoral. The ranges under streams etc, therefore not producing according to their potentials and palatable forage species which cannot stand competition are losing race in favour of unpalatable vegetation.

(b) **Erosion**

Depleted ranges are devoid of enough soil cover and hence are open to soil erosion. It results in splash floods, poor watershed deteriorate and infiltration decrease. As a consequence the fertility of soil is also deteriorating.

(c) **Socio economic problems**.

The people are generally poor and illiterate. They are bound by hard core traditions. Their methods of maintaining the livestock are medieval. They believe

in number of animals rather than their quality and keep them as a way of life rather than a way of living.

(d) **Land Tenure**.

Most private ranges are a common property of a tribe due to non-proprietary conditions of ownership. This common proprietory is no body's responsibility to maintain.

(e) **Quality of Livestock**.

The people are not conscious of improving the breeds of their livestock which are generally poor in production.

(f) **Marketing**

The marketing conditions are poor. The livestock is sold to middle men who reap rich harvest and the producers do not get their due share.

(ii) PROBLEMS SPECIFIC TO RANGE TYPES:

6.35 The ranges in tropical semi-arid tract i.e. Thal and D.G. Khan fall in low rainfall zone. The annual precipitation ranges from 6-10 inches. The seasonal distribution is also not favourable and there are long draughts The soils are sandy interspersed with sand dunes. Rate of desiccation due to high temperatures and dry winds is also high. The potential of these ranges is therefore low. Unfortunately these are the areas where livestock pressure is high.

6.36 These ranges are also often subjected to grazing by livestock of nomads from adjoining areas as well as from Afghanistan. This adds to the existing livestock pressure on ranges.

6.37 The specific problems of sub-tropical submitted zone are:-

(a) Land hunger. More and more land is being brought under plugh. The ranges areas are being squeezed leaving only most unfertile lands for grazing.

(b) Topography : The topography is usually rugged and on account of eroslon good soil is being washed away every year.

(c) People's profession:- People are adopting other profression such as Defence Service and keep livestock industry as their secondary means of earning. They have their animals at the mercy of herder and pay little attention to the livestock or the range areas.

DEVELOPMENT PROJECTS IN HAND

6.38 A large number aforestation, watershed management and range management projects are being implemented out of developmental as well as non-developmental budgets. The major schemes are listed below:-

A Strategy and watershed Management.

6.39

		Cost Rs.
(i)	Afforestation of 1600 acres of resumed lands in Attock District.	0.79 Lacs.
(ii)	Eucalyptus planting in Rawalpindi.	0.69 Lacs.
(iii)	Afforestation and rehabilitation of lands damaged through enemy action in Bajwat.	4.00 Lacs.
(iv)	Afforestation of roadside strips in Rawalpindi.	12.06 lacs.
(v)	Planting of Highways other than G.T. Road in Rawalpindi District.	8.05 Lacs.

39.40

B. **Range Lands**.

		Cost Rs.
(i)	Range Management in Potwar tract	35.00 Lacs.
(ii)	Range Management in Thal/D.G. Khan.	28.09 Lacs.

(a) **General Strategy**

(i)	To rehabilitees the depleted rangelands by increasing forage production on sustained yield basis and maximum livestock production consistent with range resource.
(ii)	To develop stock water facilities for livestock.
(iii)	To improve economy of the rural population by increased livestock production and providing job opportunities.
(iv)	To demonstrate scientific range management to the people.

(b) Projects.

Two range management projects will be taken in hand each falling in sub-tropical, submitted and tropical (sandy) plains zones. There are:

I Range Management in Potwar Tract.

6.41 This project costing Rs.39.40 Lacs will include forest Blocks devoid of tree growth covering an area of 1.02.298 acres of sub-mountainous ranges in Jhelum, Shahpur and Gujrat districts. Due to the rugged topography. Lack of top soil and irrigation facilities, most of the area is exclusively used as grazing lands and thus economy of the people is mainly pastoral. Due to indiscriminate grazing, the production of the ranges is hardly 30 per cent of the potential Due to better rainfall conditions the production can therefore be at least doubled if proper and livestock management is started there for the economy of the rural population.

II Thal/D.G. Khan Project.

6.42 The project costing Rs.28.00 Lacs will include forest cost covering an area of 2.02.290 areas in Mianwali, Muzafargarh and D.g. Khan districts. The areas fall in low rainfall zone and the soils are predominantly sandy. The relative potential is therefore rather low, due to heavy pressure of livestock which I about 3 times the carrying capacity, the ranges are in a poor state of production.

RECOMMENDATIONS :

A Forests

6.43 (i) Northern hills and sub-mentioned regions.

Following recommendations are made to remedy the situation:-

(a)	Management of Hill Forests should be intensified by shortening rotation, resorting to artificial regeneration, construction of forest roads and mechanization of logging for which adequate financial support may be provided.
(b)	Sale of standing trees through contractors be abolished where still in vogue and autonomous corporations or departmental units within the Forest Department having the facilities available to the commercial organizations be established for taking up this responsibility. The exploitation and marketing of timber through public agencies will eliminate pilferage and waste in conversion by covering timber into standard sizes in which it is ultimately used.
(c)	The rights and concessions in hill forests may be frozen forthwith at the existing levels. The rights have ultimately to be extinguished.
(d)	The private forests in the hills should be managed by Cooperative Societies comprising the owner and right holders under the technical guidance and supervision of Forest Services.

(e)	The bonafide requirements of local population be met by providing cheap hay, gas, electricity and construction materials like G.I. sheets, R.C.C. poles to reduce biotic pressure on the forests.
(f)	Cottage industries such as sericulture, basket making, fruit culture, carpet making be set up to reduce or off-set the dependence on forest resources.
(g)	It is recommended that all the out-marginal lands which at present are not feasible for cultivation of agricultural crops be acquired by the Government and afforested with suitable species.
(h)	Private forestry should be encouraged on the pattern of "dedicated woods" as in vogue in the United Kingdom under this scheme half the cost of afforestation programme is shared by the owner of the land and the other half by the Government agency. The income, however goes to the owner in full. The Forest Department will suggest suitable species and other technical information to the owner.
(i)	Pilot plantation of fast growing species like Slash pine **Pinus elliottil P Carbaca** and lobiolly pine P **teada** should be raised. These species grow at almost double the rate of the indigenous species.
(j)	Plus trees of all the important species should be selected and preserved as seed orchards.

6.44 (ii) Riverian Forest.

(a)	Some of the reiverian forests of the country are by far the most productive, however productivity is rapidly declining owing to shortage of water supplies during inundation and therefore it has become necessary to balance this loss by means of lift irrigation or by installing tube wells. Both these means require considerable financial out-lay which has to be provided alongwith land leveling equipment.
(b)	Sizable areas of land have come oput of the perennial river beds as a result of withdrawal of water. These areas are ideally suited for tree plantations as these cannot support regular agricultural crops. Such areas should be acquired and new riverian forests established on them.

	These forests will also serve as flood prevention belts. The species recommended for riverian forests are Mulboorry and willow and Shisham (……) (…….)
(c)	Range Areas General
(i)	**Range Policy and Legislation** A definite range policy at national level should be formulated and a range management legislation enacted to implement the policy. All rangelands, private or state-owned should be set aside and managed on specific lines.
(ii)	**Range Survey** One of the pre-requisites for proper range management is the assessment of potential for forage production and for determining the carrying capacity of different range types. It is recommended that all range areas should be surveyed in the country
(iii)	**Range Rehabilitation** Most of the rangelands are badly depleted and need immediate measures for rehabilitation, it can be done by restoring a cover of palatable forage species and by under taking standard range improvement measures.
(iv)	**Public Participation** There is at present a lack of understanding and suspicion of Government programmes. The people are not well aware of range problems and of the potential of these areas, well supported educational work should be under taken to attract people's coopertation.
(v)	**Pilot Projects:** Demonstration projects should be established in representative areas

	with a view to convincing the graziers regarding the feasibility of what is advocated in the management programme.
(vi)	**Research** Research knowledge of Range Management is based mostly on work done in other countries though principals remain the same practices will have to be determined suitable to local conditions Research is needed regarding adaptation trials of new forage species cultural methods, grazing management and livestock husbandry.

SPECIAL RECOMMENDATIONS :

6.45 (i) Sub tropical –

(a)	**Reseeding** In order to restore vegetative cover reseeding the rangelands with palatable forage grasses and shrubs over an area of at least 50,000 acres is suggested. Following species are recommended **Bushes:-** Atriples conecons, zizyphus nuamulis Grasses: Chr ysopogon montanus, chrysopagon, sucheril, Agropiron christatun,
(b)	**Erosion control measures:-** Due to hilly terrain checking of run-off is essential to control soil erosion. Soil and water conservation measures on a large scale extending over at least 1 lac acres are recommended. There may include gully plugging, check damning, contour bunding and terracing etc.
(c)	**Water development** : Stock water points are essential to provide water for livestock in these areas. At least 500 masonry dams and 1000 earthen bunds be constructed at suitable localities.

(d)	**Veterinary aid:** The existing veterinary facilities are inadequate. The livestock generally suffer from various diseases, therefore, adequate protection should be afforded by strengthening present facilities.
(e)	**Genetic:** The livestock have low genetic potential. Due to continous inbreeding and poor nutrition they have lost vigor to increase production. Due to better climate, there is ample scope for fine wool and mutton/beaf bread animals. It is suggested to under take large scale cross breeding and artificial insemination programme.

(ii) Sub topical semi arid zone

(a)	**Reseeding:-** The extent of rangelands in this zone exceeds 2 million acres. Hence it is recommended that at least 3 percent of the areas be reseeded/planted with following species:- ……
(b)	**Soil and Water Conservation:-** The areas are usually very such rugged and deep ravines and mullahs are found every where. Such terrain is a cause of flash floods and soil erosion. Therefore conservation operations like gully plugging, check damning, trenching, contour bunding, terracing etc. are suggested over at least 25 percent of the area.
(c)	**Water Development:** Water is a aacarcity in this region. At least 500 masonry damds and 10.000 earthen dams may be constructed in this region. Improvement of breads may be undertaken and veterinary facilities need to be strengthened.
(d)	**Water Spreading:-** This technique is used for utilizing extra rain water which runs of the locality for raising forage. Wherever the slopes are less than 5 percent. This technique be applied. At least 50.000 acres may be developed in this manner.

(iii) Sub-tropical – Sandy Plan.

The extent of rangelands in this type is about 1.6 million acres. Due to scanty rainfall the potential is low. The ranges are usually devoid of any tree, not withstanding low rainfall and sandy soil, reseeding, if carried out at proper time very encouraging results are obtained, particularly during good rain years. At least one lac acres may be reseeded with the following grasses:-

(a) Ellonur us birustus (Gorkha – Karera)
(b) Conchr us cillar is (bhaman)

Plantation of shade/fodder plants.
Extensive planting of at least 10 lac plants every year of the following species is suggest:-

a) Proposals spicigers (jand)
b) Zizypohus nummularis (Nalah)
c)Tecons sp (Lahura)

Water Development : hand water pumps have proved very economical an useful in this area. At least 20,000 hand pumps be fitted to provide drinking water.

Supplemental Fodder: Due to erratic rainfall there are prolonged droughts. Hence development of supplemental fodder for lean years by tue-wells irrigation is suggested. At least 50 tube wells be provided exclusively for raising fodder crops.

(iv) **Sub Tropical non-sandy Plans.**

Following works given under (iii) are recommended:-

a)	Reseeding	1,00,000 acres.
b)	Water spreading	2,00,000 acres
c)	Planting of fodder plants.	50,000 acres.

GENERAL RECOMMENDATIONS :

1	Production of proper sized well bardened nursery stoc on scientific lines is a perquisite to successful afforestation well spread out tree nurseries within easy reach of the farmers should be established.
2	Planting should be done in deep pits dug well in advance of the planting season with 2 years old tubed plants 2-3 ft. In length with well developed root system. Mulething with stones
3	Proper and timely preparation of the planning site is essential. Planting should be done to trenches, pits or furrows along contours with suitable water spreading measures to catch and conserve soil moisture.
4	Planting of suitable species such as Eucalyptus, Mulberry, Bakain, Shishm, Kiker, Ber, Aallandthus, Robina and Frash which are not only hardy but also comparatively fast-growing would go a long way in the establishment of the plantation with good survival and growth arates.
5	Demonstration Centre should be set up in each ecological zone to acquaint the farmer with the methodology involved in site preparation, planting of trees and after-care.

CHAPER VII
WILDLIFE AND FISHERIES

Wild Life

7.1 Barani lands in the Punjab comprise areas with a widely varying climatic conditions, temperatures ranging from below szero to 69 C, rainfall as low as 10 cm and as high as 120 cm. Monsoons contribute the maximum share of precipitation whereas some parts experience winter rainfall. Biotic edaphic variations also exist with the same magnitude. All these factors show their effect on the vegetation which differs in types accordingly.

7.2 Wildlife and vegetation have a close relationship between themselves, Wild animals depend for their existence on their physical environments, the habitat, including climate, soils and topography.

7.3 The habitat of the wild animals is being continuously destroyed. This coupled with interaction of complex biological factors and also. In the case of some species, heavy hunting pressure, both legal and illegal has resulted in the decline of wild fauna in the area.

7.4 Each vegetation type supports a particular fauna which is best adapted to the environment. Following is an account of the distribution and status of wildlife in response to habitat.

Northern Hilly areas Forests

7.5 The Himalayan temperature and sub-tropical pine forest types are distributed throughout Murree Hills in Rawalpindi district. Pheasants (Koklas and wite crested kale) were once found in plenty but have now been reduced almost to the point of extinction.

Sub region.

7.6 Dry sub tropical semi evergreen forests cover this tract in combination with that of Tropical dry deciduous forests. They are distributed in Murree foothills, Kalachitta

Potohowar and Margalla hills of Islamabad, Olive, phulai (social modesta) Sanatha, Reptonia and Bhazya are the important species of the tract, Urial, Barking deer and Chinkara are the important game monels of these only urial survives in a sizeable population where as the remaining two are disappearing foat. Leopard also inhabits the area. Indian here is the only small game nammal existing in plenty, Partridge (Three types viz Chakor, See see, Grey Titar) have however, survived the pressure of hunting as well as the habitat destruction.

Mountain Ranges

7.7 Habitat on the two mountain ranges viz Salt Range and Suleman Range comprises Tropical Inland low hill and scacia modests forests in the former and Tropical thorn in the latter. Important species are Acacia modesta, Olea, cuspidate, Capparts ophyila, Acacia Arabica and zizyphoa mauritians, Urial occupies salt range whereas a rar animal, straight horned markhor (caprs faleoneri jardaeni) inhabits Suleman range. The latter hs gained much importance due to its inclusion in the Red Data Book. Partridges (Chakor, See see and Grey Tectar) are found not infrequently. Some rare species of waterfowl inhabit lakes in Salt range. Uchhalt, Narmal amd Khabeki, Some migratory wastful alos visit these areas.

Piedmont

7.8 The areas falling in this region support Tropical dry mixed deciduous forests. The show variation in topography and their climatological behavour within the region. Species supoorted under the conditions are balbergia aissoo, salmallo malabarica, perminalla belerica, acacia catecbe etc. Associated wildlife in the area is Barking deer, Nilgal (in Siwaliks), Urial, Chinkera (in Salt range – Suleman range pledmonts) The Population is scanty and shows the trend towards

Plains

7.9 Thal and flood plains of Indus and its tributaries are included in this region. Tropical thorn forest type is acattered throughout the area. Main species are Acacia Arabica

(Babul) Prosopis spicisors (Jand) and Zizyphua mauritiana. Associated with them are also baibergia sissoo (Shisham) and Caparis aphyila. Associated wild animals are Chinkara, Desert cat, Houbara bustard visits the area in winter, Grey partridge abounds.

7.10 Another type of tropical forest exists along the rivers and flood plains, ramarix, mocia, saccharua apontaneous grow here, dolbergia sis soo, claims its share in the type.

7.11 Hog deer and wild bear are associated in this type, Black partridge also occupies the tract but its population is decreasing day to day.

AWARNESS OF THE PROBLEM :

7.12 The problem of the dwindling wildlife has attracted the attention of the authorities in Pakistan. The Government of Pakistan approached the World Wildlife Fund and as a result of this two wildlife expeditions., headed by Mr. Guy Mountfort were sent to Pakistan in the years 1966 and 1976. Pakistani expert were also associated with these expeditions. On their recommendations a Wildlife Enquiry Committee was constituted to investigate the problems and make recommendations to improve the existing legal and administrative set up concerning wildlife in the country. The Committee presented its report in 1971. Since then measures have been taken to implement the recommendations made there under:-

These include:-

i) New administrative arrangements.
ii) Promulgation, Conservation and Management Act, 1974.
iii) Declaration of areas as National Parks, Game Sanctuaries and Game Reserves.
iv) Starting research progrmame regarding species of important.

Administrative arrangements

7.13 Wildlife management division was amalgamated with Forest Department and anew department namely Forestry and Wildlife was constituted in the Provencal Government.

7.14 The same (wildlife) department was placed under the Administrative control of the Punjab Wildlife Management Board constituted in November, 1973. The Board is headed by the Chief Minister as Chairman having other keen shikaria eminent naturalists as members. The Secretary Forest and Wildlife Department is the member/Secretary of the Board and also incharge of the Wildlife Department.

7.15 Main functioning entrusted to the Board are: to make the policy decision regarding conservation and development scrutinize and supervise the activities in the field of wildlife protection, preservation, conservation and management in the Province.

7.16 Under the Secretary , Forestry and Wildlife Department amongst the regular staff are one Deputy Conservation of Forests (Parks and Wildlife), 2 Assistant Game Wardens, 23 Game Inspectors and 311 Watchers, Honorary personnel included in the setup are 5 Divisional Game Wardens, 19 District Game Wardens and 74 Tehsil Game Wardens. The honorary Game Wardens are mainly responsible for the policy and prosecution duties in the field. The idea in adopting the above administrative arrangements was to conserve and preserve wildlife with the cooperation of the public representatives. The Forest Department has been associated all along with the execution in the field.

Legal Framework.

7.17 The implement the recommendations of the Pakistan Wildlife Enquiry Committee, the Punjab Wildlife (Projection, Preservation, Conversation and Management) Ordinance 1973 was promulgated by the Government of the Punjab. This Ordinace has finally been approved by the Provincial Assembly and has now been promulgated as the Punjab Wildlife (Protection, Preservation, Conservation and Management) Act. 1974.

7.18 A special feature of this Act is that it provides necessary legal framework for the creation of National Parks, Game Sanctuaries and Game Reserves. The Act also provides for the creation of Punjab Wildlife Management Board which has already been constituted.

7.19 The Act aims at a stricter control over all means of hunting including the use of hawks and bans a score of objectionable devices for hunting. It gives protection to many species of fur-bearing animals which could previously be killed without Licence and controls the import and export in trades of valuable wild animals, trophies or products, Enhanced penalties and punishments are provided for offence in the new Act including forfeiture of arms and vehicles used in the commission of offence. The offences under the new laws have been made cognizable, Pesides, the offenders can be arrested without warrants issued by a Magistrate.

7.20 Schedules have been revised so as to offord protection to a far wider range of animals and birds than what were provided in the previous enactments. The new low also provides for the compounding of the offences which power did not exist in the previous Ordinance.

7.21 The enforcement of the law is, however, dependent on the level of public awareness of the importance of wildlife for the maintenance of the quality of life and human environment and of their extremely important role in maintaining the equilibrium of the eco-system and the productivity of an area. Along with educational and awareness campaigns through all mass communication media, efforts should be made to ensure that the law is strictly obeyed and that the general public is organized to bring about enough positive social pressure.

Wildlife Sanctuaries, National Parks and Game Reserves.

7.22 The present situation of wildlife demands adoption of a conservation policy based on the creation of a pattern of Wildlife Sanctuaries, National Parks and Game Reserves. designated to preserve an example of each of the country's major ecosystem with its endemic fauna and flora Intact. The basic objectives in the creation of special areas are:-

(a) Wildlife Sanctuary to permit wild animals and birds to breed undisturbed in their natural habitat.

(b) National Parks to provide aesthetic enjoyment to the public commensurate with its primary object of conservation through preservation of scenic beauty, flora and fauna in their natural state and with no hunting, shooting or capturing of animals.

(c) Game Reserves to provide for controlled hunting or capturing through permits.

7.23 Wildlife Enquiry Committee proposed the creation of 4 Wildlife sanctuaries viz (i) Rawal Lake (for water fowl), (ii) Rakh Phnmara (Fateh Jang – Campbellpur) (iii) Indo-Pakistan Border and (iv)Khaboki Lake (Khushab –Sargodha) one National Park in Margalla Hills, Islamabad and 10 Game Reserves scattered in different ecological zones of the Punjab Brani Areas.

7.24 Necessary steps in this regard have already been taken, Need, however, remains to implement strict measures to mange these areas according to standard procedures.

RECOMMENDATIONS :

7.25 With the measures adopted to the recommendations made by Wildlife Enquiry Committee and with the strict enforcement of law, it is hoped that the population of wild animals would start growing favourably.

7.26 The steps have however not been taken to help the population increase by providing food and shelter to the form of habitat improvement practices which is the basis of wildlife management.

Wildlife Management.

7.27 Wildlife Management involves the application of practices to maintain adequate wildlife population in balance in its natural environment, Management, therefore involves considerations on a number of factors such as vegetation, water, topographic variations, biotic interference, etc. which need careful identification. The only rational approach would, thus be the scientific management plans.

7.28 Wildlife Management plans should aim at maintaining wildlife populations at the highest level consistent with other land use and values, and to ensure that wildlife values are preserved and enhanced. Analyses of problems development of plans, activation of management through public education are the most important steps to be considered.

7.29 The plans ought to be written according to the specific needs of the animals. It would be feasible if separate plans are made for every animal. The plans should define some of the known habitat problems, state management objectives, assign responsibilities and suggest procedure for management. It should also be one of the purposes of the management plans to provide best possible habitat.

Information for providing further guidelines. Some other points to be considered are as follows:-

i)	Survey of the existing wildlife resources to define, wildlife habitat, its problems needs and to take game census.
ii)	Determination of specific needs of animals and birds, to identify biotic association, environmental changes and human interference.
iii)	Information on preferred plan species.
iv)	Death and birth rate and predator-prey ration.
v)	Study of life histories of animals and birds and their biological behaviour.
vi)	Disease incidence, investigation and cure.
vii)	Study or herd composition.
Viii)	Determination of carrying capacity of the range and the extent of harvest.
ix)	Hunting season, analysis of hunters to know age and sex of clases killed and hunter intensity.
x)	Fild surveys to determine livestock grazing pressure in the habitat of big game.
xi)	Ways and means for strict enforcement of the law.

Habitat Improvement.

7.30 Wild animals occupy 3 habitats viz I. Forest/Range Lands, II Wat Lands and III Farmlands.

Forest/Range Areas :

7.31 There are administrated by the Government Forest/Range habitat can also be manipulated as a potential source of game. Following are the general principle for correlating forestry and wildlife.

i)	Timber production should be practiced as a main object of management, but wildlife management should be given its due importance in all the forest areas based on the potential.
ii)	Concentrated grazing by domestic stock is inimical to the interests of wildlife and should be reduced where injurious.
iii)	Silvicultural practices and activities that are unnecessary destructive to food and cover should be modified, reduced or eliminated. It is not so much a matter of what as of how much and where.
iv)	The forest should not be planted or allowed to grow to single species natural openings should be preserved conifer plantations should be in small blocks or otherwise broken up.
v)	Where economically feasible, cutting operations should be in small units, well distributed over the forest, frequent light cuts are generally better for wildlife than infrequent heavy cuts.

Wetlands

7.32 Habit improvement practices on wetlands would mainly envisage the increase in bush cover around the water bodies as well as improvement of sanitary conditions. These should be strictly followed.

Farm Game Management

7.33 Discussion in the foregoing paragraphs has shown that at present the only perspective species in the filed of wildlife shooting are the partridges. All the rest are showing continuous decline in their status. Urial may be taken as an example of the marginal type but it is better to conserve, improve and then allow the shoorting of a certain species.

Developmental Potential.

7.34 Partridges are not essentially the product of forest or of natural vegetation. They can be bred at the farms and their status can be improved upon by adopting habitt improvement measures. This can be done with the help of some enlightened farmers, through the cooperation extended by Cooperative Farming schemes and integrated Programme for Rural Development.

7.35 Following are some Habitat Improvement Practices suggested to be carried out:-

Cover Improvement.

a)	**Brush piles** : Brush piles are temporary escape coverage made to help the animal in getting refuge from the sun, rain and from the predators.
b)	**New Plantations:** To provide cover to the birds.
c)	**Windbreak around/along the fields:** To provide permanent escape cover and shelter to the animals.
d)	**Development of Woodlots and Wastelands:** To provide permanent escape cover and shelter to the animals.

Improvement of food

a)	Propagation of fruit bearing perennials Selection will have to be made carefully to provide food for different species. The selection will also vary for different species.
b)	Food patches: In between the crops, patches of food can be grown. This may also be done on the abandoned roads, tracks or on some bare openings.
c)	Crop remnant: They can be used for cover as well as for food.
d)	Feeding stations: Feeding stations should be established at various places to facilitate the easy approach to the food.

7.36 Conservation and development of Water Supply. Water is basic need of any living creature. An assured supply of drinking water should be arranged.

7.37 Control of harvest Operation: Planting and harvesting of crops in bigger chunks can harm the wild animals by exposing them. Annual coupes should be made on a small scale. At the same item cropping and harvesting operations on different crops should be so staggered that there must be some cover and food supply for the animals throughout the year.

7.38 Erosion Control and Soil Conservational Techniques: Such measure would be helpful in saving the land from the hazard of it sbeing washed down or the loss of fertility.

Public Relations and Tourism.

7.39 The single important aspect of effective conservation is a strong Public Relations Policy for public support and participation. Extension and Publicity cells should be constituted independently as well as through coordination with such Ministries as Information and National Affairs, Communication, Education and Labour and Social Welfare.

7.40 Another medium through which public interest in wildlife can be stimulated is through Tourism. Success of tourism in the country would depend on the facilities provided and the degree of publicity. Department of Tourism should be responsible for operation and

maintenance of recreational facilities in the National Parks, Wildlife sanctuaries and Game Reserves and for providing necessary facilities in respect of transport, accommodation, sightseeing, conducted tours and hunting safaris wherever feasible.

Teaching/Training.

7.41 Staff entrusted to manage the resource should be properly tained. Officers should have training from the Pakistan Forest Institute, Peshawar and the Game Inspectors and Game Watchers should attend courses on Wildlife Management at Forest School Bahawalpur/Ghoragali.

Research.

7.42 Research is not only necessary for new findings but is also necessary to test the efficiency of the age-old conceptions. Very little is known by way of the life histories, food habitat requirements and behavioural patterns of the game animals and birds of the province. A study on wild Boar was conducted at the Pakistan Forest Institute Peshawar, Presently two studies are being carried out in the province namely.

i) the Biological behavioral and habitat studies on Urial, chinkara deer and Nilgal.
ii) Study of the life history status and habitat requirement of Houbara Bustard.

7.43 Research has played highly insignificant role in this field. Research Units should be strengthened in the Department as well as at the Pakistan Forest Institute and studies on individual species started.

Financial Implications:

7.44 It is understandable that wildlife conservation programme should be in conformity with the financial resources of the country. However, it is established that wildlife conservation needs both initial capital expenditure to secure a position of safety for what is desired to the conserved and subsequent annual recurring expenditure to maintain that position once obtained. Under the circumstances, it is imperative that staggered programming be avoided and concrete plans be formulated for the management.

7.45 Management should be started over forest/farm areas of sizeable magnitude say 500 acres. As the wild birds do not come in direct competition with harvest practices, management plans can be made accordingly. Some improvement practices as detailed above will have to be carried out. Management plan for the area should be prepared before starting improvement works. The plan ought to envisage, besides stating the objectives, present resource position, habitat conditions at the farm, possible improvements and the suggestions regarding harvest of the crop.

7.46 As no such works have been carried out in the country in the past, it is difficult to suggest appropriate physical funding for small scale projects without surveying the probable areas of study. It can, however be assured that if such projects are started, these will be a great help not only to the local population but will also be a measure to earth revenue for the Government..

Fisheries.

7.47 Fish is an important article of food and has better nutritional value than other animal proteins. It contains a higher percentage of fats and vitamins (A&D). In addition to useful health promoting minerals like calcium. Iron and phosphorous. Besides its nutritive value, fish constitutes an important link in the food chain of aquatic by feeding on eggs and larvae of obnoxious insects, worms and weeds, Fishing is a highly favoured spori and greatly adds to the well being of a people and brings much joy into their lives. It is also a great tourist attraction and the Barani Tract has many areas which possess a high potential as tourist resorts.

7.48 About a decade ago fish was not a very popular food in the Punjab. However meat process have been shown a sharp rise in the recent past and fish being a substitute of meat can help case the mutton-beaf crises. The development of fisheries on a large enough scale would not only help in attaining self-sufficiency. In the protein requirements of the people but would also increase the per capita income by proving job opportunities to the habitants of these areas. Accordingly, public attention is being increasingly drawn to the potentialities of this source of protective food. The consideration shown to it is as much form purely dietetic as from commercial stand-point.

7.49 The present level of fish production in the Punjab is very low i.e. only 80 million pounds for annum although the Province has great, potential for incrased fish production. In Barani Areas along the water bodies contain fish such as Chels cacius (Chal) parllius vegra (Lohari) carra modestus, Garra gotyla (Kukra) Puntuis Ticto, Puntius, sophose (Chiddu) for putitora (Mahseer), remachelve, botla (Chitala), Caprothores conirostria, Labeo syocheive (Butal) Calichrous bimaculatus (Pallu) Nyatus congara(Dayka(Channa, gachus (Daul) Callifchrous, bimaculatus (Pallu) Nyatus ,rengers, myatoa, seenghala (Tingra) Rita , (Khaya) and natachemblus aramtus (Bam). Among these ror potitors, channa, punactatus, channa gachua, callchrous bimachlatus, rite rita and nastacembelus armatus, These are fishes of large size and can be used as food. These rest of the species are of smaller size which can b utilized as poultry feed and organic fertilizer.

Fisheries Resources

7.50 The fisheries resources of Barani Areas include the Indus river (left bank) and here liver in Cambellpur district, Jhelum river in Jehlum District, Sohan and Kurang rivers in Rawalpindi district, Rawal Dam and ten small dams in Rawalpindi. Cambellpur and Jhelum districts small hill streams and rural impoundments.

Development Schemes in Operation at Presnt

7.51 Work on the development of fisheries in the Barani Tract has been minimal and needs to be undertaken more vigorously. The Fisheries Department have made efforts during the year one and a half decade to initiate some preliminary work to enable people to obtain need stock and advice. Progres achieved as far is briefly mentioned blow:-

(a) Development of Fisheries in Rawal Dam

7.52 Development work of Rawal Dam comprising an area of 1,700 acress with a permanent water area of 1,000 acres was taken up in 1967-68 under a scheme entited “Development of Fisheries in Dams and Reservoirs” which was completed in 1973. The dams has been stocked with 6,85,970 fish seed of Rahu, Mori Thalla and Mahasher. The Rawal Dam is

at present on of the best angling resorts in the Province and produces some fish as well as afford good recreation facilities to the people.

(b) Development of Fisheries in Small Dams

7.53. There are 10 small dams with an area of about 275 acres which have been developed for fish culture since 1970-71 under the scheme entitled "Development of Fisheries in Small Dams" which was completed in 1974-75. Under this scheme more than two and a half lacs of fish seed of Fahu, Sorl, Thalla, and Mahasher have propagated and are thriving.

© Extension of fish culture.

7.54 An extension programme was launched in Rawalpindi and Cambellpur Districts during 1973-74 to popularize fish culture practices, especially through the development of community village ponds and establishment of commercial fish farms by progressive farmers by adopting appropriate water conservation programme in public and private sector. Fish seed nursery units are being established in both the Rawalpinid and Camballpur districts under this programme to meet the basic fish seed requirements in these districts. A fish seed nursery depot already exists at Sohawa in Jhelum district.

(d) Fish Farms.

7.55 There are at present 64 farms (18 Government and about 46 private) in Rawalpindi Division. These also includes 100 acres of water impoundment developed for fish culture in the National Park Rawalpindi which is owned by the Cantonment Board Rawalpindi and where thousand of anglers enjoy fishing annually. Apart form this a progressive landlard of Khunda District, Cambellpur has established seven small dams at Mirjal by conserving the water of hill torrents in his private lands. The department has so far supplied him about two lacs of fish seed of culturable fishes, similarly ether farmers are being encouraged and mahy are taking interest in constructing reservoirs in their private lands on the pattorn of Miral Dams.

Future Development Schemes of Fishers Department.

7.56 The Department has prepared plans to launch a comprehensive crash programme to intensify the fish culture practices in public and private sectors for maximizing the fish production from the available resources. Major emphasis would be given to the promotion of fish culture in village ponds and small dams.

Development of Riverain Fisheries.

7.57 Mahasher (for putitors) which is highly by the anglers because of its excellent sporting qualities is available in the natural rivers in this Region. Crude type of fishing gears are being used at present and it is strongly falt that with proper replenishment programme, introduction of additional type of gears and application of new techniques, the present fish production in the natural Rivers would improve by 50 percent . The Department plans to implement a comprehensive scheme during 1975-80 for the improvement of stock in rivers.

Proposals for Fish Extension Programmes

7.58 Major constraints in the development of fisheries in the Barani Tract are the non-availability of water ad fish seeds. These difficulties may be resolved by under taking fish culture or fish farming particularly at places having adequate rainfall.

7.59. In the districts having rainfall 30-40 inches a rood number of village ponds are prennial nature. A cheap rate in interest or from Taccavi Grants or loans without interest.

7.60. In order that money thus advanced may be recovered early later. These schemes should be controlled and organized by a Fisheries Development Committee consisting of the Fisheries. Revenue and Cooperative Departments and Agriculture Development Bank for at least a period of 10 years. The farmers themselves should be persuaded to take active interest in the management of ponds for fish-keeping.

7.61. In the meanwhile, investigation into fisheries problems including induced and natural spawning of major carps. inuring of fish ponds, water quality studies of fish tanks and farms need to be further intendeified

Specific Recommendations for the Development of Fisheries in the Barani Areas.:-

1	Fish Farms for supply of quality and genuine fish seeds to the farmers and to tackle fisheries problems of the area be established in each district.
2	High yielding exotic and indigenous species of fish should be introduced.
3	To intensify fish forming educated youths and the retire men should be induced to do fish culture on individual or collective basis as may be feasible.
4	Fish extension schemes should be encouraged by the grant of Taccavi leans and financial assistance from the Agricultural Development Bank.
5	Special fisheries development schemes should be incorporated for implementation during next five years plan 1975-76 to 1979-80 for promote culture and production of fish in Barani areas.
6	Fisheries Development Committee for Barani Areas may be established in the Punjab to follow up extension work and to manage centres for supply of quality fish seeds to the village ponds and small dams and reservoirs in these areas.
7	Fish culture should be treated as on integral subject in the curricula of Agricultural University/Colleges and adequate facilities should be offered for fundamental and specially studies.
8	Pisclcultural section should be established at the Agricultural Institutes and Agriculture University, Lyalllpur with view to organizing and promoting research of fish culture problems in coordination with provincial Fisheries Department.

N.B.

The following are appended:-

(i) List of National Parks, Wildlife Sancturies and Game Reserves.

(ii) Wildlife Species in Barani Areas.

CHAPTER VIII

W A T E R

8.1 Rainfall is the most critical element in the Barani environment. Without it the crops will be the grass withers and both man and animal face the most ancient and deadly of dangers viz drought and famine. Even when the resolution in transport and communication has averted the extreme dangers viz. drought and famine. Even when the revolution in transport and communications has averted the extreme dangers of starvation and death following failure of rains, the food and feed shortages take their toll and hunger stalks and lands. Archeological and historical records indicate that long before Alexander passed through these lands, the Barani Tract people had endeavored to meet this challenge and had evolved the process of terrace cultivation for the harvesting and conservation of rain water and wells and springing were used for irrigation.

8.2 Water is essential for all life process. A steady supply of water needful for plant growth, Livestock must be provided with good stock watering arrangements. Man himself has to have adequate supplies of clean whole some water. Science and technology has added a now dimension to man's experience and wisdom acquired through the ages. In controlling and utilizing water resources. The improvement of water management practices is now well within his powers. It is necessary to use the new knowledge and technology in the field of water harvesting and utilization to improve the human condition and for obtaining greater agriculture yields from such inputs as improved seeds, fertilizers and pesticides.

8.3 Where precipitation is insufficient and irregular, as is the case in most parts of the Barani Tract. It is necessary to pay particular attention to:-

(a) Harvesting of rain-water conserving of transpiration, evolving methods of placing water within the root zone, and the maintenance of several interaction among mistune content, fertility and plant population.

(b) Mining of ground-water and improving conjunctive use of rain-water streams flood and sub-surface water.

(c) The storage of rain-water in ponds and water reservoirs.

8.4 The people of Pakistan have already experienced the momentous transformation that the application of improved technologies can cause. A revolutionary development of the resource base was initiated by the application of nineteenth century irrigation system in the world was commissioned at the turn of the century in the Indus Valley. It captured enormous quantities of surfaced water brought in by the mighty Indus and its tributaries form the snow clad Himalayas precious water that was being dumped into the areas, which was utilized into green fields.

8.5 The second revolution in water-utilization was accomplished recently through the installation of 1,30,000 Tube Wells made possible by new power resources electricity and petroleum. The tube wells have provided 25 million acres feet of water from the vast un-utilized under-ground reservoir of sweet water in the Indus plain. Not only has this provided enough water to command about 16% of the total irrigated areas in the country. It has provided water at the most critical periods, when rains and canal water supplies run out thereby stabilizing overall agricultural production. The increase in agricultural production. The increase in agricultural production due to tube well water has geen estimated to be 32 to 40 percent and according to some 40 to 50 percent of the total production in the province.

8.6 A third revolution, the green revolution was due to this maximization of the water resources by the conjunctive use of additional water supplied with high yielding varieties of seed and chemical fertilizers and pesticides. The cumulative effect of this new
package of in-puts, where-ever applied resulted in manifold yield increases.

8.7 A fourth revolution in water use is now called for a loss spectacular but infinitely more rewarding and fundamental revolution, as it has the potential of changing life and living in the loss favoured and backward areas. We must put to use as much as can be retrieved of the millions of acre feet of water, which we currently lose because we fail to apply known and proven scientific water management techniques. In-efficient water harvesting and use have been causing a loss of almost one half of the total water availability from rain water run off and from on-farm losses due to poor seed-bed preparation etc. These losses occur in the water-shed, water reservoirs, water channels and farm-fields. Enormous water losses take place due to inappropriate land use, cropping pattern and cultural practices. It is necessary to re-orient the

entire system of the land use, the crop rotations, the leveling and terracing of lands and the tillage practices, so as to harvest the rain water , now being lost through run-off and otherwise going waste in the Barani Tract and to converse and fully utilize it. The saving of these losses would mean the difference between poverty and prosperity.

8.8. The rainfall in the major parts of the Tract ranges between 10" to 30" and if the average is between these two figures, then roughly 30 million acres feet of precipitation is received over the year. Much of this water is wasted. The run-off may be as much as 50 percent of the total rain-fall but even it it is taken at 25 percent of the average participation, the loss over the Barani crop land along would represent some thing of the order of 3 million acre feet of water. If to this is added the water lost over range-lands and forest areas, the total loss would amount to nearly 9 million acre fee which is equivalent to the useable capacity of Tarbala Dam. Extremely effective water harvesting techniques have been developed in Australia, the U.S and a number of other countries. Such proven technologies need to be adapted to conditions in the various ecological zones in the Barani Tract.

8.9 Although total rain-fall in many parts of the Barani Tract is adequate for crop production, the seasonal pattern of precipitation often does not conincide with plant growth requirements. Great difficulties arise from the variability and irregularity of the rainy season causing uncertain and inter-mittent water supplies to crops. Periodic droughts result in the reduction of grazing and losses to livestock. Possibilities of tapping water resources both surface and under ground through tube wells and wells need to be vigorously pursued, systematic studies, surveys and planning should be undertaken for the construction of medium and small dams ponds etc.

8.10 The water harvesting and moisture conservation programme would increase production by capturing and utilizing water which is currently lost. The programme would rest on the introduction of scientific technology into traditional farming systems, which will resut in such management of land as to prevent run-off of natural precipitation and cause it to infiltrate where is falls, so that soil moisture is increased and used by plants for increased crop yield. Another major benefit of water harvesting is the prevention of soil erosion. The sheet erosion seen on most Barani farms carries off tremendous quantities of good soil, depleting fertility and depriving the area of its most precious resource viz top-soil.

8.11 Water harvesting is highly site-specific and therefore, certain components may have immediate applicability at one place and not at another. The first phase of a development programme should, therefore consist of identifying the area and the appropriate component and the selection of the research cum-demonstration cites. The action programme which would follow would require trained manpower, site-specific technology and an integrated plan. The first priority may be crop-land, the second water-shed and the third range land.

WATER HARVESTING

8.12 Water harvesting is aimed at capturing natural precipitation and using all available moisture for maximum benefit. The action programme would comprise (a) reduction of run-off and (b) checking moisture losses. There are two basic component of the programme. (i) Physical and (ii) agronomic. There are briefly discussed below:-

(i) Physical component:

Physical component includes use of improved from implements and such work as control of surface drainage benching, terracing contour cultivation and leveling of fields.

8.13 Improved farm implements: For ages the Barani farmer has been using a wooden plough which penetrates the land to a depth of only above 3 to 4 inches. At his depth a dense plough-pan has formed. This hard-pan is about two to three inches thick and checks the water percolation to the root-zone below. When rainfall on such land, the hard-pan does not permit water to penetrate down. A great deal is thus lot through run-off, as also through evaporation from the top few inches of soil which absorb the moisture. The country plough cannot bread this pan and a chisel plough is needed to bread the hard-pan and open up the solid to let the water soak in.

8.14 Another major problem of the Barani farmer is weeds which such up most of the summer moisture be tries to conserve for the sowing of wheat through repeated ploughings. The country plough is unable to get at the root of weeds. The farmer therefore, spends enormous energy and item in repeated ploughings of his field. He does not really know why he ploughs

repeatedly, he only knows it is beneficial. By repeated ploughings he removes the weeds on the surfaced without removing their roots, if he could get at the roots, a single ploughing with a sweep plough would be enough. A sweep plough or a simple dug type plate which can be attached to the farmer's plough is necessary to remove the roots of the weeds. He also needs proper implements to create a mulch on the surface of his land to check the evaporation of moisture. Scarifies and harrows do this very much better than the country plough. These different types of farm implements have been developed and are widely used in the rain-fed regions of the world, each type is meant for a specific purpose. Scarifies and sweeps are light implements and require much less power than the wooden plough and do not expose the moist soil to the air. The cultivation with the chisel plough is needed only about once a year.

8.15 At present, land is ploughed many times and frequently with the country wooden plough for each crop. Each ploughing means not only added cost in production but the soil gets exposed and a great deal of soil moisture is lost. What is needed is a basic change in concept and approach to replace inefficient country-plough with minimum tillage using efficient implements . Although there are other reasons it is the poverty of the farmer which makes him use the country plough for three distinctly different jobs for none of which it is an efficient instrument, He ends up with losses all around. loss of moisture, loss of moisture, loss in yields and loss of labour- his own and the oxen's. Means must be found to get the farmer the improved farm implements.

8.16 Benching and Terracing: Bench terracing is like creating a staircase out of a sloping field. The bund over the lower wall of the field is generally about 18 inches high and about 42 inches wide at the base. Provision is made to accommodate the possibility of excess rainfall. When disposal of water is necessary the entire acreage belonging to the farmer and his neighbors is considered in the design of the bench terrace system. A field terrace is a constructed channel across the slope of a field. Terraces may have a level channel or a graded one, depending upon the intensity and distribution of rainfall and the nature of soil. Level terraces are constructed where rainfall and soil conditions permit holding of all the rain water received in a shower. A graded terrace is constructed where it is considered necessary to drain out the excess rain water safe into a constructed or natural outlet.

8.17 Terraces will increase the water intake, reduce sheet and gully erosion and provide a built-in safety factor for rains of high intensity. Terraces should be used instead of

bench Terraces on some sites. If terraces are built with a wide channel having gradual front and lack slopes, the entire surface can be farmed.

8.18 **Contour Farming**: This practice is always more effective if use in conjunction with terraces. Where all tillae is conducted on the contour, each tillage mark retains the water. This is in contrast to the tillage marks that actually the water runoff.

8.19 **Contour trenching**: Trenching along contours has been found an easy and popular method of preventing run-off and conserving moisture for the use of plants. Experiments have shown the efficiency of the trenches when no run-off was recorded from the trenched area but an equivalent adjoining entrenched area gave 6 cusecs of run-off even upto half an hour after a heavy rainfall.

8.20 Contour ridging: Contour ridging is a very efficient and widely method of conserving moisture in areas of low precipitation with comparatively easy slopes. The distance between the ridges varies depending on the slope of the ground.

8.21 **Water spreading:** The method actually goes a step further that more prevention of run-off. In this method the rain-water coming from other areas in spread over low lands by a system of simple diverting device such as dams , dikes, ditches etc.

8.22 The amount of run-off water can be considerably reduced leveling the individual fields and by erecting embankments around the fields. In high rainfall areas all the rain water, especially during monsoon season cannot be stored in the soil. A part of the run-off has to be disposed of safely from the crop land into the gullies. This excess run-off cab be collected in the stock ponds and small dams to be constructed at appropriate places.

(i) Agronomic Component.

The agronomic component comprises the selection of appropriate crops, better seeds proper planting dates and rate of seeding and use of fertilizer, best control and improved moisture conditions that will result from the physical component.

8.23 The basic principle in water harvesting is to use the rain when it falls and where it falls. The rain fall pattern in Barani Tract is such that we get about two third of the annual rain fall during summer and only one third or on during winter. Yet in the present cropping pattern, the winter crops are dominion as compared to the summer crops, Most of crop land is here when the rain fall is received during summer and precious moisture is irretrievably lost. The principle of moisture utilization demands that we should shift on to summer cropping so that rainfall is utilized when it is received. A shift of emphasis to Kharif crops would lead to the immediate harvesting of millions of acre feet of rain-water, now going water. Summer crops such as ground-nuts, summer pulses and millets would utilize the moisture now going waste.

8.24 The entire emphasis, at present is on Rabi crops, in particular on the cultivation of wheat. The rainfall pattern is however, hardly sulted to this system. In order to sow wheat in winter, the farmer tries to conserve the summer moisture over many months desperately fighting the weeds on the land he has kept fallow. He loses most of the moisture, inspite of his efforts as our summers are hot and evaporation rates are high. It ha been estimated that it is not possible to conserve and carry over for the following whet crop more than six inches of rain water out of 24 inches (average) rain-fall received during the fallow period even with the best moisture conservation practices . Furthermore, wheat can succeed only if both the winter and summer rains are timely and sufficient. If either of the two fall, the crop does not mature properly.

8.25. A rain drop where it falls is very easy to conserve that when the rain drops have accumulated strength and have started running off. It is highly desirable that the soil should be maintained in a condition that the maximum amount of rainfall is absorbed into the soil. For this purpose a closely growing crop such as ground-nut during the summer season would help in the penetration nd retention of rainfall.

8.26 As mentioned earlier more than 50 percent of the cultivated land is left fallow in the rain-fed area and it has to be repeated ploughed in order to prepare it to receive and absorb the moisture. If the copping pattern is changed to something similar to the ley-farming system used in Australia, which has replaced their traditional wheat fallow-wheat rotation (which we still practices in the Barani Tract) with a wheat-legume-fodder rotation, it would utilize all the moisture. In addition, it will considerably reduce plouging and greatly increase soil fertility which in turn would increase the water use efficiency of crops.

8.27 A quick and healthy growing plant in a fertile soil is the best machine of making the most efficient use of soil moisture. For this purpose such crops must be selected as have a high growth rate compatible with the rain fall pattern of the monsoon season. Crops like millets have a tremendous growth rate and produce enormous quantities of green matter utilizing both water and sun-shine much more effectively. An actively growing crop makes use of the soil moisture utilization than others. The crops which are most efficient in moisture utilization should be grown during the rainy season. Such crops are ground-nut, millet fodders and pulses. Closely growing plants such as grasses are also very efficient in facilitation the entry of rain-water into the soil.

DEVELOPMENT OF IRRIGATION

8.28 As the map of the Tract would show, there are fingers of canl irrigated area, extending into the Barani Tract in the Muzaffargarh and D.G. Khan districts. These packets are included in the Tract as their overall development problems are common with the Barani. Excepting these canal irrigated facilities in the Barani tract are extremely meager. A few small dams have been built by the Small Dams Organization of the defunct West Pakistan Agricultural Development Corporation. A few old wells and springs exist in some parts. A small number of tube wells have been sunk. In Mianwali District and D.G.. Khan District there is flood irrigation. There are two main source for development of irrigation in Barani Areas of the Punjab Province (A) Sub-surface water resources and (B) surface water flow, which are briefly discussed below.

(A) **Sub surface Water Resources.**

This has two components (i) tapping sweet ground-water through installation of tube wells and (ii) infiltration galleries in nullah beds which have perennial flow.

8.29 Tube wells represent a modern innovation which greatly increase yields by supplying more water to supplement the uncertain and intermittent water supplies from rainfall. Noticing the spectacular success of tube well in the irrigated interested in tube wells. Government have also announced a handsome subsidy for tube wells in Barani Areas. Quite a bit

of money is , however being wasted on wrongly located tube wells which were installed without determining the aquifer recharge. There are only limited areas in the tract where adequate aquifer reservoir exists which can support tube wells, Careful surveys should be conducted in different parts of the Tract and farmers advised on the basis of scientific data. Generally speaking, shallow low discharge tube wells should be encouraged as small discharges are easier to control and facilitates precise water control. This type of tube wll is also cheaper and does not require large power units.

8.30 The Tract is not very fortunate so far as ground water is concerned. This is due to the reason that the surface of the ground is generally uneven and sloping and rain-water is lost to the streams and rivers. Not enough time is left for the rain-water to penetrate into the sub-soil layers to form ground-water. Recently the deeper layers are generally composed of rock, clay or silt which cannot store ground-water. There are, however, small packets were good anuffer conditions exist. The examples are Sialkot district, small areas along Soan river, Jalalpur plain, Hazero plain and the Chock area of Attock Tehsil. These ground-water pockets should be investigated and developed by tube wells for irrigation.

8.31 The Chock area of Attock Tehsil which lies on the left of river Indus is rich in ground-water. The farmers of this area are making use of ground-water by constructing open wells where the water table is at economical depth. Due to poor financial resources and small holdings, it is not possible for individuals to install tube wells. The area bounded by G.T.Road and Lawrencepur-Terbela Road is very promising for the installation of tube wells and needs special attention.

8.32 Soan and Haro are two main drainage channels of the catchment of the sub-monetarism region of Northern Punjab and part of N.W.F.P.. After leaving the mountain region, they enter the plains of Campbellpur district. A belt of considerable width throughout their course is regularly charged with fresh water and is rich in ground-water. There is possibility of installing a battery of tube-wells along the banks of Soan and Haro Rivers.

8.33 There are a number of streams in Campbellpur district, which run with very high discharges in Monsoon and have little flow during the dry period. It is generally not possible to

make permanent structures at economical cost to divert the water-flow. The streams which can be considered for the utilization of perennial and sub-surface flow are as under in Campbellpur District (i) Soan River (2) Haro River (3) Sill River (4) Nandna Kass (5) Dotal Kass (6) Ghimbor Kass (7) Shakr Dara Kass. Along the high banks of the above named streams, good agricultural land is available. Filtration galleries can be constructed at suitable sites in the bed of the streamds and form there water cant be lifted by installing life pumps.

8.34 In Jhelum district due to the hilly terrain and unsuitable geology, there is little possibility of installing tube-wells. The only source of water, in addition to small dams is surface and sub-surface flow of perennial stream. The main perennial streams have abundant sub-surface water flow and lift irrigation schemes combined with filtration galleries can be constructed successfully along the banks. There are a frew perennial nullahs in the Pind Dadan Khan Tehisl in the Salt Range. There is possibility of tapping sweet water which can be used for agriculture as well as domestic purposes.

8.35 In the Sargodha district Nahar area to the west of Salt Range from Katha Sughral in Isakhel has a number of hill streams which bring terrent water during the Monssons. This area is mostly flood irrigated. In the foot hills, however, private tube-wels have been sunk ranging in depth from 400 ft to 500 ft. This area should be further explored for tube wells.

8.36 The average rainfall of Rawalpindi District in various parts is from 20” to 40” annually. The area is mostly sub-mountainous. There is little possibility of permanent ground water and suitable under ground-water bearing strata are scarce. Following are the major perennial streams which have the potential of supplying water for irrigation. Lift irrigation schemes with filtration can be developed on the banks of these streams (1) Soan (2) Garma Kass (3) Ling River (4) Kanshi Nullah (5) Gullana Kass.

8.37 In Sialkot district, although there are large numbers of tube wells, yet no systematic survey has been carried out for determining the availability of ground water. It is therefore, recommended that test boarding facilities should be provided in the area.

DEVELOPMENTAL SCHEMES :

A number of development schemes have been prepared/are functioning for the utilization of sub-surface water resources. These are briefly described below:-

8.38 **State Tube Wells Subsidy.** The scheme Subsidy on Sinking of Private Diesel Tube Wells in the Siilaba, Barani, Non-perennial and SCARP I & II areas of the Punjab (Rawalpindi Division) is continuing from year to year basis since 1972-73. A sum of Rs.24 lacs has been allocated for this scheme during the year 1974-75. a subsidy amounting to Rs.6,000/- for non-perennial and SCARP I & II areas is provided for diesel tube wells to the farmers.

8.39 **Life Irrigation Schemes** There are four Lift Irrigation Schemes sanctioned during the year 1975-76 for the districts of Rawalpindi, Campbellpur, Jhelum and Gujrat amounting to Rs.5,40,000/-, Rs.2,86,000/- , Rs.4,75,000/- and Rs.4,75,000/- respectively. The schemes are aimed at the installation of mobile diesel pumps. A fixed subsidy Rs.6,500/- shall be given to the farmers for each such pumping set. The installation of diesel pumping sets is expected to result in much better agricultural production in these districts.

8.40 **Flow Pump Irrigation.** Another schemes for irrigation through flow pumps/Iron made Persian wheels amounting to Rs.48 lacs has been submitted to the Government. It envisages the installation of 400 flow pumps/Iron made Persian wheels during 1975076 for which the total amount of subsidy shall be Rs.8 lacs whereas the subsidy of Rs.20 lacs is proposed to be given to the farmers during each of the two subsequent years. The total number of flow pump/Iron made Persian wheels proposed to be installed during the three years schemes shall be 2400.

8.41 Scheme for Test Bores for Tube Wells in Rawalpindi Division. This scheme envisages acquisition of 4 special type test boring power rigs for undertaking test bores during a five year period. The total cost of the scheme is Rs.2.06 crore. This cheme will provide test boring facilities to the farmers of Rawalpindi Division as under-ground water and strata are uncertain in threes areas.

8.42 **Acquisition of Power Rigs for installing Tube Wells in Rawalpindi Division.** This scheme envisages strengthening of existing power rigs and provision of 8 more power rigs to boost up tube wells installation programme in Rawalpindi Division . The scheme has bee prepared for 5 years and the total cost will be Rs.4.29 crore.

(B) **Surface Water flow.**

Water that comes to the Tract through the rivers and the streams and rain-water that cannot be harvested where it falls, should be utilized through (i) water spreading/flood irrigation and (ii) water storage.

(i) **Flood Irrigation.**

8.43 It is an age-old system and is practiced by reminders of Barani areas in parts of Mianwali, Tehsil Khushab and D.g. Khan District. This system is mosly prevalent in D.G. Khan District, where there are a number of hill torrents originating from the Sulaiman Range and bring considerable quantity of water into the plains of "PACHHAD". This water is utilized by the land holders of the pachhad for crop irrigation through a system of diversion bunds, weirs, water channels etc. The water of hill torrents is diverted into terraced fields under high embankments which are usually filled up to a depth of 2-3 feet, after which the water is released in the next lower group of fields and so on. The rotation in which the fields receive flood water is governed by the "Saropa System". Some hill torrents have potential water which is also distributed in accordance with "Haquq Aabpashi". The system of basin irrigation practiced in the Pachhad area was once very effective and used to irrigate a much larger area than is being irrigated currently. Or the total area of 2 million acres covered by hill torrents in the Pachhad of Dera Ghazi Khan, the revenue record lists an area of 6.83,000 acres for which water rights exist, however, the area currently being irrigated is only 1,76,000 acres. The table below gives the gross area covered for each major hill torrent of Dera Ghazi Khan District, the area actually irrigated and the area for which water rights exist.

Table

Hill Torrent Irrigation in D.G. Khan.

Sr No.	Name of hill torrent	Gross area	Actual irrigation as per civil record	Area for which water right, as per Civil records exist.
1	Kaurd	6,26,700	.123	35.810
2	Veboa		12.409	15.376
3	Sanghat		26.097	56.1984
4	Sord/Lund & Khosa	2,00,448	10.556	18.238
5	Vidorc	92.160	7.518	29.350
6	Sakhi Sarwar	74.880	6.066	35.652
7	Mithawan.	64.512	6.633	37.916
8	Kaha (with Kala Khosra)	4,29,328	82,616	2,51,711
9	Chachar/	36,032	7,308	54,628
10	Pikot	4,49,280	9,562	1,08,411
11	Short & Zangi			
	Total:-	20,13,328 Acres.	1,75,908 Acres	6,83,085 Acres

It will be observed that the area actually being irrigated is much less than that for which water rights exist. This is due to the following reason:-

(i) Kacha Bunds built by farmers frequently get washed away.

(ii) There are the proper control point and the channels go on deepening with the passage of time thereby takin large areas out of command.

(iii) Once a bund is breached in Monsoon season, it is difficult to restore it against during the period.

8.44 This system could be improved by constructing pucca weirs acrose the ullah bed and deverting fllod water through regulator adjoining fields. One such weir is under construction near Vehoa village of Taunsa Tehisl. On completion this will provide irrigation to about 19,000 acres of land against 8,000 acres presently being irrigated. A series of this type of weir could be built on a torrent to bring adjoining lands under irrigation. A hill torrent division has recently

been opened at D.G. Khan. It needs to be greatly strengthened to explore the possibilities of improving the existing system of flood irrigation.

8.45 The area has been greatly neglected in the past and should receive special attention. The following recommendations are made:-

(a) Efforts should be made to harness the hill torrents, spcially Kaha and Mithawan by the construction of detention bunds. The feasibility of such proposals should , however be carefully studies.

(b) As nearly 60 percent catchment area of these torrents lies in Baluchistan and remaining 40 percent in the Punjab Province, coordinated efforts are needed for water-shed management and run-off retarding works.

(c) Proposals for the following have been made for e proper utilization of the water and land resources of the D.g. Khan hill torrent Pachhad area which should be duly investigated in view of the vastness of the resource:-

(i) Water-shed management in 8,000 sq.miles and Baluchistan including :-

(a) Afforestation and range management.

(b) Vegetal cover.

(c) Small check dams.

(d) Gully Plugging.

(e) Terrace outlet structures.

(f) Strip cropping and contour cultivation.

(g) Control of grazing and fire.

(h) Soil amendment.

(ii) Construction of detention reservoirs-cum-distributors/simle distributors outside the darraha for attenuating floods and proper distribution of irrigation supplies.

(iii) Construction of distributors on latest distribution Nullahs.

(iv) Widening strengthening and improving of existing irrigation nullahs.

(v) Soil conservation measures in the Pacchad specially on torrents like Vehova, Sanghar, Shori etc. which directly fal into the river leveling of irrigation land and other measures of land improvement.

(vi) Preparation and up-dating of record of land and water rights and implementation of land tenure system.

(vii) More intensive and extensive observation of hydrological data specially with automatic recording instruments and proper conveyance of this data by wireless so as to secure high degree of correctness and promptness. Detailed soil contour, Geological and sub-soil water surveys of the catchments and Pachhad area.

(viii) Construction of all-weather roads, village electrification and other amenities in the irrigated area.

(II) WATER STORAGE

8.46 There is definitely a place for structures to store water-ponds, small and medium dams, in the over-all development of the Barani Tract. A number of dams have already been constructed at substantial cost. Many have been built, however at places where good land for cultivation does not exist or the farmers see little use of such water.

8.47 There is a lack of combination of water and suitable lands. In many places good quality lands exist and there are possibilities of small dams but the builders have preferred some As no such works have been carried out in the country in the past, it is difficult to suggest appropriate physical funding for small scale project without surveying the probable area of study. It can, however, be assured that if such projects are started, these will be a great help not only to the local population but will also be a measure to each revenue for the Government.

8.48. Water should be managed with the clear object of increased agricultural production. Too often the water resource is considered to be of such importance that its mere presence is assumed to ensure increased production and irrigation structures are built without thorough surveys of the areas to be commanded for their agronomic potential. There is a universal tendency among Planners to divide irrigation management into separate and distinct engineering and agricultural phases. Under such an arrangement no one is responsible for the entire system, from the water source to the harvested crop. This is a catastrophic mistake in the case of Barani lands where the inter-dependence is total.

8.49. A very serious problem is the relatively low returns from some of the irrigation schemes like small dams. Practically all the benefited cost derived of projects in the Tract relate to pre-investment planning, and very little concrete information is available on the economic performance of scheme completed in the past. It is of the utmost importance that thorough scientific study should be immediately arrange for on the performance and the usefulness of the dams constructed. No further expenditure on the construction of new dams should be undertaken without such evaluation.

Storage Schemes:

8.50. There are very few sites where big water-storage structures could be built due to limitations of geology and topography. However, numerous sites are available in these areas where small and medium dams can be constructed. Such dams would pose lesser problems of foundation geology and engineering.

8.51. Small Storages built in the area will prove extremely valuable for the following reasons:

(i) Irrigation water for crops would become available and help increase agriculture produce and put the agricultural economy of the area on a sure footing.

(ii) Permanent source of water supply to neighboring villages for domestic and stock use. In most of the areas the people have to walk miles to obtain their daily domestic water requirements. The cattle have also to be taken long distances every day for drinking water. In times of drought cattle die by thousand due to the shortage of water.

(iii) Fish culture could be introduced at the sites to provide much needed protein food to the people at low cost.

(iv) Such storages assist in flood control and soil conservation work.

8.52 In the Northern areas of Punjab, in the Districts of Gujrat, Jhelum, Rawalpindi, Campbellpur and Mianwali, a large number of streams flow down to meet the Jhelum and the Indus Rivers. These streams have eroded through sandstone and shales at various places and the gorges thus farmed provide suitable sites of Small Dams. These physical

characteristics and geological investigation, whereby a number of suitable Small Dam sites have been selected.

8.52. Since the inception of the Small Dams Organization in 1960 it has already completed 12 schemes in the

The following table gives the list of Schemes completed and under construction:

Completed schemes:

Sr. No.	Name of Scheme	Date of Completion	Capital outlay Rs. (Lacs)	Total storage (A.F)	Area to be irrigated annually (Acres)
1	Sipiala Dam	Nov 1964	3.24	568	140
2	Tanaza Dam	Nov 1964	1.78	87	50
3	Bango Dam	Sept 1965	1.13	161	75
4	Churabh Dam	Aug 1966	13.39	830	500
5	Misriot Dam	1963-1966	3.32	513	100
6	Dungi Dam	1967-1971	14.91	1760	900
7	Nirali Dam	Dec 1970	9.73	682	Run off below expectation
8	Ratti Kassi Dam	1967-1970	7.40	1650	650
9	Dhurnal Dam	1967-1971	17.59	1625	700
10	Chichali Dam	June 1971	52.36	6600	5000
11	Dhoke Tahlian Dam	June 1971	11.50	1419	800
12	Qibla Bandi Dam	Dec 1971	14.90	1820	1000

Under Construction Schemes:

Sr. No.	Name of Dam	Location (District)
1	Channi Bore Dam	Campbellpur
2	Kanjoor Dam	-do-

3	Garat Dam	Jhelum
4	Khokhar Zer Dam	-do-
5	Walana Dam	-do-
6	Vehoa Pick Up Weir	D.G Khan

8.53. A brief description of the possibilities of small dam construction district-wise is given below:-

Campbellpur District:

8.54. There are four Tehsils in this District. In Tehsil Talgang rainfall veries form 18" to 22" which is sufficient for providing enough runoff to be stored. Culturable lands are gently sloping. Two of the dams already constructed, one at Dhurnal and other at Gurabh are said to be beneficial. In Pindigheb Tehsil annual rainfall varies form 18" to 23". Three main basins of drainage are Silkas, Dotal Kas, and Resi Nullah. Ratti Kassi Dam has already been completed and is showing rapid development. Channi Bore dam in its vicinity is under construction.

8.55. In Fateh Jang Tehsil annual rainfall varies form 23" to 25". There are three main basins viz: Nanda Kass, Dotal Kas and Bhagwan Kas. The people realize the importance of rain water storage and its utilization. Three dams have already been built at Sipiala, Tanaza and Bango. One dam viz; Kanjoor Dam is under construction.

8.56. Campbellpur Tehsil itself is divided into hilly and plain area and has fewer sites for storage. The bing plain around Hazro is Water-logged. However, well irrigation, being done in some areas, is very successful and a lot of tobacco and vegetables are grown. One dam viz, Qibla Bandi Dam has already been completed and is showing rapid development.

Following dam-sites in Cambellpur District have been suggested for future development.

Sr. No.	Name of Scheme	Approximate Cost	Expected annual irrigation
1	Musa Dera	Rs. 35.0 Lacs	1000 Acres

2	Kanura Dam	Rs. 32.0 Lacs	1000 Acres
3	Qarar	Rs. 40.0 Lacs	1200 Acres
4	Noorpur Kanalia	Rs. 38.0 Lacs	1000 Acres
5	Nara Kas	Rs. 35.0 Lacs	1400 Acres
6	Kalu Khurd	Rs. 40.0 Lacs	1200 Acres
7	Dhok Jallar	Rs. 70.0 Lacs	2000 Acres
8	Triune Kas	Rs. 37.0 Lacs	1500 Acres
9	Surang Kas	Rs. 40.0 Lacs	1000 Acres
10	Kutera Kas	Rs. 42.0 Lacs	1300 Acres
11	Kund	Rs. 40.0 Lacs	1000 Acres
12	Klichian	Rs. 38.0 Lacs	1200 Acres
13	Nawab	Rs. 40.0 Lacs	1000 Acres
14	Cover jabbi	Rs. 47.0 Lacs	1500 Acres
15	Shahpur	Rs. 80.0 Lacs	3000 Acres
16	Hajipur	Rs. 48.0 Lacs	1200 Acres
	Total:-	Rs. 700.0 Lacs	21500 Acres

Rawalpindi District:-

8.57. The terrain in Rawalpindi District varies from steep hill slopes to uniformly and gently sloping lands. There are four tehsils in this District viz; Murree, Kahuta, Rawalpindi and Gujar Khan. Main drainage lines of the area are Kansi, Soan, Gumrah, Sil and Bhudra. Yearly average rain fall varies from 28” to 54”.

8.58. Soan, Kansi and Gumrah in their upper reaches pass through high and rugged hills and the slopes are steep. Consequently, the chances of finding reservoir sites with enough capacities are rare. Further down, the nullah basins become very wide and are not suitable for construction of small dams. However, as we come lower down in the old alluvial areas the smaller tributaries joining these nullahs provide many good sites for construction of small dams. Sil and Bahudra, the other two drainage lines however start from lower regions and therefore, many sites are available on their tributaries right form the beginning.

8.59. Construction of the first small dam was started very near to Rawalpindi at Misriot in 1963. Two more dams, viz; Dungi and Narali Dams were completed in Tehsil Gujar Khan. The development on the above three schemes has been discouraging and the farmers are reluctant to use dam water for irrigation purposes. The engineering aspects must be integrated with agronomic/economic considerations and a study of the problem is called for.

8.60. The Following four schemes have been sanctioned by the Punjab Government but before work is started, the study proposed above should be completed to take a reasoned approach to the problem.

Sr. No.	Name of Scheme	Original	Revised	Area
1	Khasala Dam	Rs. 18.19 Lacs	Rs. 60.0 Lacs	1600 Acres
2	Pattain Dam	Rs. 11.22 Lacs	Rs. 35.0 Lacs	1400 Acres
3	Dhok Sandymar	Rs. 4.65 Lacs	Rs. 15.0 Lacs	400 Acres
4	Moondi Dam	Rs. 3.65 Lacs	Rs. 10.0 Lacs	300 Acres

The following additional sites have been proposed

Sr. No.	Name of Scheme	Cost	Area under irrigation
1	Kallar Dam	Rs. 20.0 Lacs	1000 Acres
2	Jandi Wala Dam	Rs. 15.0 Lacs	500 Acres
3	Chokar Dam	Rs. 15.0 Lacs	400 Acres
	Total:-	Rs. 53.0 Lacs	1700 Acres

Jhelum District:

8.61. The yearly rainfall varies from 28” to 30” near Sohawa and 24” in Chakwal. Main drainage lines of the area are Bakrala, Kahan, Bunha which cut across the salt range and fall into Jhelum. The area lying between the southern slopes of the Salt Range and right bank of Jhelum is not generally suitable for construction of small dams as the hill slopes are steep and do not provide good storage sites. Salt inth ewater of nullah crossing salt beds is another hazard. This has created saline conditions in plains of Pind Dadan Khan Tehsil and

this water goes waste into Jhelum without benefiting a single acre of land. Jalapur Canal Project if approved by ECNEC could bring prosperity to this area. Perennial flow in the following four nullahs is available which if tapped in the upper reaches could be utilized for irrigation as well as drinking purposes. Pind Savika Dam is also under investigation to supplement the supply of Jalapur Canal.

Following three schemes are under investigation:-

Sr. No.	Name of Scheme	Approx cost	Area to be irrigated
1	Makhrach	Rs. 50.00 Lacs	1500 Acres Annually.
2	Pir Khara	Rs. 55.00 Lacs	1600 Acres Annually.
3	Nilawan	Rs. 60.00 Lacs	1800 Acres Annually.
	Total:-	Rs. 165.00 Lacs	4900 Acres Annually.

8.62. On the other side, the area on the north of the Salt Range, forming part of Jhelum Tehsil and entire Chakwal Tehsil provides suitable sites for construction of small dams. One Dam viz; Dhok Tahlian Dam has already been completed and three dams viz, Khokhar Zer, Garat and Walana Dams are under construction. Following sites already located are perspective.

Sr. No.	Name of Scheme	Approx: cost (Lacs)	Area to be benefited annually (Acres)
1	Saliel Dam	18.0	260
2	Suriah Dam	40.0	1200
3	Ghatia Dam	3.50	1000
4	Chakwala Dam	70.0	2500
5	Nagial Dam	15.0	300
6	Nikka Dam	50.0	800
7	Pandori Dam	335.0	1200
8	Total:-	Rs. 258.50	7200 Acres

Sargodha District:

8.63. In the Sakesar Valley north of Salt Range the rainfall varies form 12" to 16". There is no source of irrigation except a few wells. There are two lakes viz; Soon and Kahar but their water is also saltish. The area has not been investigated properly. During the current year investigations have been started to explore possibility of small dam sites. There are various small streams having catchment form 1 sq. mile to 3 sq. miles. The following three dam sites and two flood diversions weirs have been proposed for further investigation. These are as under:-

Sr. No.	Name of scheme	Approx: Cost	Area to be benefited
1	Pattern Dam site	Rs. 5.0 Lacs	120 Acres Annually
2	Sabral Dam site	Rs. 5.0 Lacs	100 Acres Annually
3	Uchhali	Rs. 4.0 Lacs	100 Acres Annually
4	Tarapi flood Diversion Weir	Rs. 50.0 Lacs	2000 Acres Annually
5	Golay flood Diversion Weir	Rs. 30.0 Lacs	3000 Acres Annually
	Total:-	Rs. 94.0 Lacs	5320 Acres Annually

Sialkot /Gujrat District:

8.64. There is no possibility of storage scheme in Sialkot. In Gujrat there is no possibility of any storage scheme except at Bhimber nulla and WAPDA is investigating the possibility of developing a storage site in adjoining Azad Kashmir. If this fructifies, it will bring a large area in the Gujrat District under irrigation.

There is a tract of land between Upper Jhelum Canal and G.T Road in Tehsil Kharian which can be irrigated by canal from Khokhra head subject to availability of water during Kharif. This possibility needs thorough investigation.

Medium Dams:

8.66. The Water and Power Development Authority (WAPDA) have prepared the Soan and Haro Basin Reconnaissance reports through a firm of consultants. A summary of their findings is given below.

(a) Soan Basin Irrigation Development Plans

8.67. The total yield of the basin is 1,525,000 acre feet which at present is not being utilized for the benefit of the cultivators inhabiting the area. There are feasible sites for constructing reservoirs for providing irrigation facilities to the lands. All the projects mentioned in the report, if implemented, will irrigate 275,000 acres which will utilize 49.000 acre feet of water. It will thus be possible to utilize 28 per cent of the yield within the basin. All the projects give a reasonable benefit cost ratio. These proposals are based on preliminary investigations at reconnaissance stage. Detailed investigations of these schemes will have to be undertaken for the preparation of feasibility reports.

(1) Bhaun Dam:

8.68. Based on the preliminary investigations, it is proposed to build a rock-fill data across the Ling River near Bhaun village in Kahuta tehsil. The site is about 5 ½ miles from Kahuta and about 23 ½ miles from Rawalpindi. At present, there is a 2 ½ -mile long fair-weather jeepable road, from Rawalpindi- Kahuta road to Osmanpur village, which can be extended upto the dam site.

8.69. From a study of Survey of Pakistan contour maps, it appears that the canal system from this reservoir can command a cultivable area of about 17,400 acres.

(2) Morgah Weir:

8.70. In order to develop the culturable lands on either bank of the river in this sub-basin, the river in this reach has been inspected for selecting suitable sites for constructing reservoir and diversion works. The site selected is 1 ½ miles downstream of Morgah village, at latitude 33°-0’-54" & Longitude 73°-4'-42".

8.71. The bed level of Soan at the proposed site is M.S.L. 1356 and the level of the G.T. Road bridge across the river Soan, 6 miles higher up is M.S.L. 1435. In order to avoid the submergence of the G.T. Road, it is proposed to construct a diversion weir 49 ft. high

above the river bed with 5 ft, high automatic falling shutters and utilize the run of the river for irrigating about 16,000 acres of C.C.A.

(3) Khairi Murat Dam:

8.72. There are fertile lands on either bank of the river and the cultivators are eager and anxious to get water for irrigating their lands, as they are fully aware of its influence in improving their economic conditions. Preliminary reconnaissance shows that there is a feasible site for constructing a medium reservoir near Khari Murat Village, in Rawalpindi tehsil. The site is 4 miles from Maria Khurd which is a road-side village, 13 miles away from Rawalpindi. The dam site can be easily approached by constructing a road 4 miles long.

8.73 From a study of Survey of Pakistan contour maps, it is seen that the canals on either bank taking off at M.S.L. 1400 have n gross command of 26,240 acres on the left flank and 16,000 acres on the right flank. From the dependable yield available it will be possible to irrigate only about 8,000 acres of cultivable land, It is ,therefore, proposed to irrigate pert of the command on the left flank of Khairi Murat reservoir by including the right bank canal of Morgah Diversion Weir.

8.74. The gorge in narrow and deep. The bed level of the stream at the site of the proposed dam is M.S.L. 1269. It is proposed to construct an earth-fill dam with a homogeneous section and suitable materials are available locally. The sill of sluices of the canal on either flank will be at M.S.L. 1400.

(4) Papin Dam:

8.75. Based upon the preliminary investigations carried out by ACE so far, it is proposed to build a rock fill dam across Wadala Kas at n site about 1 ½ miles upstream of Papin Village in Fatehjang tehsil. The site is about 23 miles from Riwat village (Rawalpindi tehsil). At present, there is a fair weather jeepable road about 19 miles long, from Riwat to Mohra village. A donkey track about 4 miles long leads from Mohra to the dam site. From a study of Survey of Pakistan contour maps, it appears that the catchment area of

Wadala Kas upto the dam site is about 214 sq. miles. With the proposed elevations at the dam site, the reservoir will be able to command a cultivable area of about 31,400 acres. A rock-fill dam about 125 ft. high (maximum) above the river bed, alongwith a fated spillway having a lined discharge carrier constitute the major part of the Project.

8.76. A proposal was made by WAPDA for the consideration of a dam site at Saura across the Badala Kas valley. Here the catchment of this stream is only 51.68 sq. miles. The countryside in the neighborhood is badly gullied and broken. However, it suggested that when Papin Dam is being investigated the possibilities at Saura can also be examined simultaneously.

(5) Dhok Stal Dam:

8.77. The scheme envisages a stone masonry dam (gravity type) across Dhart river; which is one of the main tributaries of Ghamhir river at a site close to Dhok Sial Village in Chakwal Tehsil.. A masonry spillway that forms a part of the dam is included in the project, to take care of unusual floods. Culturable area to the extent of about 7,400 acres is available for the Project.

(6) Dharabi Dam:

8.78. The scheme envisages en earth-fill dam of homogeneous section across Ghambir River, near Dhrabi village, about 4 miles upstream of the confluence of Ghambhir River with Dhrab River. A masonry spillway has been provided to the left of the main embankment to take care of unusual floods. Pipe-sluices through the main embankment supply irrigation water to the canals, with a gross command area of 22.850 acres.

(7) Kot Fateh Dam:

8.79. Based upon the preliminary investigations, it is proposed to build an earth-fill dam across Sil II at a site about one mile upstream of Kot Fateh village. The site is about 43 miles from Rawalpindi, At present there exists a metalled road from Rawalpindi to Gaggan railway station, which covers a distance of about 36 miles. There is a 6 mile long 'Katcha'

road from Gaggan to Kot Fetch village. The dam site is approachable from Kot Fateh by a fair weather jeepable road, about a mile long.

8.80. From a study of Survey of Pakistan contour maps, the catchment area of Sil II upto the dam site has been estimated to be 98 sq. miles, With the proposed elevations at the dam site, the reservoir will be able to command a cultivable area of about 7,900 acres.

(8) Dhok Ham Dam

8.81. The scheme envisages a stone masonry gravity dam across Ankur Kas at a site about a mile east of Dhok Ham village and about half a mile downstream of the confluence with Gandial Nala. A gated spillway forming a part of the main dam takes care of heavy floods. An outlet sluice through the masonry dam conveys water to the main irrigation canal that provides water for about 8,030 acres of culturable command area in Talagang.

(9) Shah Bilawal Dam:

8.82. The scheme envisages an earth-fill dam across Gabhir River about three miles west of Danda Shah Bilawal village. A gated spillway on the left flank takes care of heavy floods. Two outlet sluices on each flank provide water to 12,840 acres of culturable command area in Talagang tehsil.

(b) Haro Basin Irrigation Development Plans:

8.33 The average annual yield of the basin is 648,800 acre-feet which is not utilized and is going waste at present. There are feasible sites for constructing new reservoirs for providing irrigation facilities to Barani farm lands. 5 medium reservoirs and one lift irrigation scheme have been recommended (of these Khanpur Dam is already under construction and the feasibility report of Sanjawal Dam project was submitted to WAPDA in December 1964). The total irrigable command area under these projects is 171,500 acres. These proposals are based on preliminary investigations and detailed investigation will have to be undertaken for the preparation of feasibility reports.

Sanjwal Dam:

8.84. The location site is near village Sanjwal in campbellpur District.

Total Catchment area	: 703 sq. miles
Free Catchment area	: 395 sq. miles
Type of Dam	: Rock fill in river gorge and Earthen dam on right flank.
Deepest bed level of river	: 1025 M.S.L.
Top level of Dam	: 1190 M.S.L.
Full reservoir level	: 1180 M.S.L.
Maximum water level	: 1184 M.S.I.
Sill level of irrigation Canal (Gravity)	: 1140 M.S.L.
Gross Capacity at F.R.L	: 177,252 Acre ft.
Dead Storage at 1140	: 47,932 Acre ft.
Live or effective storage	: 129,320 Acre ft.
Maximum flood anticipated	: 240,000 Cusecs

(2) KALA KAS IRRIGATION SCHEME:

8.85. There is a belt of fertile lands lying in between Kheri Mar Range and Ghhiri Kas. The cultivators in this part of the country are extremely anxious to get water for irrigating their lands, as they are fully aware of the beneficial effects of such a scheme.

8.86. The command under Khanpur Project extends upto Ghhiri Kas and there is no proposal to irrigate the cultivable lands on the right bank of the above Kas.

8.87. The Kala Kas is passing through clayey soils with deep scours on the bank and there is no feasible site for constructing either a reservoir due to (1) non-availability of reliable foundations at a reasonable depth, and (2) to avoid submergence of Wah, Hasanabdal and the industrial area which are nearby. The alternative is to lift water from thin perennial nullah and irrigate the lands as has been done by WAPDA near Hasanabdal.

8.88. Preliminary reconnaissance shows that a sump well can be located near Pathargarh Village, Rawalpindi tehsil. Its latitude in 33°-47'-5" and longitude is 72°-40'-54", The site is approachable by a jeepable tract 1- ½ miles long from the 3rd mile of Wah-Fatehjang Road. This track can be converted into an all-weather road.

8.89. From the Survey of Pakistan map, it in seen that the first reach of the canal taking off at R.L. 1450 will command the lands situated in-between Kheri Mar Range and Ghhiri Kas. Near Mian Ki Ban Village, the bed level of the canal will be about R.L. 1400 and after about a mile from here i.e., near the village Mian Sultan Ki Dhok, it will be R.L. 1350 from where there will be a net work of channels to irrigate the area.

8.90. The total gross command planimeters to about 15,000 acres. By lifting about 30 cusecs it will be possible to irrigate about 6,850 acres which is about 45 per cent of the gross command.

(3) THATTA KHALIL DAM:

8.91. The scheme envisages the construction of an earth fill dam across Bahudra Kas which is a major right bank tributary of Mandna Kas, near Thatta Khalil Village. The site is approachable by jeepable tract 9 miles long from Taxila. A masonry spillway is proposed on left flank for disposing of the maximum floods.

8.92. With the available dependable yield at the site of the dam it will be possible to irrigate about 9,500 acres. There is no major problem of submergence due to the construction of this reservoir and a part of Dhok Maliaran may get affected. Sufficient provision is kept for paying compensation for the property that will be damaged and for rehabilitating the displaced people. Further adequate provision is kept for acquiring about 1360 acres which includes the area that will be submerged and the area required for the construction of embankment and canal.

(4) SHAHPUR DAM:

8.93. The scheme envisages the construction of a masonry dam 91 ft high across Nandna Kas about 1 mile south-east of Shahpur Village and about ½ mile downstream of the confluence of Jabba Kas with Nandna Kas with spillway in the gorge. The site is approachable by a jeepable track from Fatehjang to Hasanabdal. It is proposed to irrigate about 9,000 acres of land on the left bank of Nandna Kas which lies just below the foot hills of Kala Chitta Range.

8.94. The area that will get submerged in the reservoir is 1300 acres of which about 400 acres will be culturable lands and the rest hilly reach. There are two roads in the submerged area (1) a gravel road from Fatehjang to Hasanabdal and (2) a black-topped road from Pindi to Kohal. At present, there are causeways at the crossing of the valley along these two roads which will get submerged. Provision is kept in the estimate for constructing bridges and the approaches to the required level.

(5) PINDI NIAZI DAM:

8.95. Based on the Preliminary survey and investigations conducted so far, it is proposed to construct a medium reservoir across Nandana Kan near Pindi Niazi village in Campbellpur Tehsil. The dam will be of an earth-fill section. The site is approachable by a metalled road from Fateh Jang upto Jabbi R.H. and then by a jeepable track two miles long.

8.96. The canal on either bank takes off at R.L.1210 and the gross command is 29,780 acres of which 18,900 acres are on the left flank and 10,800 acres on the right flank. As stated earlier, a part of the land is cut up and eroded and as such about 45% of the gross command i.e. about 13,000 acres can be taken as irrigable command. However, keeping in view the yield available, the area proposed to be irrigated is only 10,500 acres. In order to utilize this water, a dam about 95 ft. high above the river bed will have to be constructed.

8.97. There will not be any serious pattern of submergence due to the construction of this reservoir. At the proposed F.R.L. of 1230 Kot Salabat village, which is sparsely populated will get affected. The lands which are likely to be affected are barren and waste

lands. However, adequate provision is kept in the estimate for compensation. In all, an area of 1500 acres will be acquired for the reservoir and the distribution system.

8.98. The gorge is narrow and deep. On the site of the proposed reservoir the bed level is R.L. 1145. The dam comprises of zonal section and the soils required for the same are available within reasonable leads.

CHAPTER IX

ENERGY

9.1. The provision of fuel for domestic use to the one crore people living in the Punjab Barani Tract is a problem, which in its magnitude and urgency, is in the same class as food. With the exception of a small number in the cities, the mass of the people use little commercial fuel for domestic use and are dependent generally on fire-wood and dried animal dung for their fuel needs. Nearly 70 percent of the fuel used today is animal dung and about 30 percent is fire-wood. The exponential growth of population has caused a sharp rise in the demand for wood and animal dung in the Tract and man has literally been on a rampage, cutting forests and uprooting scrub and bush, and burning animal dung, there-by denying the land of valuable manure, while depleting it of nutrients year after year through cultivation of exhausting crops, such as, wheat and millets.

9.2. The ecological balance of the Tract has been completely upset and the recuperative processes of nature have become inoperative. It has greatly decreased the fertility of soil and crop yields are abnormally low. The land, which was only a 100 years back thickly wooded, is now denuded of forest cover except on n paltry four percent of the total area. Nearly half the rain water is lost due to run-off and there is widespread soil erosion. Man with his axe, in quest of fuel, is causing a total degradation of environment. The fuel demand dominates the entire ecological picture and represents one of the most serious problems faced by the economy of the Tract.

9.3. The living standards, prosperity and economic development of an area are reflected in the per capita energy consumption. In Pakistan, the energy consumption per capita from the commercial sources is only 200 Kg of coal equivalent. The rate is about one tenth of the world rate of energy consumption which is 2,074 Kg equivalent of coal and one thirtieth of the western industrial countries which in 6000 Kg equivalent of coal per capita per year. One reason for such a low rate of energy consumption is that the vast majority of our people live in the rural areas where their energy needs have been traditionally met

through the use of non-commercial sources, and bullocks are used for draft power and local transportation. Even where electricity and oil are available. they are not used for cooking as their price in beyond the purchasing power of the people and are used mainly for running tractors and tubewells.

9.4. Inspite of the very low consumption of energy, the sharp rise in oil prices and the resultant global energy crisis has added a new dimension to our misery. The national bill for import of petroleum products has risen from Rs.6 crore ten years back to Rs.387 crore last year. The sympathetic hike in the prices of other imported goods such as chemical fertilizer and machinery has completely upset our balance of payment position. The current gap in exports and the import bill is of the order of Rs.13350 million which in 1970-71 prices would have been only Rs.4400 million. Added to the numerous internal stresses and strains caused by this situation, is the chaotic behavior of the international market, and the world-wide inflation and recession that the energy crisis has generated. It has seriously affected our export goods industries and trade.

9.5. Energy thus occupies the centre of the stage and is a major area of concern in national affairs. While the affluent nations face one energy crisis, due to the fivefold rise in petroleum prices, Pakistan in common with a number of poorer countries in Asia and Africa face two serious crises, viz., the oil crisis and its related complications and the infinitely more pernicious and damaging crisis in the availability of the fuel for domestic use by the rural poor. The real crisis for the mass of the people is the daily scramble to find the fuel they need to cook their food.

9.6. There are four major sources of commercial energy in the notion i.e. oil, gas, coal and electric power; the nuclear power has recently been added to the energy mix. The data regarding source-wise consumption of the various energy resources in the Barani Tract is not available. However, the energy consumption pattern in the sub-continent (Table-1) and in Pakistan for year 1974-75 (Table-II) provides a general picture for the Tract as well.

9.7. The pattern of energy consumption for the Tract is not very different. In the rural areas, the consumption of non-commercial type of fuels is perhaps greater, compared to other

parts of the country, due to the greater forest area and larger livestock population. Assuming a growth rate of around seven percent per annum in our economy, and 10-12 percent annual rate of increase in energy consumption, by the year 2000 AD the estimated demand for commercial energy sources comes out to be somewhat as given in Table-III, This estimated energy consumption at the close of the present century based on the existing pattern shows a stage of development which would still be much lower than the present stage of development enjoyed by even the lowest consumers amongst developed countries. Besides, at the projected economic growth rate, the known gas reserves would be exhausted by the end of this century and unless more reserves of oil and gas are discovered, we shall have to face a serious imbalance between the energy demand and supply. The oil bill alone may rise to a gigantic amount of Rs.20 billion a year in foreign exchange. It is thus obvious that the pace of development in this critical field should be very greatly accelerated and all efforts made to explore and exploit new oil, gas and coal reserves and to develop nuclear power. Besides the exploitation of conventional sources of energy there is an urgent need to develop the use of non-conventional energy sources such as solar, wind, bio-gas and geothermal energy. Therefore efforts should be made to overcome the technical/economic social problems involved in introducing these technologies to the masses and make them aware of the urgent need to change the age-old energy consumption pattern with the newly available technologies.

9.8. The Barani Tract is richer in mineral resources as compared to the rest of the country, and according to a recent survey does have huge unexploited reserves of oil and gas. Besides, the people have, in the north central part of the Tract, comparatively a higher education level and higher labour force participation rate of women. Sociological surveys indicate that the perception of ideal family size in the Tract is also one of a small family and there is a keen perception of the inadequacy of living standards. As agriculture would generally remain risky due to the dependence of the Tract on uncertain rain fall the long-term strategy for improving the standards of life and living, would emphasize industrialization which would depend on the development of the energy resources. A sustained push is, therefore, needed to explore and exploit the sources of energy which no doubt exist. For this, 1% of the cost of all projects in the energy sector must be earmarked for R&D work. As well, manpower development must be undertaken in a manner that a sufficient pool of

skilled personnel should be created out of which a certain percentage may be allowed to go out of the country and acquire the most recent technology. A brief picture of the known commercial sources of energy in the Tract is given below:

Oil

9.9. At present, oil has the biggest share in our pattern of energy consumption. Of the total consumption, the transport sector is the largest consumer and accounts for 58.2 percent of the total followed by 7.0 percent in industry, 14.5 per cent in domestic, 8.3 percent in power and 12.0 percent in agriculture and other sectors. The total consumption was estimated at about 4 million tons in 1974-75. The country's own production is only half a million tons per annum which is hardly 10-15 percent of the total requirements of oil. The balance is imported.

9.10. In view of the sharp increase in the import bill due to the rise in crude oil prices, high priority in bring given to oil exploration. At present, five oil fields at Dhullian, Joyamir, Balkassar, Tut and Meyal, all located in the Punjab Barani Area, are producing a total of a little over half a million tons annually. The known oil reserves amount to 6.5 million tons (Table-IV gives a picture of the reserves of these oil-fields). It has not been possible to determine the total reserves due to the complicated nature of the structures. However, to increase the oil production more wells are being drilled at Tut and Mayal. There are high hopes of Tut-5 yielding enough oil not only to cover the deficit caused due to the depletion of Tut-4 but also to increase the production further. The primary recoverable reserves of oil fields discovered at Tut-5 are being assessed. Moreover, the Oil and Gas Development Corporation (OGDC) is expected to dig about 60 more wells during the 1975-80 period in the province.

9.11. The demand for oil and its products is increasing by 10-12 percent every year. It is estimated that at the current prices i.e. neglecting any further increase in oil prices, by 1979-80 the import bill will reach $566 million in case no sizeable oil and gas reserves are discovered in the country. The Tract has all the requisites for the generation and accumulation of petroleum. Its vast sedimentary basin, wide-spread oil and gas seepage and established oil and gas fields are strong indicators of the existence of sizeable

reserves. The large gap between the discovered reserves and petroleum potential is attributed to inadequate exploratory efforts. The solution lies in the intensification of the exploratory efforts, systematic planning a nd well formulated exploration programmes, and the induction of qualified manpower and modern technology equipment.

9.12. To achieve a real break-through in the discovery of oil reserves, sufficient facilities and equipment should be provided to the recently established Oil & Gas Development Corporation (OGDC). Furthermore, to activate the exploration and drilling efforts in the area, the Pakistani scientists and technologists working with OGDC need to be provided more attractive salaries and other facilities, as many trained and experienced workers have left the country because of low salaries and poor facilities.

9.13. As regards processing, two refineries in Karachi process the imported crude oil while a refinery in the Punjab Barani area, near Rawalpindi, processes the indigenous crude oil. With existing capacities the refineries do not fulfill the demand of petroleum and its products. Efforts should be made to increase the capacity of these refineries as the price of petroleum products is much higher than that of crude oil.

Gas

9.14. Natural gas is the second biggest source of energy among commercial sources Gas is being used mainly as fuel for the industrial sector and for power generation The present pattern of gas utilization is as follows: power 32.5 percent, fertilizer 20 percent, cement manufacture 16 percent, general industry 26 percent, commercial 2.3 percent and for domestic use 3.2 percent.

9.15. In the Barani Areas of the Punjab, gas is being produced alongwith the soil and from the oil fields at Dhullian, Meyal and Tut. The total proved recoverable reserves at these oil-fields are 249,900 million cubic feet (details given in Table-V). The current production of as from Dhullian oil fields is 34 million cubic feet per day. During the drilling of wells at Rhodo-2 additional gas reserves have also been discovered and being estimated.

9.16. Besides the production of gas at Dhullian, gas from Sui in also piped into the Tract for thermal power generation. At the present rate of consumption, the sui gas reserves which are the biggest in the country, can lost only up to the end of the century. Already up till December, 1976 about 11 percent of the total known reserves of the country have been exhausted. Keeping the economy of the country in view we must make better and more efficient use of the existing reserves. As gas is a valuable raw material for petrochemical industries, burning it away as fuel is very waste-full. The use of natural gas should be encouraged only as feed stock in industry and its indiscriminate use of such purposes as power generation and cement plants should be discouraged. New gas reserves have been discovered recently at Rhodo-I in D.G Khan which should be further investigated vigorously to ascertain the reservoir capacity and future economic use.

9.17. At present, 16,800 tons of liquid petroleum gas (LPG) is being produced at Dhullian. Recovery and use of LPG should be increased as fuel for transport sector and as domestic fuel replacing the use of kerosine oil which is in short supply.

Coal

9.18. The coal produced in Pakistan is of low quality. It has a high percentage of sulphur and ash and low content of fixed carbon. It is not, therefore, suitable for conversion to metallurgical coke. At present, 90 percent of the coal produced in used in the brick-kiln industry, 5 percent for power generation, 4 percent in fertilizer industry and one percent for domestic uses.

9.19. The total estimated reserves (Table-VI) from the coal mines of Makerwal and Salt range in the Punjab Barani Tract amount to 94 million long tons. The coal production from Makerwal collieries amounts to 1,80,000 tons per year which is about 50 percent of the total coal demand in the area. The balance is obtained from Baluchistan. However, new areas in the Punjab Barani Tract are being developed which will produce 1,50,000 tons of coal per annum within a period of 5 years which may further increase to 3,00,000 tons per annum when additional coal reserves are proved.

9.20. The indigenous coal deposits in Barani area are associated with the tertiary rocks and show high range of variation even within the name bed. This coal has one of the highest moisture contents and its storage is a serious problem as n stock of 4-5 feet lends itself to spontaneous combustion. For this reason the coal should be utilized for power generation near the site as is being done in Quetta, where the coal from Lakhra mines will be used for the purpose. The establishment of a large number of small and medium thermal power stations, based on local coal and supplying the need of the rural industry is the best way to quickly change and develop the economy of the Tract. A higher priority should be given to undertake a feasibility study of the problem.

9.21. At present, 90 percent of the coal is being used for brick-kiln industry. These requirements could perhaps partly replaced by using lime-sand or soil-cement building blocks which do not require much heat to prepare. The coal ------- could be more profitably utilized for fertilizer production and power generation instead of the waste-full use of natural gas for producing thermal power. Better quality coal found in small quantities should be reserved for metallurgical and other industrial uses. Extensive research should be carried out for producing coal gas of high BTU from low grade coal for efficient use of the resource. Besides, exploration and exploitation of the coal reserves should be expanded in new areas and production from the existing collieries should be maximized.

9.22. A review of the coal industry needs to be undertaken with a view to critically examining various cost components particularly aimed at increasing productivity and reducing transport costs. In the context of increased oil prices, and changed price relationship since devaluation the techno-economic prospects of utilizing the indigenous coal reserves should he reappraised. Also considering the relative cost economics, the consumption of cool should be increased by switching back to coal from natural gas to meet the fuel requirements of the industry.

Hydle power

9.23. Supply of the electricity in the Barani arena in from thermal as well as Hydro electric plants. At present Hydle power is supplied from the northern grid centre. The major sources are the power plants at Warsak and Mangla. In the near future, Tarbela will be another major source which has a potential of producing 2100 M.W. of electricity. The entire hydro-potential of Pakistan is dependent upon river Indus and its tributaries, namely Kabul, Ravi, Jhelum and Chenab. The theoretical hydro-potential of Pakistan is about 18,000 M.W. out of which 867 M.W. In presently being utilized and 2,500 M.W. capacity is under consideration for operation by 1985. Hydle power has a share of 7 percent in the total energy consumption pattern of the country.

9.24. The use of electricity is dominated by the industrial sector which uses about 50 percent of the total production. All other sectors such as residential, agricultural and commercial etc., account for less than 20 percent of the total use of electricity. In the agriculture sector running of tube-wells with electricity has been given a priority in recent years but the growth rate in usage matches the overall growth rate.

9.25. Among the short-term hydle projects in the Tract to be completed by 1985, are the Kalabagh hydro-electric project and the Kunhar valley project. Preliminary feasibility studies for the Kalabagh hydro electric station, which would generate 800-1200 M.W. have been completed. It is envisaged that three units of 400 M.W. each would be installed there.

9.26. There is need not only to utilized sites from which large quantities of electricity can be produced which are few, but also to undertake work on a high priority basis for the development of intermediate technology and cheap electricity producing units at village level for the production of hydro-electric energy in the less accessible areas, which cannot be linked with the national grid systems due to high cost of transmission lines. Work is now in progress in developing low cost impulse turbines and water-wheel electric generators which would produce energy for village level use, under Pakistan Science Foundation aided projects.

Nuclear Power

9.27 Nuclear Power, is currently about 0.7 percent of our total energy consumption. In view of the limited fossil fuel reserves. nuclear power would undoubtedly play an increasingly greater role in augmenting national power supplier. Negotiations have recently been completed with France for the setting up of a 600 MW nuclear plant at Chashma in the Tract which will start working by 1979-81. It is intended that a whole complex of nuclear power plants will be set up. The site near Chashma Barrage in Mianwali District has been selected for the complex due to technical, economic and safety reasons. The current proposals envisage 24 more nuclear power plants in the country by the end of this century.

9.28. Radio-active mineralization has been discovered in the Tract at Rakhi Minch. D.G. Khan in the Siwalik sand-stone. Various other localities hove fast, been identified where prospecting is being undertaken for the production of these minerals. It is said that local deposits are sufficient for the requirements of the country.

9.29. The projected economic benefits of the nuclear power plants are relatively high compared to the high prices and scarcity of the fossil fuel. The favorable aspect of the nuclear energy is its lesser dependence on continuous supply of fuel but it requires large initial investments for installation of the plants. However, there are problems of resources, both financial due to the high cost of the plants and of man-power and technological competence to run efficiently and safely a large number of nuclear plants. Other problems are the disposal of the nuclear wastes, but Pakistan shares such problems with the rest of the world where improved less hazardous technology is being rapidly developed.

9 30 Beside, there are several limits to the proliferation of the nuclear energy plants. We are still dependent on world sources for such plants and pressures are very great against the potential suppliers. At the global level, by the end of the current century, it is expected that only about 10 percent of the world's commercial energy would come from nuclear sources. Only a break-through in nuclear fusion could result in a significant difference. Since Pakistan would for quite sometime remain dependent on outside sources for nuclear power plants, it is necessary that we relentlessly pursue all avenues open to us to increase our energy supplies from other local sources.

Non-commercial energy sources:

9.31 Non-commercial energy is an important component of the overall energy system in Pakistan, more particularly in the domestic and farm sectors. As a sub-system in the overall energy consumption pattern it is exceedingly important. Dung, firewood, etc. are gathered by individuals and processed or stored as part of the overall activity of farming and rura.30l life. The low-income group of the urban areas also do the same. The task of fuel gathering is largely manual and with the dwindling of the resources and the increase in population it is increasingly becoming more and more time-consuming and difficult.

Animal duns

9.32. In rural areas, dung is available to the farmers who maintain animals for fate power and for milk. In cities as well people keep animals for commercial purposes. In the rural sector, part of the animal dung is used as manure and the rest for domestic cooking and heating purposes, while in urban areas it is mostly used as fuel, except in a few organized dairy farms where it is sold to be used as manure.

9.33. However, the use of dung as fuel is robbing the fields of much needed organic manure which has to be substituted by chemical fertilizers. The Barani Tract's share of chemical fertilizers at the element is infinitesimal and soil fertility is thus very low. With the exponential growth in population, there is occurring a much greater use of animal dung as fuel since the commercial sources of energy are beyond the financial resources of the mass of the people. The drop in the application of farm-yard manure in crop-land is resulting in the sharp fall in soil fertility in the Tract which is already very low due to water erosion and leaching of the soil and washing away of the top soil. In the more inaccessible parts of rho Tract there is little possibility in the near future of replacing the manure with chemical fertilizers. The replacement of dried cattle dung fuel with bio-gas prepared by fermenting cattle dung and organic term waste, which will provide both energy and manure is, therefore, an exceedingly high priority area for both research and extension.

Fire wood:

9.24. Fire-wood consumed in the country is of two types. One type is the wood gathered from branches of trees and bushes etc. and the other type is wood collected in bulk from the forests which is sold in the market and is used mainly in towns and cities. However, in rural areas and hilly tracts, where no other sources of energy are available, people not only cut their own trees but also cut those which do not belong to them, through illegal means. With the increase in the price of wood, charcoal and alternate fuels, people are indiscriminately cutting and selling trees on a large scale, thus causing extensive deforestation. We are already in the unhappy position of being amongst the countries with the lowest area under forests in the world, the per capita forest area being 0.06 acres in the Barani Tract. Further depletion of the forest resources would be simply disastrous. Extensive deforestation particularly in the water sheds is a major ecological threat not only to the Barani Tract but to the nation as a whole. When the tree cover is lost on slopes, the top soil is washed away and fertility dwindles. The washed away soil must settle down some-where, and the rising load of the silt carried by rivers is choking up expensive reservoirs behind major dams, and filling up irrigation canals. Most threatening of all to food production prospects is a rise in the frequency and severity of floods in the country.

9.35. In the absence of suitable alternative energy sources further demands would continue to be made on fire-wood. The devastation that is being caused in the Barani Tract through water-erosion is due mainly to the cutting down of the tree cover because of the rapidly increasing needs of fuel by a burgeoning population. The continuation of this process at an ever increasing rate is truly frightening and the most urgent attention needs to be given to the problem.

9.36. The firewood needs in the area depend upon the number of people using the fire-wood as fuel. Approximately, fuel wood consumption per capita per year in around one quarter of a ton and works out to around 2.5 million tons of fire-wood annually. The community must be educated to understand that this quantity of wood is no longer available and that new resources will have to be created by establishing energy plantations in every locality. Since the people have traditionally unrestricted and free access to grazing, and wood-gathering, they are apt to view the programme of energy plantation with suspicion or

even hostility. The State should mount a vigorous educational programme through all the mass communication media and use all public forums for the purpose. It should also develop carefully considered research programmes to find out what quick growing species could be planted. The State can provide stimulus, technical advice and financial assistance but the programme of re-afforestation would only succeed if the people themselves are involved.

9.37. Fuel-wood production through governmental efforts is just not feasible. It can only be undertaken through the full participation of the people themselves. Forest services are under no circumstances in a position to undertake the task, except for planning and supervision of the work to be done. The mobilization of the people for fire-wood plantations or energy plantation should be, however, entirely practicable as such schemes have been successfully carried out in a number of countries with the institution of programmes under U.N. auspices such as the World Food Programme. The following are the fast growing trees which could he planted depending on their suitability for flourishing in a given ecological zone:-

1. Acacia cyanophylla (australian acacia) 2. Acacia arabica (Kikar or Babul) 3. Dalbergin sissoo (Shisham) 4. Zizyphus mauritiana (Ber) 5. Melia azedarach (Dhrek) 6. Morus alba (Tut) 7. Ailanthus glandulosa (Tree of heaven) 8. Robinia pseudacacia (Robinia) 9.Eucalyptus tereticornis (Lachi/Sufeda) 10. E. camaldulensis (Lachi/Sufeda) 11. Tamarix aphylla (Farash) 12. Prosopis Spicigera (Jand).

9.38 To give a rough idea of the size of a fuel-wood plantation it is estimated that by the end of the century it would be necessary to produce an absolute minimum of an additional 8 million cubic meters of fuel-wood annually to replace the volume of animal dung used. Assuming that a plantation of quick-growing trees could he harvested after about 10 years to yield some 100 m^3 per hectare, the additional fire-wood needed annually could be obtained from the clear cutting of about 80,000 hectares of plantation. On the basis of a ten-year rotation, the total plantation area required would be of the order of about 800,000 hectares. In terms of the rural man-power needed a project of this size would require some 60,000 man-years in the field. It may be mentioned that the per capita area of forest lands is less than 0.06 acres which is amongst the lowest in the world for the type of climate and land resources. Pakistan must steadily increase the area wider forests

to the recommended 75 percent of total land. The programme outlined above would raise it to about 10% by the end of the century. Forest land is beneficial to rural development not only because of the wood supply but also because of its protective role. If an adequate proportion of land were allocated to forestry there would be less harm to Agricultural development from erosion and flooding and there would be greater stability as regards streams, reservoirs and irrigation installation.

Non-conventional sources of energy

9.39. Non-conventional sources of energy which are receiving world-wide attention are solar radiation, atomic fusion, synthetic fuel from solids and shales, bioconversion processes, geothermal energy, wind energy, tidal energy, and energy stored in under-sea currents etc. Most of these sources of energy require considerable research and development efforts to make them economically viable while others will involve complex technical operations. Considering the prevailing conditions in the Punjab Barani Tract the use of bio-gas and solar energy appear to offer scope for exploitation in the near future. Potential development of these sources is very briefly described in the following paragraphs:

Bio-gas Energy

9.40. About 50 percent of the animal dung which is equivalent to several million tons of superior quality manure is being burnt as fuel, which can otherwise be saved for use to increase soil fertility. Bio-conversion of organic materials, such as animal dung, farm-yard waste, tree leaves, algae and municipal refuse, in a bio-gas plant yields methane gas for burning and the sludge for manure, thus providing a renewable source of energy and fertilizer. Rough estimates are that one ton of dry organic matter can be converted into almost two barrels of oil or about 280 cubic meter of gas and 0.73 tons of fertilizer, through anaerobic fermentation in the bio-gas plant.

9.41. A beginning has already been made in Pakistan on the bio-gas plants using animal dung. The number of large animals in the Punjab Barani Area is around 33 lacs. Theoretically, the dung from these animals could supply energy equivalent of one nuclear power station

of 400 Megawatts. There is certainly the potential to harness energy from about 25 percent of the livestock droppings. If processed through bio-gas plants it will not only yield three million cubic meters of gas per day but also about 4,38 million metric tons of wet manure annually. This would mean about two-third of a ton of valuable organic manure per acre of cultivated land with increased soil fertility. The area could easily wipe out its chronic food deficit. In fact manure and gas produced in the plant are available at their peak efficiency as for the same volume 43 percent more manure and 20 percent more heat are produced. Research is in progress to make the plants cheaper and more efficient.

9.42. According to the statistical data available about 20 Kg of dung is produced by one animal unit. One Kg. of fresh dung produces 0.05 m^3 of gas. The gas required for cooking and lighting needs per person per day is 0.6 m^3 and 0.45 m^3 of gas is required for an engine per H.P. per hour. Accordingly, a farmer with 6 family members having 8 heads of cattle who installs a bio-gas plant can meet his energy requirements for cooking and lighting. Besides he can use the gas for running a water pump of 3.H.P. for about an hour a day. Initial cost for the installation of plant, amounting to Rs. 5,000/- would be paid back in a period of 2-3 years in terms of fuel, fertilizer and higher grain production and all through simple, non-technical local labour. Therefore, wide use of bio-gas plants in the rural areas should be encouraged and government should give subsidies for The purpose on the same principle on which initially subsidies were given for fertilizers. Banks should also be induced to given loans to the farmers for the installation of bio-gas plants.

9.4. Another important advantage of installing bio-gas plants is the safe disposal of all sorts of organic wastes. There are more than 100 diseases naturally transmitted between animals and man and dung and manure carry multitude of dangerous micro-organisms. The anaerobic fermentation destroys all disease organisms and parasites and makes the environment safe for man and animals. The surroundings of the bio-gas plants are free from fossil smell, mosquitoes and flies which generally hover on the dung cakes left in the streets for drying. The plants therefore, could be installed near the residential areas and provide a cleaner and healthier atmosphere. This aspect as well needs attention besides other multi-purpose uses of the bio-gas plants.

Solar energy

9.44 In a world fast running out of fossil fuels and also highly dependent on them, development of solar energy has great potentials for the future in the long run. The fuel in this case is free and is not going to runout.

9.45 Pakistan is situated between 24N° and 37° latitudes which covers a sunny belt of the subcontinent. This energy when converted to heat below 95C° has the efficiency between 40 to 50 percent and can be used for water heating, air heating for crops, fruit and fish dying, desalination of brackish water, industrial process heating, house heating and cooking. Conversion of solar energy for power generation has an efficiency lying between 3 to 15 percent. On the whole the solar energy can provide between 40 to 60 percent of the total energy requirement but the system always has to be boosted up with alternative source of energy when it is cloudy or at the night time when there is no sun

9.46 The technical feasibility of harnessing power from the sun is no longer in doubt and the technological possibilities of solar energy are immense. However, the cost involved is still high and the technologies have still developed so that the energy can be made available at a cheap price.

9.47 At present applications of solar energy for domestic cooking and water heating appear water feasible and should be encourages. However, significant technical break-through is required before solar energy could be used cheaply for electricity generation to overcome the energy defect.

N.s.: Table I. II. III. IV. V and VI referred to in paras 9.6, 9.7, 9.10, 9.15 and 9.19 are given on the following pages.

TABLE-I

Energy Consumption System of India-1946

Total population	387 million
Total Energy Consumption	154 MTCE (Million Tons of Coal Equivalent)
Energy consumtion per capita	400 kgCE (Kilograms of coal equivalent)

Source-Wise Energy Consumption

Source	Total MTCE	Per Capita kgCE	Percent
Coal	29	75	19.00
Oil	8	21	5.20
Wood	6	14	3.60
Dung	111	290	72.20
Total	154	400	100,00

TABLE – II

ENERGY CONSUMPTION PATTERN OF PAKISTAN 1947-75

Total population	70 million
Total energy consumption	30 MTCE (Million Tons of Coal Equivalent)
Per capita energy consumption	430 kgCE (Kilograms of coal equivalent)

Source-Wise Energy Consumption

Source	Total MTCE	Per Capita kgCE	Percent
Oil	6.0	86.0	20.00
Gas	4.4	61.0	14.50
Coal	1.6	23.0	5.30
Hydro-electricity	2.17	30.0	7.00
nuclear	0.2	3.0	0.70
total	14.37	205.0	47.50

Conventional dung from waste and wood etc	16.00 30.37	228 433	53.50 100.00

Table –III

Estimated energy requirements of Pakistan in 2,000 A.D.

Total population	125 million
Total energy consumption	14 MTCE (Million Tons of Coal Equivalent)
Per capita energy consumption	1144kgCE (Kilograms of coal equivalent)

Source-Wise Energy Consumption

Source	Total MTCE	Per Capita kgCE	Percent
Gas	50	400	35.0
Electricity Oil Coal	29 27 15	932 216 120	20.3 19.0 10.5
total	121	968	84.8
Conventional dung from waste and wood etc	22	176	15.2
Grand total	143	1144	100.0

Table – IV

Crude oil reserves and Production as of December 31, 1974

Filed and formation	Oil in place MBBL*	Original recoverable reserves MBBL*	Cumulative production MBBL*	Remaining reserves MBBL*
Balkassar: Bhadar				

Sakesar				
Proved:		30,200	28,245	1,955
Probable		1,400	_	1,400
	140,000	31,600	28,245	3,355
Dhulion: Saki-Raniko-Jurrasic				
Proved:		40,100	39,163	937
Probable		1,700	_	1,400
	93,000	41,800	39,163	2,637
Joya-Mari				
Proved:		4,700	4,005	695
Probable		700	_	700
	25,000	5,400	4,005	1,395
Mayal: Chorgalli Sakesar				
Proved:	29,300	14,600	4,129	10,471
Probable	22,600	11,300	_	11,300
	51,900	25,900	4,129	21,771
Jurassic				
Proved:	3,900	1,000	550	450
Probable	15,300	3,800	_	3,800
	19,200	4,800	550	4,250

- Thousands of barrels

Table – V

Natural Gas Resources and Production As Of December, 1974

Filed and formation	Gas in place MMCF*	Original recoverable raw gas reserves MMCF *	Cumulative production MMCF *	Remaining marketable gas reserves MMCF *	Remaining reserves MMCF *
Non associated gas					
RHODO					
Proved:	4,400	3,200		3,100	3,469
Probable	14,600	10,200		10,200	11,224
	19,000	13,400		13,000	14,693
Associated Gas					
DHULLION					
Proved:	341,200	153,700	139,100	14,600	15,000
Probable	58,800	26,522	_	26,500	27,347
	400,000	180,200	139,100	41,100	42,347
HEYAL					
Proved:	139,600	60,100	19,200	40,900	42,143
Probable	224,500	75,700	_	75,700	78,061
	364,100	135,800	19,200	116,600	120,204
TUT	61,400	32,900	4,600	28,300	34,694
Total Associated Gas					
Proved:	542,200	246,700	162,900	83,800	91,837
Probable	283,300	102,200	_	102,200	105,408
	725,500	348,900	162,900	186,000	197,245
Total (Associated + Non-Associated)					
Proved:	546,600	249,900	162,900	86,900	95,306
Probable	297,900	112,400	_	112,400	116,632

Total	844,500	362,300	162,900	199,300	211,938

*million cubic feet

Table –VI

Punjab Barani Areas Coal Reserves (Million long tons)

Coal Field	All categories in place	Assigned heating value BTU/LB	Rank	Estimated Economic Recoverable Reserves
Makarwal	19	9.000	Sub-salt	10.2
Salt range	75	8,500	Sub-B Sub-C	10.4

Source: Geological Survey of Pakistan (1975)

Chapter – X

MINERALS

10.1 The Punjab Barani tract is rich in minerals resources:

Almost 90 percent of the known minerals wealth in the Punjab is located in the tract. At the time of the dissolution of one unit about 41 percent of the total number of prospecting licenses and mining leases were in the Punjab Barani Tract and about of the total royalty of solid minerals occurred from this area.

10.2 The development of the minerals wealth of the nation has however been very sadly neglected. This is reflected in the very low contribution of this sector which is only about 0.5 percent of the gross national product compared to for example 5.4 percent in Turkey and 9 percent in the USSR. This is basically due to the historical neglect in developing the resources and wealth of the part of the subcontinent now constituting Pakistan and particularly its less developed areas. Even after independence there has been no significant improvement in building national technological capability in this field and the country is dependent on outside help and technical assistance which can at best be only marginal.

10.3 The minerals are found in some of the more backward parts of the Barani Tract and in many cases are the only resources which could provide higher income and could form the basis of the prosperity of a people who would otherwise remain poor and deprived, if these resources remain under-developed. They occur in mountainous parts of Kala Chitta Range, Potwar, Salt Range in the districts of Campbellpur, Jhelum, Sargodha and Mianwali and also in the confines and the flanks of Suleman Range in the District of Dera Ghazi Khan.

10.4 The institutional structure in the country for THE exploration of the mineral wealth as well as its utilization is very weak. The only agency working in the field with ant sizeable resources in scientific man-power and logistic support is the Geological Survey of Pakistan. There is a federal government Board for mineral coordination. A Pakistan mineral development

corporation was established in 1974. The Punjab Government also created a Mineral Development Corporation on 1975. These institutions are however, still embryonic. The utilization side is even weaker. The Pakistan council of Scientific and Industrial research which has the responsibility to undertake research and develop processes for the utilization of mineral wealth has not been able to make any significant contribution because of its lack of field orientation. The fourth five-year plan listed some 20 minerals whose reserves have been proved by the Geological Survey of Pakistan but even now we are importing the products of many of these minerals. Many of our minerals deposits are low grade. Research work and pilot plant studies are needed for their beneficiation

10.5 it must be understood clearly that the future prosperity of the people of Pakistan, the province of the Punjab Barani tract rest on large measure on its rapid industrialization which in turn would depend largely on adequate supplies of minerals. In fact, even for the little progress we have achieved in industry, we have characteristically relied not only on the import of technology and the machines for the factories but have also been importing numerous minerals raw materials to run these industries as we have not been able to develop our own mineral resources. Apart from the huge amounts spent on oil imports, we spend over Rs.200 crores on the import of metallic minerals only. The lack of such raw materials has been a major constraint in the development of numerous industries.

10.6 There is an extreme shortage of high level manpower to work in the field of mineral exploration and mineralogy. We are dependent essentially on foreign institutions for training our man-power. The few trained men that we have are under continuous temptation to leave the country as new unlimited job opportunities exist for scientific workers in this field in the neighboring oil countries.

10.7 The technical capability of the nation is also very modest. Our knowledge of newer techniques is limited and we lack in suitable instruments. Remote sensing techniques for example comprising serial geo-physical surveys, scintilla-metric studies, infra-red and extensively employed by the advanced nations for exploration of mineral resources. Using remote sensing techniques other were able to advise us of the location of huge deposits in Baluchistan. We need extensive aero-magnetic surveys to locate ferrous metals needed for our

nascent steel industry. Factors which will continue to retard the progress of the sector include shortahe of technical manpower, inadequate labortaries and the inaccessibility of potentially rich areas. The importance of an adequate scientific/technical base for the development of this sector has not been realized. There is need to greatly stregthening all the universities in the province fore researh and advanced studies in the disciplines related to mineral development and for the creation of specialized research units/establishments to undertake work on specific problems.

Deposits and Production

10.8. The known minerals deposits in the tract include:

a. salt mines at Kewera, Warcha and Kalabagh

b. coal at dandot and in sargodha and Mianwali districts

c. limestone and gypsum in Jhelum, Mainwali and D.G Khan districts

d. iron ore at kalabagh and rakhi Munh and

e. Bauxite at Khushab and in Kala chitta Range. Various types of industrial betonite, fireclay, china-clay and fuller's earth are also available.

10.9. In addition to the above known deposits the presence of a number of other minerals has been detected in various parts of the Tract which need detailed survery and investigation. These include laterite deposits near Fort Munro in D.G Khan (which may also have deposits of Nickel and Titanium), oil shales near Rakhi munh, Gorge and Zinda pir in D.G Khan, China Clay deposits in district Campbellpur and potash, sulphur and other evaporite minerals in the Salt range. A proposal to revive a former WPISC project for recovering brine from a slite near dhaiala, District helum is also being considered. This brine is reported to conein potash salts which can be used for production of fertilizer.

Production:

10.10. The production of minerals in the Tract during the last three years is given in table-I. The estimated value at constant price of the minerals produced 1973-74 was Rs.110 Million as compared to Rs.80 million during 1972-73 and Rs.70 Million during 1971-72. The figures for mineral production mentioned above are probably under estimated as it is likely that the production is under-reported by the private sector to avoid payment of government royalties.

10.11. Only a small part of the minera wealth has been partly explored and is being utilized and there is little doubt that huge qualities of this wealth still lie hidden indicating the need to mount a vigorous resource exploration endeavour. For example, uranium mineralization.

Table-I

Production of minerals in the Punjab 1972-73 & 1973-74

S.No.	**Mineral**	**Production Tons**		
		1971-72	**1972-73**	**1973-74**
1.	Bauxite	138	506	325
2.	Bentonite	662	411	394
3.	Chinaclay	2,406	20	294
4.	Coal	360182	309,492	329,500
5.	Dolomite	98	Nil	N.A.
6.	Fireclay	21,007	18,089	12,306
7.	Gravel	8,728	8,250	13,107
8.	Gypsum	16,335	126,091	35,610
9.	Iron ore	Nil	Nil	N.A
10.	Limestone	866,589	715,249	512,401
11.	Marble	47	6	N.A
12.	Ochres	454	495	581
13.	Ord. Stone	700,039	286,022	223,422
14.	Ord. Sand	20,478	3,056	12,120
15.	Rock Salt	310,183	294,561	236,910
16.	Silica Sand	28,926	10,873	17,019

has been discovered in the sand stone beds of Siwlik formations in D.G Khan. A team of Pakistani and American geologists has recently discovered indications of large depostits of Potash and Sulphur in 900 sq. miles area in the middle of Salt Range. The Tract abounds in what are called, non glamorous minerals. These minerals though important in their own right are taken for granted and not much attention is given to them. These very common place minerals claim for the running of multibillion industries in the advanced countries of the world and are in no way un-important in our setup. Besides these minerals the Tract has sizeable resources in oil and gas which are dealt within the chapter on energy. A long description of the more important minerals found in the Tract is given below: _

Coal:

10.12 In the Barani area of Potwar - salt Range coal seams are exposed both in Cis and Trans Indus Range. The coal is of indifferent quality and is classed. The coal needs special treatment for extracting bye-prodcucts that are being wasted. The history of coal mining in the tract dates back to the last two decades of the last century. After independance the necessity was felt of increasing the coal production in the known fields of the Punjab and other provinces and its better utilization and efforts made to evaluate the total resources.

10.13. Coal beds of economic significances are found enveloped in the Cis and Trans Indus Salt range Indus Salt Range and also under the cover of Potwar Plateau. The coal belt extends from about 20 miles northe of khushab to about 15 miles north east of Khewra covering an area of over one hundred sq, miles. The belt comprises a number of areas where coal in workable thickness is present. At or near out-crop, the coal seam is being mined. The Bandot coal seams ranging in thickness from a few inches to about five feet is present in the whole of the salt range. It occurs in the lower part of patala Shake of Eocene age and is overlain by massive sakesar limestone. The original estimates by n.M khan (1950) of all the categories for this field has been 75 million tons over an area of 50 sq. miles. Proving of reserves in other areas needs drilling and detailed geological investigation. There are blocks of plateous which enavle the opening of numerous small out-crop working. Most of the mines have commenced operation from the outcrop and their workings are restricted to the shallow depths only. A much greater proportion of potential still remains to be extracted.

10.14. The makerwal coal field extends from about two miles of makerwal to about 8 miles west of kalabagh covering an area of abput 8 miles of kalabagh covring an area of about 30 sq. miles. The coal occurs in a single bed ranging in thicknes from 2 feet to 10 feet and averages 4 feet in greater part of the makerwal area. The field is structurally complex and a big fault greatly affects the mining operation. Most of the output in the past has been from the mines that were developed on out-crop. The present day production by the Pakistan Mineral Development Corporation of about 1000 tons per day is from the deeper reserves through a newly completed mile long low-level haulage tunnel. The measured or proved reserves of 1.9 million tons include reserves that occur above permanenet water table in the Makerwal coal fields. All categories of reserves to a depth of 200 feet below sea level have a total reserve of 19.2 million tons. The Makerwal coal is classed as sub-bituminous inrank. It has fixed carbon content of about 36 to 43 percent, Ash content 7 to 21 percent, sulphur content 4 to 5.6 percent. It has a range of calorified value of 9,550 to 11,850 B.T.U. The coals from Makerwal and some from Salt range contain high contents of resins, which make it distinctive from others.

10.15 The reserves of coal in Cis and Trans Indus Salt range are given below: _

S.NO.	Local	Workable are in Sq. miles	Average thickness of seam in feet	Workable probablre reserves million tons (1949)
1.	Area	5	2	7.68
2.	Rakh makhiale	12	2	18.81
3.	Drengan Diwan	9	2	13.80
4.	Watli, Manihala Nabi	3	2	4.60
5.	Dandot, Pidh, Ratucha	7	2	10.75

6.	Chitil Dand	4	1 1/2	3.07
7.	Dalwal	4	1 1/2	3.45
8.	Murpur	3	3	3.68
9.	Dak Katha	3	2	5.76
10.	Dil Janna	2 1/2		3.84

Production tons

1969-70	1970-71	1971-72	1972-73	1973-74
399,450	347,589	360,182	309,492	350,364

10.16. The coal in the Salt Range area has been classed as lignite or Lign-bitumous in rank; is high in ash and sulphur content and very variable in composition. It deteriorates badly during storage and is liable to spontaneous combusttion during hot weather. But it contains high resin content which merits special attention.

10.17. The coal in the Tract contains higher proportion of hydrogen than would be expected from the rank or carbon content. The result is that they igite readilty and produce high proportion of volatile matter when heated. Large storages are therefore impossible because of the dangers of spontaneous combustion. The best way to utilize such coal would be to have a large number of small thermal electric power plants fired with local coal. This emergy could be the base of small-scle rural industry on the tract.

10.18. When used as a fuel the latter point is a dis-advantage since large volume of smoke is produced in the initial stages of combustion, but in the carbonization process the reverse is the case since high yield of gas and liquid products are obtained. Consequently, if it proves possible to evolve a commercial process for preparation of a solid carbonized product such as carbonized briquettes from any of the Pakistan Coal, the yield of gas and bye-products obtained will be higher than for example with British Coal.

10.19. The one reason for high hydrogen content of the coals is that they contain relatively high proportion of resins. From the high proportion of hydrogen present in many Pak coals and the indication of resinous inclusions that may be observed in the lump coal. It was anticipatd that large yields of resins could be obtained by extraction with organic solvents. This fact has been borne out by subsequent experimental work which has conferened the view that economic extraction of the resin us possible by solvent extraction and a yield of 12 percent resin can be expected.

10.20. The resin so obtained from the salt Range coal be utilized in the manufacture of warnish and paints and the residue can be carbonised fuel which could be briquetted for other purposes.

Limestone

10.21 Limestone when pure is carbonate of Lime ($CaCO_3$). But in general it does not occur in such a pure form expect in crystals of calcite. Generally limestone contain impurities in the form of magnesia, iron oxide, aluminia, silica and occaisionally phosphorous and sulphur. In the commercially usable limestones, the lime (CaO) content may vary between 22 to 56 percent, the rest being impurities.

10.22. Limestine has been used for various purposes since times immorial. During the present day. Limestone besides being used as building stone, is the principal raw material for the manufacture of cement. It constitutes about 80 percent of ther raw material needed for cement manufacture. Limestone after calcination (in the form of lime) is extensively used for chemical and industrial purposes of construction. By far the greatest number of uses of lime are chemical and industrial. It is used in steel manufacture, ore concentration, refining of base metals, petroleum and sugar. Liime is also used in the manufacture of alkalies, calcium carbide, insectisides, bleaching powder, paper, glass, leather goods, varnishes and petro-chemicals. In agriculture, it is used for soil neutralization and conditioning. It is used as refractory and reducing agent in metallurgical industries. Besides these, it is used in treating wastes and sewerages. In short limestone is a very versatile material which plays a very important part in the complex of present-day industrial civilization.

10.23. High grade Limestone occurs in unlimited quantities in Potwar, Kala Chitta Range and the Sulaiman range in the Tract and is in the vicinity of rail and road communications as such is accessible for any industrial development. Most of these easily accessible deposits are suitable for the manufacture of Portland cement and soda ash.

10.24 The division-wise discription of major limestone deposits is given below (Cowhar, 1966)

a) Cis - Indus Salt Range area
b) Trans - Indus Salt Range area
c) Potwar area
d) D.G Khan area

10.25 The thick limestone and marls associated with thick palaecene and Eocene rock units near Beth. Baghanwalaw to Jaba Nala and near Ara for a distance of 110 miles are generally called the Sakesar Limestone which overlie the shales in which Dandot coal seam is include.

Thickness near Dandot	250 Ft. (approx)
Thickness near Nurpur	400 Ft. (approx)
Thickness near Sakesar	550-600 Ft. (approx)
Thickness near Nammal	650-700 Ft. (approx)
Thickness near Jaba	600 Ft. (approx)
(East of Daudkhel)	

Analysis of typical Salt Range Palaecocene and Eone Liemetone.

	a	b	c	d	e	F	g	h	i	J
	%	%	%	%	%	%	%	%	%	%
SiO_2	3.0	7.90	8.16	1.10	3.84	1.84	1.94	2.22	0.30	5.32
FE_2O_3	1.52	2.57	2.20	.80	1.00	0.24	0.21	0.80	0.20	0.84
Al_2O_3						0.52	0.28		0.16	1.98
CaO	50.19	45.24	47.27	54.42	49.52	54.40	53.34	52.96	55.25	46.64
MgO	4.40	2.53	0.52	0.38	3.38	0.15	0.96	0.54	0.42	3.68
Loss on ignition	40.47	41.42	40.09	43.13	42.38	42.38	42.48	42.97	42.88	40.63
	99.59	99.58	98.34	99.83	100.09	99.53	99.21	99.49	99.21	99.09

a) Sakesar Limestone from near Choa Saidan Shah
(32◦ 43′ : 72◦49′).

b) gray Shaley limestone or normal limestone of noraml Lime-stone-shale stage just below the namnal dam
(32◦ 40″ : 73◦06″).

c) Sakesar limestone from near Basharat (32◦ 42′ : 73◦06′)

d) Sakesar limestone from 1 ½ miles S.E. of Mari Indus station.

e) Sakesar limestone from near Dandot (Analyzed by Messer Bird and Co. Ltd.)

f) Khairabad Limestone from east of Daudkhel.

g) Hard grey Khairabad limestone from ½ mile S.S.E. of Mari Indus Station (Analyzed by Messer Bird and Co. Ltd.)

h) Soft Khairabad limestone from M.E of Daudkhel.

10.26 (ii) The late Jurassic limestone occurs only in the western part of the salt range in the Sargodha division and important economically within the Mianwali City. Further investigations may reveal more of this limestone.

Analysis of typical Salt Range Late Jurassic Limestone.

	Specimens ½ mile E. of Khairabad	Specimens from near Mari Indus
SiO_2	1.52	1.97
Fe_2O_3	1.55	0.92
Al_2O_3	1.55	0.92
CaO	53.10	53.13
MgO	0.33	0.42
Loss on ignition	42.57	41.80
Total	99.07	99.04
Sp. Gr.	2.718	…

10.27 (iii) The middle products limestone from the other escarpments in the Salt Range. It is found in the gorges of the Tredian Hills and just south of Khairabad. Bearing in the mind the extent of the deposits, the reserved are more or less unlimited.

10.28 The analysis of four samples collected from three different places in the salt range are as follows

CaO	53.88 – 55.00 %
MgO	0.04 – 0.76 %
$Al_2O_3 + Fe_2O_3$	0.40 – 0.78 %
SiO_2	0.22 – 1.98 %
Loss on ignition	42.70 – 43.80 %

Sp. Gr.	2.67 – 2.72

Trans – Indus Salt Range area:

10.29 (b) In continuous of the salt range: _ west of the Indus, the Nummulite and late Jurassic Limestones from regular outcrops, the former as far as Mitha Khatak (32◦ 48′: 71◦10′) and the latter to the Makerwal locality (32◦ 52′ : 71◦09′). Their thick nesses are on the whole appreciably greater than to the east of the Indus.

10.30 The most accessible outcrops, near the railway, are those of Kalabagh and of Makerwal – Maila Khel area. At Makerwal, the Nummulite limestone occurs in unlimited quantity in the basal of slopes as well as in the upper parts of the range whilst large outcrops of the late Jurassic Limestone are seen near the exists of Makerwal and Miranwali gorges, all within two miles of the railhead at the colliery depot.

Analysis of Limestones from the Tans-Indus Salt Range

	A	B	C	D
	%	%	%	%
SiO_2	5.06	1.83	2.56	1.17
Fe_2O_3	2.34	1.36	1.46	1.53
Al_2O_3	2.34	1.36	1.46	1.53
CaO	49.61	53.630	52.91	53.41
Mgo	1.57	0.54	0.54	0.72
Loss on ignition	41.93	42.89	41.64	42.20
Total	100.51	99.92	99.11	99.03
Sp. Gr.	2.66	2.63	…	2.73

(a) (b) Nummulite limestone from near Makerwal

(c) Late Jurassic Limestone from near Mala Khel

(d) Late Jurassic limestone from Sheikh Badin Hill.

10.31 A recoverable tonnage of 966 million of medium and good quality limestone has been proved near Chichali and Kalabagh areas and another 9.3 million tons near Mari Indus in Cis Indus Salt Range.

Analysis of limestone show the following variation:

SiO_2	44.16 – 53.81 %
Fe_2O_3	1.14 – 3.83%
Al_2O_3	0.25 – 0.4 %
CaO	0.39 – 0.95 %
Mgo	0.4 – 13.2 %
Loss on ignition	37.42 – 41.33 %

Potwar area:

10.32 (e) On the northern side of Potwar area in the foot hills of the Himalayas, Limestone from prominent hill outcrops. They include Late Jurassic limestone of Kala Chitta and neighboring hills together with Nummulite limestone as large inliers cropping out among the Siwaliks and the alluvium. One important outcrops is just south of the railways near Tarki.

The chemical analysis gave the following range.

Total insoluble	R_2O_3	Fe_2O_3	CaO	MgO	Loss on ignition
0.44 – 13.18	0.10 – 3.86	.02 – 2.85	43.18 – 54.11	0.14 – 3.97	35.77 – 43.99

10.33 After excluding the exposures of undesirable material, Bhatti (1966) has estimated a reserve of 820.4 million long tons of good quality limestone from the southern face of Marghala Hills between the G.T Road and Saidpur.

Limestone in D.G Khan:

10.34 (d) Limestone in Multan Division occurs only in the Dera Ghazi Khan District. Total available reserves of Limestone near Taunsa area, one mile north and one mile south of Sori nala with a workable thickness of 100 feet, are estimated at more than 8 million tons.

The average analysis show the following variations:

Insoluble matter	6.5 – 18.6 %
R_2O_3	1.0 – 3.0 %
Fe_2O_3	0.4 – 1.7 %
CaO	43.0 – 52.0 %
MgO	Traces to 2.87 %
Loss on ignition	36.0 – 42.0 %

Production:

10.35 Limestone is quarried for lime burning for use in buildings and also for making cement and soda ash. Good deal of limestone is also quarried for road metalling. Record of production is generally not properly maintained. The figures of Production of limestone mostly deal with limestone produced by industrial concerns and Govt. agencies. The production figures for the last five years are given below.

1969 – 70	1970 -71	1971 – 72	19721 – 73	1973 -74
846,985	861,378	886,589	715,249	641,709

Dolomite:

10.36 Dolomite is a double carbonate of calcium and magnesium with an theoretical composition of CO_2 – 47.7 %, CaO - 30.47 % and MgO – 21.9 %

10.37 It is extensively used in the metallurgy of iron and steel furnaces. Clinkers dolomite is used for the construction of foundry bottoms and the granulated calcined dolomite acts as protective cover to the refractory brick linings of the furnaces.

10.38 Dolomite or magnesium limestone in general occurs in association with limestone sequence of sedimentary rocks. These rocks are associated with rock sequences exposed in the salt range escarpment, in the Kala Chitta range and also in the Surghar range of Kalabagh and Makerwal.

10.39 All of these geologic horizons of dolomite rock are easily accessible and amenable to easy working. However, exposures of dolomitic rock in the salt range and Surghar range are being worked on a small scale by PMDC. Dolomitic rock exposed in Khisore range in the form of Kingrali dolomite and flaggy dolomite of gypsum groups near Kahuta are remotely located and are away from lines of communications and also from possible places of consumption.

10.40 Kingrali dolomite occurring at the base of Surassic sequence has the following chemical composition.

SiO_2 – 0.88 %, R_2O_3 – 1.66 %, CaO – 31.05 %, MgO 20.11 % and loss on ignition 46.24 %

10.41 Surghar range of Sargodha Division is ideally situated near the iron ore deposits of Kalabagh and also near the iron ore deposits of Kalabagh complex of Daudkhel. In this range Kingriali dolomite beds are exposed and extend for a distance of about 40 miles between Mullakhel to kuch. The dolomite is about 220´ to 330´ thick and is fairly good and is connected by road and rail links with the main towns of the area viz. jalalpur, Kalabagh and Mari Indus.

The following blocks of reserves have been demarcated: _

(i).	Datta	–	12 miles N.E. of Jalalpur	=	242 million tons
(ii).	Narma-Punnu	–	8 miles N.E. of Makerwal	=	202 million tons
(iii).	Doya Lundu	–	17 miles N.W of Jalalpur	=	295 million tons
(iv).	Barbare deposit	–	3 miles of kalabagh	=	Small reserves

10.42 All the deposits are high grade and contain 20.3 percent, 20.2 percent, 21.6 percent, 21.8 percent MgO respectively. The total reserves of the area are more than 921 million tins which is more than ample fir the requirements for proposed iron and steel industry for a long time to come.

Gypsum

10.43 Gypsum is one of the few minerals that occur in abundance in Pakistan. After independence, its primary use has been confined to the cement industry. In 1958 however, its most important application as industrial raw material started as a primary source for the production of ammonium Sulphate in the fertilizer factory at Daudkhel in Manwali District. Since then, its other industrial uses

have also started increasing viz. in the manufacture of plaster of Paris at Karachi and Khewra.

10.44 Gypsum is hydrous sulphate of calcium (CaSO4 2H2O). The anhydrated variety is known as anhydrite (CaSO4). Its clear crystalline variety is known as selenite. The fibrous type is alabaster. Alabaster is light in color and translucent and is used in statuary.

10.45 Gypsum is mainly used in advanced countries of the world for the production of Plaster of Paris. Plaster of Paris has many used in the form of building plaster, molding plaster, decorative, plaster board, plaster for surgical and dental work. Three to five percent of gypsum is ground with cement clinker for retarding setting time of cement. It is used in paint, paper and textile industries as filler. Inferior quality ground gypsum is used on soils deficient in sulphate and thus improves the soil. Calcined gypsum is molded into black board chalk and crayons. Anhydrite and gypsum are now being increasingly used for the manufacture of sulphuric acid. This use of gypsum and anhydrite is of particular interest to Pakistan as native sulphur available in the country is imported from abroad to meet the growing industrial requirements. In Pakistan, gypsum is primarily used for the manufacture ammonium sulphate, a much needed fertilizer for increasing the productivity of the soil and also in the cement industry. Recent gypsum has proved to be very useful as soil additive to counter-act salinity in the water logged areas. Demand of gypsum and anhydrite for salinity control will increase directly in proportion to the area reclaimed by tube wells.

10.46 Sizeable deposits of gypsum occur in different parts of the country. The more accessible and economic deposits occur in the greater part of the southern escarpment of salt range. In Sargodha and Rawalpindi divisions associated with salt range formation of pre-Cambrian age. Multan division, large deposits of high grade gypsum occur on the eastern flank of Suleiman range in the districts of Dera Ghazi Khan forming part of sequence of Eocene rocks.

10.47 Cambrian gypsum and anhydrite beds are found associated with marl beds and Bhandar has gypsum member of Salt Range Formation. The gypsum beds which very in thickness from few inches to several feet, are inter-bedded with marl and dolomite beds. About 100 feet thick gypsum beds are exposed north

of Khewra in Bhandar Kas nala. The deposits of Cambrian gypsum and anhydrite are located at Jutana, Khewra, Makrach, Warcha, Chidru and Buri khel and other places on the southern slope of salt Range. These places have easy access to the railway line running south of salt range scarp joining Malakwal junction with Mari Indus and Daud Khel.

10.48 Eocene gypsum and anhydrite deposits are located N.E. of Daud Khel. These deposits are in the form of four hills. These deposits of massive gypsum are associated with Eocene Limestone and clays.

10.49 The drilling has proved the presence of anhydrite in the core of a hill which is at present being mined by PMDC

The reserves of gypsum and anhydrite are as follows: _

Total proved reserves in Salt Range	=	131 million tons
Daud Khel : Gypsum & Anhydrite	=	45.274 million tons
Daud Khel proved Anhydrite	=	16.026 million tons
Daud Khel : Gypsum and Anhydrite	=	2.367 million tons
Chidru : Gypsum	=	0.427 million tons
Warcha : Gypsum	=	0.439 million tons
Jabbi : Gypsum	=	0.168 million tons
Makrach : Gypsum	=	0.500 million tons
Dandot : Gypsum	=	0.738 million tons
Khewra : Gypsum	=	63.750 million tons
Jutana : Gypsum	=	1.700 million tons

10.50 The average percentage chemical analysis of important deposits are given below: _

Constituents	Khewra	Daud Khel		Jutana
		Gypsum	Anhydrite	
Insolubles	0.18 – 1.40	0.60	0.40	0.16 – 0.40
R_2O_3	0.20 – 1.60	Trace	0.30	Trace - 0.20
CaO	31.50 – 39.81	32.20	39.84	32.20 – 33.20
MgO	1.08 – 2.80	0.28	1.08	0.72 – 2.42
SO_3	42.0 – 56.0	45.20	56.75	43.10 – 45.13

HO_2	1.12 – 19.47	20.27	0.30	16.67 – 18.90
CO_2	1.20 – 4.60	0.70	1.10	2.50 – 4.47

Eocene gypsum in Dera Ghazi Khan District:

10.51 Extensive deposits of good quality gypsum exists in the form of thick sedimentary bed in the rock sequence exposed on the flanks of anticlines and synclines that form the lower reaches of Suleiman Range and its eastern and western flanks.

10.52 Gypsum deposits occur in Baska Shake of Eocene age. Gypsum beds are exposed on or near the surface in the Zinda Pir and Rakhimunh Anticline areas. Its northern most outcrops are exposed in the Zinda Pir Anticline in Sanghar Lahar about 7 miles west of Taunsa. From this point the gypsum continuously extend towards south up to Vidor Nadi about 11 miles from Dera Ghazi Khan.

10.53 The most easily approachable deposits occur in the Haft Chat Nai, Mohai Nadi which are only 10 and 12 miles respectively from Shadien Lund railway station. The deposits in the vicinity if Rakhi Munh occur about 40 miles from Dera Ghazi Khan near the main Fort Munro, Dera Ghazi Khan road.

The reserves of gypsum in the area have been estimated at : _

1.	Eastern flank of Zinda Pir anticipate	=	27 million tons
2.	Western flank of Zinda Pir anticipate	=	12 million tons
3.	Rakhi Munh area	=	27 million tons
	Total:	=	66 million tons

Production:

10.54 Production figures for gypsum produced in the Punjab (Barani Area) during the last five years is given below in long tons:

1969 – 70	1970 – 71	1971 – 72	1972 – 73	1973 – 74
86.390	163.695	16.335	126.091	146.819

Rock Salt:

10.55 Rock salt is the commercial name of mineral halite, a chloride of sodium (NaCl). It is one of the most important numbers of evaporite series of minerals crystallized as a result of evaporation of sea water in an enclosed sea or cut-off water body.

10.56 Salt is one of the few minerals that occur in abundance in a number of countries of the world. It has been used by man since times immemorial. Besides its culinary and domestic uses, it has been put in a number of industrial and other uses. In chemical industry, alt is the essential raw material for the production of sodium carbonate (soda ash), chlorine, sodium sulphate, sodium cyanide, sodium per-oxide and metallic sodium and also in the manufacture of soap, dye stuff, dying, finishing of fabrics, refrigeration and glazing of earthen ware. It is used for soil stabilization and as fertilizer for crops like sugar beet.

10.57 Caustic soda which is primarily produced from salt is used in the manufacture of soap, wood pulp, rayon, aluminum and also in the refining of minerals and vegetable oils.

10.58 In Punjab, in the Barani area of salt range. Potwar region the rock salt occurs at the base of rocks of Cambrian age and extends for scores of miles beneath the Potwar plateau towards the north and also towards south. In a deep test hole at Dhariala north of Khewra, salt beds 7000 feet thick were encountered.

Salt Range Deposits

10.59 Salt range extends for about 150 miles from Jhelum River in the east to the Indus River in the west. In the major portion of the Range from Jutana to Mari Indus salt outcrops at a number of localities. It is part of salt range formation (saline series) and is exposed at the base of salt range escarpment and in the cores of anticlines and domes dissected by the transverse streams. Salt bearing strata

10.60 Although rock salt crops out a number of places in the salt range, mining is confined to Khewra, Warcha and Kalabagh.

Khewra:

10.61 Khewra, a small town in Jhelum District is the oldest and the largest producer of rock salt in the Indo-Pakistan as sub-continent. Khewra salt mine from a part of a large dome exposed in the Khewra gorge. There are seven seams of pure

rock salt in the mines totaling more than 500 feet in the thickness. These seams form part of sequences of salt and marl of over two thousand feet thickness.

10.62 Salt is mined by chamber and pillar method and mining is mechanized to a large extent. The mine is about 1.3 miles long and 1800 feet wide. More than 12 miles of rail track has been laid out at different level of the mine. The total length of all development and chamber tunnels in the mine is about 45 miles. Mining is done by local hereditary labor and the annual production is about 50 lakh mounds. About 83 million tons of salt have been proved in the mine and with the present rate of production it will last for hundreds of years.

Warcha

10.63 Warcha, a town in Sargodha District is the second largest producer of salt from the salt range. Warcha mine is located 3 miles north of Quaid Abad railway station. The salt mine is situated on the western slope of Warcha gorge, about half a mile from the exit of the gorge. In the Warcha gorge, the exposure of the salt bearing formation is comparatively small. Here the salt seams are thinner. In all five seems with a total thickness of 50 feet are worked. The estimated reserves of the mine are about 2.5 million tons. Annual production is about 15 lakh mounds.

Kalabagh:

10.64 Kalabagh is the western most exposure of rock salt bearing formation. Here the strata are highly disturbed and as a result salt mining is rather difficult. There are only 3 salt seams in the mine and are highly inclined. Hining is done by hand and the annual production is about 5 lakh mounds. The workable reserves depend upon the possible economical exploitation depth and the thickness of the seams. The estimated reserves are over 251 lakh mounds.

Production: Annual production of rock salt from these mines is given below in long tons:

1969 – 70	1970 – 71	1971 – 72	1972 – 73	1973 - 74
226.590	42.122	310.183	294.561	314.420

General remarks:

10.65 Its most important industrial use ti which it could be put is to produce soda ash (sodium carbonate). The only factories, one at Khewra and the other at Lyallpur are producing Soda ash for country's requirement which falls short of actual need. There is still scope for setting up a few more units in the salt range where its basic raw materials like salt and limestone occur side by side. Daud Khel, Khewra, Warcha could be possible sites which are also facilitated by lines of communication also and connected with the tail and road communication lines of the provinces.

Hidden Sources and Relation Mining

10.66 Besides these exposed salt beds being mined, there are large deposits hidden underlying younger formations both in the north and south of salt range escarpment with places and deposit structures which may also have accumulations of native sulphur, if proved this sulphur can be extracted directly by Frasch process.

10.67 The hidden sources of rock salt in the Potwar salt range area and also along the southern apron of the salt range are considered suitable for solution mining of the rock salt for which there is growing inclination in the industries using rock salt as major raw material. The demand for mineral rock salt has been rising steadily and the existing mines find it difficult to meet the demand.

10.68 Foreign expert possibilities for rock salt from salt range. Salt mines exist due in their extreme purity. Perhaps inland freight charges up to Karachi stand in the way of developing export potential in the countries of East Africa, Japan etc.

Clays

10.69 Clay is an earthly mineral aggregate consisting essentially of hydrogen silicates of alumina. It is plastic when sufficiently pulverized and wetted and rigid when dry and become vitreous when fired at sufficiently high temperature. When mixed with varying proportions of impurities. It has varied properties and yields different types of clays used in industry.

10.70 The principal industrial clays are Kaolin, ball clay, fire clay, bentonite, fuller's earth and miscellaneous clays. Except for bentonite and fullers earth greater proportions of remaining clays are used for ceramics and refractory purposes.

10.71 The clay deposits found in Salt Range and Kala Chitta range are generally high alumina clays and as such are in great demand for refractory brick making and also for the production of pottery wares.

Bentonites

10.72 Bentonite clay is a special variety clay which swells many times its volumes on being wet. It has a non-swelling type as well. It is high in sodium whereas the non-swelling type is rich in calcium, the swelling type is used in drilling mud and is found four miles S.W of Rohtas in Jhelum District. Its band is 3 to 6 inches in width and extends for a distance of about 1 ½ miles. It occurs associated with rocks of Middle Siwalik group. Bentonite is also found near Gonda about six miles from Sohawa railway station. The quality of all these deposits is not, however, large.

Puller's Earth

10.73 This is similar to bentonite but is essentially composed of montmorillonite. It is used for cleaning textiles. It absorbs grease and is also used for cleaning fatty material and also for cleaning oils and wool. Its extensive deposits exist in Dera Ghazi Khan District and are exposed on the flanks of Zinda Pir and Rakhimunh anticlines and other structural elements of Suleiman range. It is associated with Baska Shale and other younger shales of the region. Its beds are extensive and run for miles. It occurs in number of beds and has variable thickness. Locally, it is quarried and is known as Multani Matti. It is used by women for cleaning their hairs. Reserves are enormous and can be developed with gypsum beds of the region without any difficulty.

Fire clay

10.74 The most important clay deposits of salt range and Kala Chitta range are fire clays. Some are high alumina clays, most suitable for manufacturing heavy duty fire blocks.

Salt range deposits

10.75 In the eastern salt fire clay deposits occurs.

Manhiala	815.000 tons
Zekali	526.000 tons
Hali	418.000 tons
Wehali (Copi)	125.000 tons
Dalwai	348.000 tons

The clay deposits of these localities are good quality fore clay and used for making fire bricks in Malakwal railway fire-brick factory and also in the old Dalwia cement for producing fore bricks.

10.76 In the western part of salt range the clay deposits occur mostly in Sargodha division and lie in the vicinity of Musakhel. This clay in general is of better quality as compared with deposits of eastern salt range. Alumina cement at Musakhel clays is high and ranges between 30 to 50 percent.

10.77 The reserves of fireclay in the various areas are as under:

Musakhel deposits

Dhak Pass sites

Bed No.1	11,25,002 tons
Bed No.2	5,90,000 tons
Bed No.3	1,95,000 tons

Mauza Bazar area

Bed No.1	5,85,000 tons
Bed No. 2	54,000 tons

Bed No. 3	1,09,000 tons

Chabil area

Bed No.1	9,94,000 tons
Bed No. 2	70,000 tons
Bed No. 3	15,67,000 tons
	15,01,000 tons

Besides these deposits, a high alumina clay deposits occurs in the central Salt range area in Kaita (Khushab). The deposit is being developed by P.M.D.C for exploitation and use in the production of alumina which would be exported to an aluminum extraction plant in Iran jointly sponsored by R.C.D. The alumina content of the deposit varies from 42 to 70 percent. The total calculated reserves are about 34 million tons.

Clay deposits of Kala Chitta Range

10.78 High alumina clay deposits in the Kala Chitta Range. District Campbellpur occur as part of Datta formation on the east of Choi Village and are found in the vicinity of Bagh Nilab, Choi, Surg, Bita and Akhori and are the biggest deposits so far discovered in Pakistan and can be used for extraction of aluminum manufacture of N.T. insulators.

10.79 The geology of each of these deposits is not different from others except that some individual structural disturbances and peculiarities of the area impart working distinction to the deposits. The reserves of these deposits are given below.

1.	Bagh Nilab Area	2 million long tons
2.	Choi Area	11 million long tons
3.	Surg Area	13 million long tons
4.	Bula Area	17 million long tons
5.	Akhori Area	3 million long tons
Total:		46 million long tons

Chemical analysis of a few samples from salt range and Kala Chitta range is given below.

Locality	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	HgO	L/I	Alkalines	Calculated PCE °C
Musakhel	59.82	25.44	2.89	1.32	1.10	0.23	7.33	1.47	1639
	48.49	35.21	0.61	2.79	Nil.	Trace	12.19	0.78	1714
Katha Sughral	13.19	64.38	2.07	0.67	2.88	Trace	16.46	0.11	1836
Choi	6.00	74.24	0.64	3.64	0.74	Trace	14.51	0.20	1881

The annual production of fireclay for the last five years is given below: _

1669-70	1970-71	1971-72	1972-73	1973-74
23,878	27,816	21,007	18,089	42,245 tons

10.80 High alumina refractory clay is suitable for making firebricks for requirements of iron and steel mills. Different types of clays should also be tested for their swelling property (bloating property) on heating. Bloated clays could be used for producing light-weight aggregates weigh 50-92 lbs. per cubic font while the conventional concrete weighs 145 to 150 lbs. per cubic feet. The saving of weight in the light weight aggregate reduces the amount of reinforcement iron and thus affords saving in construction const. This material is increasingly used for producing light weight roofs for large halls and auditorium.

Iron ore deposits:

10.81 The province though not very rich in metallic minerals has two iron deposits in the Trans-Indus salt range of Kalabagh-Chichali region of Mianwali District and in the Rakhimunh area of Zinda Pir anticline of Dera Ghazi Khan District.

Kalabagh Iron ore

10.82 The Kalabagh iron ore deposits are the largest known sedimentary deposits of low grade iron ore in the country. The iron ore beds occur in the Surghar Range and also parts of Salt Range near Sakesar. The iron ore occurs in the upper part of the Lumshiwal sandstone of upper coetaneous age. This iron ore has been classified in the two types based on its mineral constitutes. They are the kuch type (chamesite siderite) and the Chichali type (glauconite-siderite). A transitional type contains glauconite-siderite with excess of limestone and hydro-hematite.

Average chemical composition of different types are given below: _

One type		Deposit	Fe	SiO_2	Al_2O_3	CaO	P	TiO_2	S
1.	Chamesite-siderite	Kuch-Khartop-Chuglan NE	34.2	21.8	12.1	2.7	0.25	0.68	0.33
2.	Traditional zone	Chuglan NW	32.00	25.00	6.8	2.8	0.30	0.34	0.26
3.	glauconite-siderite	Chichali Makerwal	33.0	24.0	6.0	3.5	-	-	-

The reserves of all categories of the kuch iron estimated at 34.6 million tons and Chichali type 206 million tons and the reserves of transitional type are estimated at 51.91 million tons. Thus in all the Kalabagh iron ore of all types has a reserve of over 292, 56 million tons.

10.83 This deposit occurs near Rakhimunh area and is known as Rakhi iron ore bed. The bed occurs at the base of Nari Formation of Oligocene age. The ore bed varies in thickness from 1 to 6 ½ feet. The ore body extends for a distance of over 17 miles along 17 the strike on two eastern limbs of the Suleiman anticline. Chemically the ore showed the following analysis.

Fe	SiO_2	Al_2O_3	CaO + MgO	Mn

%	%	%	%	%
37.5	13.9	7.4	6.6	1.8

Minerologically, this ore is chiefly composed of limonite (50 to 55 %) with subordinate iron silicate minerals (6 to 15 %) and detrital quartz (0 to 5 %). The iron ore compares very favorably with other similar sedimentary deposits of East Germany and Lorraine (France) which have been successfully exploited for producing iron.

10.84 The ore on the whole comprises 70% iron as limonite (hydrated iron-oxide) and about 23.3 % in the form of siderite (iron carbonate). Thus chemically and Minerologically the ore is of good quality which is easy to smelt. The reserves of iron ore have been calculated by PMDC to be 14.5 million tons up to a working dip deposit of 2000 feet. Deposit though small offers possibilities of establishing a small iron and steel mill in the area.

Radioactive Minerals

10.85 Uranium mineralization has been discovered on the sandstone beds of Siwalik formation in Rakhimunh area of Dera Ghazi Khan District. Mineralization has been studied in great detail in Baghalachur area north of Rakhimunh and the deposit is being developed for exploitation by Atomic Energy Commission of Pakistan.

Other Minerals

10.86 Minerals which occur in smaller quantities or on which further investigation is needed are briefly mentioned below: _

Copper

10.87 Copper is used mainly in electrical industry. It is used in making alloys such as bronze, German metal, bell metal, touch manganese alloy and in the manufacture of copper salts and copper wares. Cuprite, malachite and native copper have been reported from Kathha, Nilawan, Warcha, Khushab etc. as sporadic showings in the “speckled sand-stone” of the salt range. No detailed

work has been carried out yet. Due to importance of this metal detailed work should be carried out on priority basis.

Gold

10.88 Gold is used in ornaments, electrical industry, gold platting, and coinage and in international monetary transactions. Gold has been reported in the analysis of certain basis rocks of the Kirans hills with values up to 6ppm. Although the known values are in the economic levels, yet no detailed work has been done. Detailed work is needed on the entire rock types of the Kirans Hills.

Celestite

10.89 Celestite is used as a fertilizer in a white paint and in oil-drilling mud. It is used in the manufacture of strontium salts for use in pyro-electric, ceramics, dielectrics, plastics, metallurgy and sugar industry. Irregular veins are known over a length of 4 miles near Daud Khel in Sargodha Division. Estimated reserves are about 10,000 tons which an average $SrSO_4$ content of 82.7 percent.

Division with the P_2O_5 content varying from 5-10 percent. Phosphate rock is present in the Zinda Pir and Rakhi Gaj areas of Multan Division, with P_2O_5 content between 5-20 percent. Due to their importance as fertilizer raw material, the phosphatic showings need a careful investigation for exploitation.

Silica Sand

10.90 Silica sand is used as a refractory material, an abrasive and in the manufacture pf glasses, silicon alloys, silicates etc. Good quality silica sand is available in the Salt Range near Mianwali and Daudkhel. The deposits are extensive. The silica sand should be used for glass industry and for making abrasives and refractory material.

Conclusion:

10.91 Non-glamorous minerals like limestone, gypsum, rock salt and clays occur in abundance in the Barani area of the province and their development and utilization possibilities should be encouraging with a view to providing employment to greatest number of people inhabiting the region.

10.92 (i) Limestone is primarily used in the manufacture of cement, which remains in short supply. Up to the recent past when cement was known, lime mixed with clayey material used to be employed as mortar and for plastering in the building construction. Extremely beautiful monumental buildings of historical importance in the country are standing testimony to the durability and usefulness of lime mortar. There is no reason why lime mortar should not be used by our local population in the construction of their houses. Lime can very easily be made from the ubiquitous exposure of limestone. Renewal of traditional use of lime mortar and encouragement are needed for establishing small lime burning kilns all over the country. While encouraging more and more use of lime in building construction, more cement factories need to be installed. Cement thus saved and produced could be put in the export market for earning foreign exchange.

10.93 (ii) In the case of gypsum, efforts should be made in a similar way to encourage production of Plaster of Paris on a large scale but in small units scattered throughout the region where suitable raw material exist in abundance. Small roasting kilns and grinding mills may be designed that could be installed by the people of moderate means to produce Plaster of Paris. The Plaster of Paris thus produced should be encouraged to be used as wall plaster in place of cement. It could also be used in the manufacture of plaster boards to be used in the construction of houses and buildings. Plaster boards can very conveniently be used as partition walls and ceilings.

10.94 Chemical composition of gypsum and anhydrite is $CaSO_4 \cdot 2H_2O$ and $CaSO_4$ respectively. For the constituent Sulphur of the mineral, processes have been developed with the help of which Sulphuric acid could be manufactured. Ordinarily, manufacture of Sulphuric acid requires raw Sulphur which is not produced locally in sufficient quantities to meet the growing demand of industrial requirements as such gypsum can be used for the manufacture of

large amount of Sulphuric acid. This has been tried in England by ICI and their process could possibly be Imported with their technical know-how. It is said that the process is difficult and costly but, in the national interest the possibilities of its usefulness can be explored.

10.95 (iii) Different types of clays occur in different parts of Barani area. The clays so produced are generally sent to market without treatment or beneficiation. Beneficiation of these clays should be encouraged for better results of produced goods. Clay testing and beneficiating labs, at a couple of central places in this region could help the producers of raw material in sending better quality material for the production of high quality finished products. Every effort should be mad to extract alumina from Bauxite in Khushab area.

10.96 Different types of clays should also be tested for their bloating (swelling) properties, when subjected to heating. The clays that show bloating properties, could be utilized for production light-weight aggregate to be used in building construction. Light-weight aggregate to be used in building construction. Light-weight concrete aggregates to produced, weight less than the usual aggregates of sand gravel and crushed rocks and should be popularized in building construction with saving in steel used.

10.97 (iv) the coal produced from the coal mines of the Barani areas has a high resin, tar and volatile content and efforts should be made to carbonize the coal and extract its valuable bye-products. Coal briquettes should be made and used for firing the small thermal power stations. They could also be used for household burning purposes.

10.98 (v) every efforts should be made to produce steel from the iron ores available at Kalabagh and D.G Khan, although the Kalabagh ore is considered a more difficult are, but considering the strategic importance of steel, development of a process for the extraction of iron from this ore needs to be given high priority.

10.99 (vi) Dolomite is extensively used in the metallurgy of iron and is used as a refractory material. Efforts should be made to exploit the easily accessible sources of dolomite.

10.100 (vii) Efforts should also be made to extract some of the newly found and useful minerals, such as, copper, gold, celestite, laterite, potash salts, phosphate rocks and silica sand for numerous used.

10.101 (viii) Deposits containing radio-active minerals should be fully investigated and developed in the Rakhimunh area of D.G Khan .

CHAPTER –XI

INDUSTRY

11.1. The Punjab Barani Tract has been historically a technologically advanced region. Archaeological investigations indicate that in the first millennium B.C. the whole of the north central Barani Tract from Campbellpur to Pindi Gheb and beyond was building with small cities and towns which had flourishing industries based on the smelting of local from deposits. The furnaces and foundries of these times still litter up the land-scope. This iron industry was indeed the major factor in the emergence of the Taxila-based civilization which held over vast areas for almost 2,000 years. It was the decline of this technology amongst other reasons was responsible later for the fall of this great civilizations and the stagnations of the economy of the area.

11.2. The future development of the Tract would also depend on the measure of success achieved in industrialization and the acquisition of the 20th century science based technology. Crop production in the tract, dependent as it is on uncertain and intermittent rainfall, would always carry a certain amount of risk and would not this be a sufficient base for the total economy of the tract. In nations such as the USA, in similar ecologically less-favored areas, the thrust program for economic advancement has been rapid industrial growth.

11.3. The pressure of population in the tract is so great that in most parts more than 80 percent of the farm holdings are already less than 2 ½ acres with the doubling pf population by the end of century, the farm size would become very small and uneconomical. Unless a very rapid industrialization is achieved to provide non-farm employment to the majority of the population, the poverty in the area may become over-whelming. Only industrial would generate a high enough level of income and would enable adjustments of surplus man-power in the non-farm sector.

Potential:

11.4. The Punjab Barani Tract has numerous advantages for developing a sound industrial base and the ultimate goal of development in the tract should be to achieve as rapidly as possible a high level of industrial growth. The mineral resources of the province are all concentrated in the Barani Tract. A determined effort at Research and development in the field of minerals for establishing mineral based industries. The potential of the tract for the development of energy

resources is similarly considerable. The entire oil production in the country is confined at present to the Punjab Barani Tract and large unexploited reserves of oil and gas are known to exist. A 600 Megawatt nuclear power plant is being established in the tract and a whole complex of such nuclear plants is planned to be built by the end of the century. Adjacent to the tract at Tarbela, additional hydro-electric energy would be produced, the potential being 2100 MW. The tract has large reserves of coal. The recent oil crisis has triggered off an unprecedented research effort. In particular, in the U.S and in the United Kingdom under OECD auspices, to develop technology for the economic use of their very large but low-grade coal deposits in the Barani Tract. There are distinct possibilities of establishing mini-steel-mills based on the D.G Khan and Kalabagh iron-pres. The heavy Mechanical Complex already functioning at Taxila in the tract provides another basic resource for industrial development. A heavy electrical complex would also be established at Taxila. In parts of the tract, notably Sialkot, Gujrat, Rawalpindi, Hassanabdal and Daudkhel, a great deal of industrial growth has taken place. A modest base for industrialization, therefore, does exist in the tract.

11.5. A very great deal of money is flowing into the Barani Tract as remittance from the large number of migrants from the area who are working in the Middle East, Europe and America, in the army and civil services and as workers in industry and business in the urban centers. At present this money is not being utilized for the development of the tract and is either spent on conspicuous consumption or its channelized through the usual banking channels to the development of the more affluent parts of the country. Furthermore, the agrarian reforms have reduced the ceiling on the area of land per holding and there are a large number of persons belonging to the landed classes who are looking to the cities for investments. Such persons would be greatly interested in making profitable investments in industry nearer to their home and retain their family's former position in the tact. This capital could be retained within the tract if special incentives are provided for the establishment or rural industry.

11.6. The tract has a vast reservoir of trained manpower in the person of ex-serviceman. Amongst the major employers in the country, the army is about the best educational machine. All armed forces personnel are regularly trained through educational programs to improve their literacy, numeracy and skill levels. The handling of modern tools and techniques for the better performance of tasks, whether they be soldiering, farming or industrial. The ex-army person is thus a most eager person in the community to accept improvements in techniques and he is

handler with machines. It is also interesting to find that the percentage of artisans in the Central Barani Tract (Rawalpindi Division) is reported to be considerably higher than any other part of the province. It is 17.2 percent of Bahawalpur and 13.8 percent for the Punjab as a whole, indicating the higher potential of the tract for work in industry. The initial thrust in the utilization of this man-power should be in rural and small sale in industry. The initial thrust in the utilization of this man-power should be in rural and small scale industry. Widespread development of small scale industry would produce the care of skilled man-power and the entrepreneurs who would ultimately progress to build medium scale and large industry.

11.7. With the establishment of the national capital at Islamabad, in the heart of the Barani Tract, a number of technological and scientific institutions are being setup which would ultimately provide the base for research and development in the region. These would include the Quaid-e-Azam university, the institute of Nuclear Science and Technology, the Hydro-carbon institute, the proposed Institute of Electronics, the National Council Laboratories, and a number of poly-technical and technical institutes.

Constraints:

11.8. Rapid Industrialization of the Area, is however, not easy, as the existing economic/technological/industrial base is weak and there are difficult choices to be made in determining priorities and securing the means for development what is even more important, is the inappropriateness of the existing industrial system. Pakistan like many other developing countries was unable to take a positive part in the industrial exclusions. It has no choice except what was planned for it by the colonial power which ruled it. This country was producing raw materials to keep the chimney of England’s factories going and served as market for the finished products.

11.9. Before the industrial evolution and the occupation by Britain, the Tract has a rich tradition of Handicraft industries. This traditional sector was wiped out by the in-flew of cheap machines produced goods from England. The small modern sector grudgingly created in the subcontinent was all located in the predominantly Hindu Areas that now constitute India of the industrial units in undivided India, only 8.6 percent were located in Pakistan. The contribution to CNP of manufacturing which was mainly in the traditional sector was only seven percent in 1949-50

11.10 Soon after independence, there was a period which may be termed as a period of laissez. Soon later government supported freely the establishment of Industry through private enterprise anywhere and of any type. The development was first aimed mainly at important substitutions and later at export-goods industries to ease the balance of payment difficulties. Since industrialization through private sector encountered serious obstacles in terms of financial and material resources, dependence on world markets and technical know-how, the state took the initiative by establishing in 1952 the Industrial Development Corporation. Thus the Government became responsible for establishing and developing many new large-scale industries. The private sector was, however, given an important role in this process and a series of measures were adopted including tax holidays, subsidies, exchange rate incentives, protective tariff and duties and a system of quantas, permits and licenses, in order to provide protection to this import industry and incentive for investments.

11.11. As a result a variety of industries have got established including cotton textiles, vegetable oil and sugar mills, engineering and electrical goods, machine tools, leather goods, tamaris, sports goods industries, surgical instruments manufacturing, manufacture of metal products, cast iron foundries etc. A heavy mechanical complex was established and the establishment of a steel mills is in hand.

11.12. In-view of the overall poverty of the country and the inability to quickly mobilize internal resources, most of this industrialization took place, with the help of loans and aid from the developed countries and thus the pattern of growth was affected by the view-point and economic considerations of our powerful creditors. Many new industries began by assembling imported units and using many foreign components and semi-finished subsidiaries in collaboration with the Pakistani entrepreneurs. The type of technology used in this industrialization process was capital intensive and hence became the prerogative of those groups within the country who were the richest. The basic assumption was to establish more and more industry so that the country’s gross national product becomes larger and every one’s slice of the economic cake would automatically get bigger. The cutting of that cake in a more equitable manner, however, did not materialize.

11.13. The industrialization of the country was started so late that it coincided with the scientific and technological revolution in the developed countries which was reflected in much greater automation and labor-saving techniques, large size of industrial units and capital intensiveness. As most of the industry was imported on a turnkey basis, there was little relevance to the local factor situation in terms of labor or capital.

11.14. Attempts were made from time to time to avoid concentration of industry in a few urban and urban-orbit centers and to spread the benefits to all parts of the country, first by the PIDC and then by a series of measures such as directives, creation of industrial estates, tax holidays for establishing industries in the backward areas, loan facilities, legislation etc. only marginal benefits were, however, received by the backward areas as the overall objectives remained by the increase of G.N.P and there was always justification for adding one more unit in the big city where numerous facilities already existed.

11.15. After nearly three decades of independence and the struggle to achieve modernization, industrialization and just distribution of benefits, the eradication of mass poverty remains a pipe-dream. The majority of the population is rural but industrial development is concentrated in a few urban areas, thus by passing the large majority of the population.

New Policies:

11.16. The difficulties and disproportions caused by this lumpy growth aggravated social tensions caused political strife, and was in large part responsible for the dismemberment of the country. The people's Government committed to a program of social justice and national reconstruction introduced sweeping and revolutionary reforms which included inter alia (a) nationalization of a number of categories of industrial enterprises and (b) nationalization of banks and insurance companies.

11.17. With the nationalization of the major segments of industry and of the banks and insurance companies, a wide measure of reforms was introduced in all other sectors a national life. In the permanent constitution it was made a mandatory function of the state to promote with special care the economic interests of backward classes or areas and to enable the people of

different areas through education, training, agricultural and industrial development to participate fully in all forms of national activities. The stage has thus been set to develop workable policies, for the industrialization of the Barani Tract so that the spectra of poverty from this neglected area is banished.

11.18. In framing policies for industrialization a clear distinction has to be maintained as to the type of industry or the optimum mix of industrial types to be promoted. The types are (a) cottage industry or the traditional sector (ii) small scale industry and (iii) medium and large-scale industry. The issues involved are briefly discussed below.

Cottage industry:

11.19. In the Barani Tract in common with other rural areas, the cottage industry or the traditional sector plays a very important role, social, cultural and economic. The growth of the modern sector and the market economy8 have hit this sector very hard. Cheap machine goods have made it impossible for the craftsman to earn a reasonable living and his ability to buy raw materials has been greatly reduced. Over the years, the productivity of this sector has been little realized. Small agricultural processing plants, artisan's undertaking and handicrafts are a source of considerable employment and the migration of people to the cities. Traditional activities that help the people to remain in the village should therefore, be given as much protection and support as possible.

11.20 The cotton industries are identified by qualitative features, such as pre-dominant use of hand tools and importance of manual skills, small capital and the use of family labor, organization and manpower centered on the family labor, organization and manpower centered on the family and concentration in certain trades such as pottery and weaving. A special characteristics of handicrafts is that production calls for artisan's production are special types of textiles and carpets, wood carrying and indigenous furniture, leather craft and pottery, metal work etc. Government support policy should be based as a thorough assessment of the whole artisan economy in order to determine as to which activities should be promoted in the national interest. Special attention should be paid to handicrafts that typify the national or regional culture or whose products reflect skills of a high order. Two basic questions must, therefore, be decided:

(a) which of the traditional activities have the ability to withstand the economic composition of the modern sector in industry and (b) what measures are necessary to prepare artisans for work in alternate small-scale rural industry, if a traditional craft would inevitably get wiped out for economic reasons. Surveys should be conducted to identify such handicraft activities which can hold their own and arrangement made for (1) training the workers (ii) financing for the purchase of raw materials and tools (iii) marketing of produce and (iv) extension advisory services for development and guidance.

11.21. The traditional sector has an important role to perform, in particular, the manufacture of articles which have high aesthetic value and which depict the culture and ethos of a society and an area. There can be, however, no denying the need to introduce technical change in rural manufacturing, deploying modern scientific advances in techniques, materials and skills. In order to initiate industrial development and to assure its continuous growth, more advanced and improved technologies must progressively replace traditional methods of manufacture. We can draw on a vast body of a new technology evolved in other advanced societies and adapt it for our use and also use our own research and development organizations in developing technologies required in particular conditions. This technical change is being brought about through the migration of village artisans to the cities and the setting-up of small-scale urban industry with their labor. The challenge lies in accomplishing the same end without migration by establishing small scale industry in the rural areas.

Small-scale rural industries:

11.22. The establishment of many big industries, based on wooden and sophisticated technologies, highly automated and labor-saving, requires capital and savings which poor nations like Pakistan cannot generate. In view of the resource constraints only a few such plants get established under foreign aid or with outside grants. In highly favored localities. The backward areas are not benefitted. As such plants are imported from industrially advanced affluent nations. They are based on modern sophisticated technologies which are highly automated and labor saving. They don’t therefore, employ any large number of workers and the mass of the people who are under-employment or employed in poorly paying occupations receive little relief. Many a time they have little or no relevance to the raw materials locally available. While they produce and provide some goods. They crate numerous problems, unintended but nevertheless extremely serious. They also tend to absorb whatever little savings and entrepreneurship a poor nation can

generate and perpetuate a colonial and dependent status of the nation. There is, therefore world-wide concern that the type of industries chosen should be appropriate to the resource base of a nation and to take into account its raw material, labor supplies, level of economic and social development and its needs in terms of self-reliant growth in all parts of the country.

11.23. Development through small-scale industry based on intermediate/appropriate technology has, on the other hand, a special role in the progress of the backward areas. This would help in the dispersal of industry to all parts of the country, check mass exodus of labor to large urban center, thereby avoiding enormous social costs and much personal misery, and create additional income and deployment. In the rural and less advanced areas, serve as the breeding ground for skilled workers, managers and entrepreneurs, support agriculture by providing locally available inputs, such as fertilizers, pesticides and improved farm implements and provide a variety of locally produced consumer articles. It could develop complementary association with big city-based industries through sub-contracting. There is often scope here to utilities. In ancillary processes methods which would not be economical in developed countries facing labor shortages but which may be highly desirable in order to provide based on either local handicrafts, skills or more advanced modes of production. It does not involve transport of large quantities of bulky raw materials and transport bottle necks are avoided. It does not require types of equipment which cannot be maintained and repaired locally. Considerable savings can be achieved in construction and operation cost. Many small-scale enterprises can be built in a short time, because of the smaller scale of the enterprises, bringing quick return on investment and adding to productive capacity e.g. small fertilize plant can be built in about 6 months, while a large plant would take 6 years, at enormous cost. The fertilizer from the small plant would help produce six additional bumper crops before the larger plant becomes productive. With small plants, it is possible to quickly achieve decentralization of industry and use local resources, raw materials and labor which otherwise would remain unutilized, thereby achieving a perfect adjustment to the factor proportions situation, and it fosters regional self-sufficiency and brings about balanced development of resources. It enables the use of poorer quality raw materials which could otherwise go waster producing low-priced products to be consumed locally. It achieves a low capital intensity thereby reducing dependence on foreign loans.

Successful Model:

11.24. The best example of the massive application of the small-scale rural industry based on intermediate technology approach for rapid development and equitable, distributions is the People's Republic of China, although numerous other countries are now achieved not only in upgrading the traditional technologies by partial mechanization and improving processes and design but also in suitably reducing the scale of the larger plants used in affluent countries. The approach does not, however, preclude absolutely the establishment of bigger and more sophisticated industry, such plants are installed and sophisticated technology was considered desirable for the achievement of defense, export or other national objectives.

11.25. A nation-wide network of small plants, well within the resources of local communities to finance and manage have transformed the Chinese country side. Over the years, steady improvement has been effected in modernizing the smaller units. In order to evolve and adapt technologies suitable for such plants, central research and design institutes are assigned tasks. Much local innovation is also encouraged by continuous improvements in equipment and techniques. A brief mention of the types of plants which have made an outstanding success in China and are of particular relevance to the conditions in the Punjab Barani Tract illustrates to the advantages of the approach.

Chemical Fertilizer Plants:

11.26. Within ten years of independence, small fertilizer plants were established all over the country-side. Today nearly 70 present of the chemical fertilizer used in China is produced in small plants usually run by countries. Most of these produce synthetic ammonia, which is used directly in liquid form or is further processed. New standardized small plants have an annual capacity of 3,000 to 5,000 tons. Intensive research has also enables the use of relatively poor quality coal-lignite and low quality anthracite instead of gas. The Barani areas have a large supply of such coal which could be used for the production of nitrogenous fertilizers thereby effecting large savings of the gas.

Cement Plants:

11.27. Almost three fourths of China's countries have their own small cement plants, which range in capacity from a few hundred tons per year to 50,000 tons of cement. The Chinese are still using, for their bigger units, vertical kilns and find these economical under their conditions. The very small units may be simple concrete ditches on the ground for the interesting process. Barani areas have an unlimited supply of the raw material for cement. Small plants could become the base for the construction industry which in turn could become the growing point of economy in the Tract.

Iron Foundries:

11.28. China has now had a long experience of blast furnaces, starting with very small units. In View of the early furnaces a great deal of painstaking research and development has gone into the problem and now improved equipment is allocated from central sources, based on standard furnaces of 8,13,28,50,100 and 120m^3. The smallest of these yields an annual production of approximately 2,000 tons of pig iron. These furnaces although of small capacity, are extremely well designed. While the blast furnace processes have been fairly modernized the casting of ingots, produ8ction of cake and internal transportation are all found in large quantities in the Barani tract. A total transformation of the area could take place, if the small blast furnaces are introduced of the area could take place, if the small blast furnaces are introduced and the iron so produced is used locally for improved farm implements manufacturing.

Bio-Gas (methane plants)

11.30. Marsh gas seems to have solved the Chinese peasant's problem of lighting and fuel and to have saved coal and paraffin and the costly transportation. Areas remote to electricity have greatly benefitted. Farm yard manure, night soil and vegetable waste are all used. In many cases simple fermenting of grass and straw in sealed pits is used to generate gas. The Barani areas major problem today is fuel for domestic use. Most of the dung of the animals is burnt resulting in the breakup of the nature's fertility cycle and lowering the productivity of agriculture. Instead of burning the same, dung could be fermented in order to get both gas and manure.

Sophisticated Technologies and Large Industries:

11.31. The traditional sector has its place in manufacturing and the small scale industry based on appropriate technology must be vigorously developed, but there should be no question of the nation denying itself the benefits of applying the latest technologies. The advanced nations are today in the midst of a second industrial revolution. Automation, transfer machines and the use of electronics are being increasingly employed and revolutionary changes in production techniques are being about Pakistan cannot and must not accept a colonial subservient status in technology. The existing gaps should be filled up as early as possible. When opting for capital saving techniques, country should be careful not to precipitate stagnation. Steady pace of modernization should be maintained and wherever feasible, necessary and appropriate, the best and the latest technology should be used. For that purpose critical industries such as electronics should be quickly established. Furthermore, there be in certain processes great economies of scale and the appropriate choice may be establish larger units. There may be in some cases no practicable or efficient alternatives to the Capital-intensive technology. In newly developing fields certain types of operations may not even be possible without sophisticated highly automated technology. The aim should, therefore be balanced industrial development based on pragmatic approach. The rural orientation of technology should not mean the rejection or neglect of advanced technologies ***(*… missing line in the end)*** **…** very important national goals which must be ***(*… missing line in the end)*** **…** amongst others, to equal as quickly as possible the technological development of the advanced nations and no buildup quickly national defense capability which require a strong progressive industrial system in the nation. Even when employment becomes a determining factor in the choice of technologies/industries, the use of a technology that will reduce employment in the short term may also reduce opportunities for future expansion of employment. Some highly capital-intensive industries give rise to ancillary or subsidiary occupations which may be labor intensive. There are, in addition, very bright opportunities in develop an export trade in products, such as fertilizer and cement and there is reason in such cases to establish large plants based on local raw materials. The industrial development strategy should not be doctrinaire but it should be based on careful planning.

Institutional Framework:

11.32. At the national level, the government of Pakistan have established ten holding corporations, with the responsibility of coordinating the management and development of the

operating companies, after the nationalization in 1973 of ten basic industries. The Federal Government have also setup a number of institutions for the promotion of industries, including the Pakistan industrial and Technical Advisory Center, the Central Training Laboratories, the Investment center, the Pakistan Standard Institutions, the Patent Office and the Council of Scientific Research.

11.33. At the provincial level all matters pertaining to Industries are dealt within the department of Industries and Mineral Development, which is the principal executive agency of the Government. It had formerly the sole responsibility for the nurturing and development of industrial activity in the province, ranging from cottage industries to government-owned factories and dealt with all aspects of industrial development, such as planning, sanctioning and licensing of industries and imparting industrial and vocational training. With increase in the tempo of development, certain specialized functions have been entrusted to newly created organizations. A small Industries Corporation has been setup to cater to the needs of cottage and small industries, vocational training institutions have been handed over to the Directorate of Technical Education and a Punjab Industrial Development Board has been constituted.

11.34. The present government has laid emphasis on the establishment of industries in the Public sector. It was, therefore considered necessary to have a specialized Development Board was established in 1973. First of all the vegetable ghee factories which were taken over by the government were placed under its control. The Board has also undertaken to establish a number of new factories in various parts of the province. In fact, the Board has already negotiated for the establishment of six sugar factories, three textile mills and six modern rice husking mills in the province and a block provision of Rs.6 crore has been made in the Annual Development Program for the purpose. About Rs. Two crore are proposed to be spent on various promotional, training and research schemes sponsored by the Department.

11.35. The Punjab Small Industries Corporation (PSIC) came into being on the dissolution of the West Pakistan Industries Corporation on June 1, 1972 through the Punjab industries Corporation Act. The scope of PSIC activities was also widened by giving a new definition to small industries in the Act. Industrial units having fixed assets, excluding land, values at Rs. Five lacs and below were formerly classified among small industry. The limit was raised to Rs. 20 lacs, thus blurring the line somewhat between small and medium-scale industry.

11.36 To encourage investment in the small industry in the small industry sector, the PSIC has arranged to provide financial assistance to the entrepreneur in local currency through a consortium of commercial banks. Under existing arrangements the creditworthiness of the entrepreneur is accessed by the commercial banks but the local is sanctioned by the Technical Committee comprising of representatives of the PSIC and the member banks of consortium. This measure has been successful in paving the way for expanding industrialization for instance, to rehabilitate the war-affected people of Sialkot 136 units were sanctioned in the Shaker Carh Tehsil involving fixed assets of Rs.48.66 lacs.

11.37. To provide infrastructure facilities for the establishment of small-scale industries, such as, roads, electricity, gas, water, sewerages etc. Government have established industrial estates setup by the PSIC, two are in the Barani Tract, namely Sialkot and Gujrat. The provision of basic amenities such as water, power and roads reduces the initial investment of entrepreneurs and men of small means are able to get established.

11.38. To provide technical know-how to the smaller units and to provide trained man-power the PSIC has setup 11 services centers in the field of leather, footwear and pottery which provide common facilities for smaller units.

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11.38. To provide technical know-how to smaller units and to provide trained man-power the PSIC has set up 11 services centers in the field of leather, footwear and potter, which provide common facilities for smaller units.

These centers have played a useful role in standardizing the output of the smaller units. These facilities have all been set up, however, in the irrigated areas and although same benefit accrues to the tract, there is urgent need so locate such centers in the Barani Tract also.

11.39. To encourage growth in the export oriented carpet industry the PSIC has set up 37 training cum development centers in the Barani Tract. These centers will train about 1100 carpet weavers every year. A design center has been set up at the PSIC headquarters at Lahore to provide new and attractive designs for the carpet industry. In assist the trainees desirous of setting up their own carpet weaving units the PSIC has arranged to provide financial assistance through the people's finance scheme upto Rs. 2,500/- for the purchase at one carpet loom and raw materials for one carpet.

11.40. Pakistan handicrafts are a source of foreign exchange because of their attractive and appealing designs. There is however, a need for countries guidance for their growth. The PSIC has set up six handicraft development centers in the field of basketry made dragger land would work. These centers improving the quality of their products to provide the alternate an effective marketing channel sales shop have been opened amongst other stations, at Rawalpindi and Murree During the next financial year PSIC propose to undertake the following development programmes in the tract (1) establishment of one industrial estate at Jhelum. (2) establishment of ten carpet centers in the Barani Tract, and (3) initiation of dehimazdoor credit programme in addition to the above schemes it is proposed to expand or modernize the present industrial training institutes. This programme includes expending of the ceramic institute at Gurrat, carpet centre at Gujar khan and Lyiah matting development center at Kotaddu, and construction of office building for the zonal office at Rawalpindi.

11.41. Details of on-going schemes in the Barani Tract and of new schemes for the year 1975-76 are given in appendices.

Existing Situation:

11.42. Industry-wise, the Barani Tract can be roughly divided into three blocks; (1) the area flanking the grand truck road from Hasanabdal down to Taxila and Rawalpindi., Jhelum, Gujrat and extending south-east to Sialkot, (2) the area covering parts of Sargodha, Jhang and Mianwali districts, and (3) Muzaffargarh and D.G. Khan districts. Block (1) is comparatively well developed industrially and compared with the rest of the country cannot e called a backward area, Block (2) has some industrial development mainly concentrated on Daud Khel in Mianwali. While Block (3) has hardly any industry worth the name. The development of industry in the Tract is very uneven. Especially it is ribbon development along the grand trunk road and the railway line. Expect in specially endowed pockets such as daud Khel in Mianwali which has quite a few large plants due to the minerals found there.

The industry, in the Tract includes a number of factories based on local minerals-cement factories at Wah, Ghareeb-wala, Dandot and Daud Khel, a soda ash factory at Khewra and a fertilizer factory and a plaster of paris factory a Daudkhel. There is a large number of small and medium-sized industries in Sialkot. And Gujrat producing sports goods. Surgical instruments, cutlery, metal goods, ceramics and pottery, electrical appliances, furniture, carpets, leather and rubber goods. In Campbellpur, Rawalpindi and Jhelum there are wood working, Ply-wood and chip-board factories in Jhelum, a santonin factory and a large heavy mechanical complex at Taxila, Cement &Woollen factories at Wah and a number of woolen and cotton textile mills, wire netting factories, a spark plub factory, pharma-ceutical factories, petroleum refining and a brewery at Rawalpindi. There are textile mills at Muzaffargarh.

11.43. Based on information from the industrial census of 1969-70, the district-wise distribution of industry in the Barani Tract is tabulated below. It pertains to factories having annual production of Rs. 60,000 and over.

NAME OF DISTRICT	TOTAL NO OF UNITS	REGISTERED UNITS	UNREGISTERED UNITS
Campbellpur	16	12	4
Jhelum	23	16	7
Rawalpindi	181	117	64

Gujrat	71	60	11
Mianwali	8	8	-
Muzaffargarh	3	3	-
D.G. Khan	22	8	14
Sialkot	202	130	72
Total:	526	354	172

11.44. The district-wise distribution of the registered factories along with the name of the product and production capacities is given the appendix. This appendix is based on the annual census returns received from the registered units for the year 1972-73. About 10 per cent of the registered units generally fail to put in their returns.

The total number of industrial units in the province is 2953/ The number of units in the Barani Tract in 526. The tract has roughly one fifth of the industrial units in the province, for one forth of its population and one third of its area. The detailed survey of the rural industry and cottage craft is under way. The report will be available after a year or so. It can be stated, however that, with the passage of time. The contribution of cottage crafts to the gross product of the sector is slowly diminishing.

Future Development

11.45. The future development of industry in the Barani tract would depend, in a large measure, on the enunciation of clear policies and plans, the development of instructional and physical infra-structure, the generation of capital and the acquisition of technological capability. Both physical and human resources should be utilized to increase industrial out-put, wealth and living standards. There should be a wide dispersal of industry so that benefits of development may reach all people.

11.46. There is firstly the basic need to improve the industrial base. The proposed Heavy Electrical Complex should be established at Taxila as soon as possible as a complementary institution to the Heavy Mechanical Complex and electronic industry should be established in the Tract. No time should be lost in developing mini-steel mills in the Tract. There is a substantial

base of mineral resources on which mineral base industries such as cement and petrochemicals can be developed.

An area which should receive much greater attention in the Tract is the construction of industry-houses; civic and commercial buildings have to be built and electricity. Bridges, roads, railways, air-fields have to be provided. Supporting industries would be needed for providing the variety of goods needed by the construction industry.

11.47. Compared to other areas in the province there is a large number of artisans in the population of the Barani Tract and a larger participation of women in the labour force, both are strong indicators of the potential of the people to take to industrialization. Industry based on skill and entrepreneurship should be specially promoted. The conditioning process to prepare the labour force for participation in a high level technically based industrialization process can best to achieved by mechanizing the

Traditional crafts without creating large capital requirements. Among the other occupation groups such as the tenants and the small farmers, the generation of off-time non-farming activities in industrial work would greatly add to productivity and create potential for the larger participation in the technologically higher industrial process.

11.48. Precision tool industries which are usualy limited by the availability of technical manpower can best be located specially in the districts with pre-dominant army traditions. These industries can easily capture and capitalize upon the trained manpower of Armed Service returnees. In the Barani Areas a large part of the out-migrants have traditionally taken up jobs in the various branches of the Armed Forces and as a result of their early retirement they represent a very potent source of education and training, much needed in man institutions and industries required for the development of the Tract. It may also be pointed out that up till now much valued humar capital of there areas has been employed in services in other parts of the country. The economic development of these areas, therefore, would not only need arrest of the human capital flight but also to train additional manpower to achieve the developmental objectives.

The industries which do not require bulk transportation of both input material and final product and are not necessarily market-oriented can also be considered for location in the Barani areas.

11.49. The agro-industries offer a very challenging field. There are in-put industries for agriculture, such as manufacturing of fertilizers, pesticides, farm machinery, cattle and poultry feed, which may be large scale where the factor endowment so warrants but should generally be small scale so that the benefits may be as widely dispersed as possible. There are other agro-based.

Industries which process agricultural produce. These would be located most suitably where the re materials are available or can be produced in abundance. Such industries include, for example, fruit preservation and wood work in Murree hills, vegetable oil-mills in Eastern Potwar and beracempolleting plant in Sialkot. Then there are industries for the recycling of produce that goes waste e.g., bio-gas plants, medicinal plants products, non-conventional oil from plants such as plazi(Asphodelusfastulosis) which grows as wee in Rabi yielding seed in large quantities.

11.50. There are numerous agro-industries that are of particular relevance to Barani Tract. A partial list would include; Chemical fertilizers and pesticide plants, live-stock processed feed mills, berseem and Lucerne drying and pelleting plants, tanneries, mobile mini-plants for extraction of perfume oils, non-conventional oils (from poli, Plazi and harmal), bio –gas plants, medicinal plants and herbal medicine plants, essential oils (from wild menths) roller flour mills, oil expellers for oil seed. Wool processing and opining, paper or board mills baded on wheat straw of grasses along river beds, carpet, and rug making, cordage rope spinning, shoe making factory to produce guar gum, fruit preservation and canning and sorghum products

11.51. The selection of a particular industry and a particular site for its location requires detailed survey and investigations but a brief district-wise situation review to bring out the potential of different parts of the Tract is attempted below:-

Campbellpur District:

11.52. This district lies in Potwar plateau. The main towns are Campbellpur, PindiGheb, Talagang and Fateh Jang. There is general shortage of water and electricity in this district. The river beds it too deep for irrigation of the lands. The district is rich in minerals, About 49 mining licenses for the exploitation of coal, bentonite, dolomite, fire clay, Eypsim, Iron ore lime stone, ordinary sand, silica sand and marble gravel have been allowed. Small refractory industries using high alumina clay of which the biggest deposits in the nation are in the district, can be established. High tension and low tension insulators can also be manufactured out of such a clay. There are also chances of stricking oil in this region and greater efforts must be made for its exploration. A gas field exists in the district and the possibility of setting up a petro-chemical complex which may manufacture plastic materials as well as fertilizer should be investigated. Lime stone is found in abundance and small lime stone kilns need to be encouraged for producing quick lime that can be used in building industry.

11.53. At present, there are 9 industrial concerns manufacturing woolen taxtiles, glass, cement, iron, steel, ice, etc., in this district and other seven industries for the manufacture of cotton, fire bricks, cermics etc. costing over Rs. 71 million have been set up or sanctioned during 1973-75.

11.54. Since large quantities of oil seeds, such as mustard, groundnuts, rapeseed, sun flower, can be grown, a number of oil expellers can be installed for producing oil. The oil cake can be used for poultry and animal feed manufacturing industries.

11.55. Since the district carries a large sheep population small industries such as wool processing and carpet making should be established. Five carpet centres have been established but more are needed to encourage carpet manufacture on a cottage-industry basis. Bio-gas plants, farm implements manufacturing, small fertilizer and pesticide plants should be steadily developed.

Rawalpindi District:

11.56. This district is wholly Barani and has a varied topography with high hills, plateaus, valleys, ravines and plains. The district in general suffers from water shortage, though this problem has been cased at Pindi and Islamabad by the construction of Rawal Dam.

11.57. There are over 125 industrial concerns manufacturing cement, telephone equipment, pharmaceuticals, steel goods and numerous other products in the district and twelve industries for the manufacture of cotton, light engineering goods etc. with an investment of over 37 million rupees have been sanctioned during 1973-75. A petroleum refinery, an Ordnance factory and a heavy mechanical complex have also been established in the district.

11.58. A heavy electrical complex is envisaged at Taxila. There is urgent need to establish an electronics industry in the nation and Rawalpindi appears to be ideal for the purpose in view of the numerous industries and defiance installations in the neighborhood which require electronics equipment. The Quaid-e-Azam University, PINSTECH and other federal Govt. research establishment could provide much technical support.

Limestone being found in abundance in the district more cement factories and lime manufacturing kilns for producing cement and lime needs to be setup. The number of carpet center and handicrafts, development centers have been started at Pindi, Gujar Khan, Murree, Kohata, KalarSyedan, Rawat and Kotli. Their activities need to be expanded and more such centers can be setup.

11.59. The northern hilly region of the district grows a lot of fruit and small scale canning and preservation industries can be easily established. There is a large area under forests and forest and recreation-oriented industries should be located in these parts. Training in carpentry and wood work can play a dual role by providing employment opportunities within the area as well as transferring technical know-how to other places in the country. It is likely that the timber-oriented technology and skill may transform these areas into centers of sophisticated manufacturing of furniture and other household accessories and to supply these to more affluent urban-industrial centers in the country. Forest-based industries are highly complementary to recreation-based economic activity. The development of tourist resorts with hotels, golf courses, hunting sanctuaries, hiking etc. cam attract a great deal of seasonal income in these areas.

Jhelum district

11.60 A large portion of this district is occupied by Salt Range. Jhelum is the only developed town. Dina and taraki are situated on the GT Road have great potential for

development. The district suffers from lack of communication and in also short of water, but rich in minerals. 144 mining licenses have been granted for the exploration of coal, limestone, gravel, sand etc. The rock salt production of this district is the largest and that of limestone the second largest in Pakistan.

11.61 There are 34 industries concerns manufacturing glass chemicals, paper products, food products etc. Another 9 industries units for the manufacturing of Gypsum Powder, resins etc. at an estimated cost of 26.5 million rupees have been sanctioned. Limestone and Gypsum being available in abundance, cement factories in addition to the already existing two need to be setup. Coal mines need to be developed and coal production should be increased as much as possible. Since limestone and gypsum are also found in as possible. Since limestone and gypsum are also found in abundance. The production of lime and plaster of paris, both useful buildings should be boosted up on the cottage scale basis. Coal mined from these areas could be used in. These kilns. Industry for the production of resins and other chemicals from this coal can also be established. Potassium malts are also available here and a brine industry for the extraction of potassium malt can also be established. Clays are also available in abundance and small-scale pottery and fire brick industries can be promoted. Rock sald being abundantly available soda ash and caustic soda factories may be easily installed. Groundnut oil expelling mills should be established. Bio-gas farm machinery. Small fertilizer plants need to be set up. Jhelum has been a traditional centre of wood working industries. Factories for making specialized wood blocks for textile shuttles and molded furniture can be set up.

Gujrat District:

11.62. The district has shown remarkable progress since independence and is today one of the biggest centre for electric fans, pottery and furniture. There are hardly any minerals in the district but there are about 85 industrial concedrns manufacturing all sorts of products. More than half of them produce electrical appliances, china and earthenware and furniture. 48 new industries for the manufacture of pottery, electric fans, cotton textiles etc. with an investment of over 50 million rupees have been sanctioned during 1973-75.

11.63. The small industries corporation has set up a ceramic institute, industrial estate and carpet centres whose activities need to be expended and strengthened. Small industries for

the manufacture of agricultural implements can bed easily established. Facilities, such as sui gas., should be provided as early as possible.

Sialkot Djistrict:

11.64. Sialkot is renewed for its sports goods, surgical instruments and musical instruments industries. There are many other industries, such as cutlery, based essentially on skill and entrepreneurship, all of which should be promoted and supported. An electric-furnace for the manufacture of alloy steel should be established to provide the metal required for surgical and medical appliances. The entire economy of the district could be very favorably transformed if a leguminous fodder (berseem and Lucerne) drying and pelleting industry is established, and a rice-legume crop rotation is established instead of the rice-wheat rotation which is very exhausting for the soil. Livestock feed mills, abattoirs and meat packing plants offer very good prospects. Bio-gas plants, farm machinery and farm implements manufacturing should be established.

Sargodha District:

11.65. Un-irrigated areas situated in the west of the river Jhelum are Barani and are highly undeveloped. The northern areas forming of the salt range are rich in minerals. Deposits of Coal, Aluminum, Rich Clay, are found in the Tehsil of Khusab. 75 mining **losses** for the exploitation of coal, fire-clay, limestone, ordinary stone and silica sand have been sanctioned for in this direct. Gypsum based industries for the manufacture of plaster of paris and Gypsum board need to be established. Bauxite Clay in Khusab can be exploited for the manufacture of Aluminum for producing Aluminum in a joint RCO enterprise. Fire-Clay is available in the salt range. This can be used in small industries for manufacturing Fire-Bricks and pottery products. Cattle and poultry, Feed mills and abattoirs, small fertilizers plants, farm machinery manufacturing units and Bio-Gas plants should be established. Carpet centers need also to be setup in this area.

Mianwali District

11.66 The northern portion of this District mainly falls under the Barani Area. This is rich in Minerals. About 60 mining licenses for the exploitation of coal, copper, fire-clay, gypsum and iron ore, limestone, ochres, ordinary stone and sand , silica sand and gravel have been sanctioned. Most of the development has been taken place in the around DoudKhale. Good quality silica is found in DoudKhail and Kala Bagh where small scale industries can be established. In the proximity of the salt mines at Mari Indus and soda ash factory using the abundantly available salt can be established. This product has a large local and international market. Good quality limestone and the bigger known deposits of coal in the country are also found in this area. Small-scale fertilizers plants based on coal need to be setup. Limestone kilns and small collieries also need to be established for producing quick lime and coal. The largest iron ore deposits in the country established at 291 million tons with 33 percent iron content are found in Kala Bagh. The mineralogy through difficult needs closer examination for the extraction of iron, so desperately required in the country. Local processing of iron are to make it suitable for the Karachi steel mills should be undertaken to avoid iron foundries should be established.

11.67 There are nine industrial concerns manufacturing sugar, cotton, cloth and yarn, pharmaceuticals, Sulphuric acid, fertilizers, cement, dyes etc. Manufacturing of plaster of paris and gypsum board for the construction, as cottage industries needs to be established. Small industries for the manufacture of card board from the wheat straw and grass growing along the river bed can also be established around the areas of Esa-khel. This grass can be used for starting mat makin, card and rope spinning industries also.

11.68 The animal wealth of this region can also be easily developed and industries, such as wool processing, carpet manufacturing, developed as early as possible. Three carpet centres have been established and carpet making industry on cottage scale should be encouraged. Bio-gas plants, farm machinery and implement manufacturing plants should be established.

Dera Ghazi Khan:

11.69. District of D.G. Khan lies across the river Indus and most of the area is hilly and covered by Suleman range. The area near river Indus has well developed canal system were the main agricultural produce are cotton, wheat and grams. Most of the district is, however, hilly and arid or semi-arid but possession mineral wealth. Irom ore with good mineralogy has bee found near ZindaPir and SakhiSarwar. Limestone, gypsum, clay and radio-active minerals are also found , Eleven mining licences for the exploitation or gypsum, ordinary stone and mill stone etc. have been sanctioned. There are 15 industrial concerns mostly manufacturing cotton and another 11 industries costing over 5 ½ million rupees for the manufacture of cotton seen oil, gypsum powder, woolen carpet yarn, and cotton Cox-tiles have been sanctioned during 1973-75. Extensive Laterite deposits containing titanium exist. Processes should be developed to extract this valuable mineral and industrial units established for preparing products based on titanium. Iron ore reserves with good mineralogy have been estimated at 14.5 million cons upto a depth of 2 thousand feet. Mini steel plants need to be developed for the exploitation of this are. An electric furnace for the manufacture of alloy steel should be established to provide the metal for industries such as medical appliances. Limestone and gypsum ore also available and a cement factory near Rakhimunh can be easily established. Besides clay and limestone marl is also found near Rakhimunh which can be

readily converted into cement. Cement factories in the area will have the advantage of easy transport for export Small scale gypsum based industries for the manufacture of plaster of paris can also be started. Cottage industries for the manufacture of millstone from local sand stone which is dust hard, can also be established. Cottage industries for the production of fullers earth can also be started. Sufficient cotton is available in the district and more cotton mills at Rajanpur and at D.G. Khan proper need to be established.

11.70. In the arid areas castor plantation for the manufacture of castor oil, having grant international demand, also need to be encouraged. Jojoba (sicsmondsiachinenais) plantation needing small quantity of water should be popularized. This can be used for the production of a good quality non-drying oil used in place of sperm-oil which has a good international market. Cultivation of medicinat plants can also be promoted. Small cottage industries for manufacture of gypsum board for use as building material can also be established. Six carpet centres have been opened wool processing and manufacturing industry for supporting increased number of carpet manufacturing industries also need to be started. Bio-gas plant, farm machinery and implements manufacturing should be undertaken.

Muzaffargarh District:

11.71. The district lies in between the river Chenab and Indus. The area near the river Indus has well developed network of canals where cotton is the major crop. The area adjacent to Chenab is mostly Barani. The mportanty towns of the district are Leiah, KotAddu, Ghazi Ghat and Muzaffargarh. Muzaffargarh alone is situated in the Barani Tract and most of the industries are also concentrated in this town. It has a industrial concerus manufacturing cotton. Sugar, Hessian etc. and another 4 industries for the manufacture of cotton and canvas have been sanctioned during 1973-75

Six carpet centers and matting and handicraft development centers have been started and more are needed.

11.72. Since the district grows cotton as a major crop more cotton ginning and spinning factories, dyeing and printing factories, handloom factories for the production of coarse cloth need to be established. Guar plant is grown is this region from which gum is extracted for use in paper and food industries. A guar gum plant can be easily installed. Mangoes and dates are grown in this area. Fruit preservation industries would be must appropriate. Sugarcane is grown in this area. Gur plants may be encouraged. The molasses from the suger factories can be used as a growth nutrient for micro-organisms rich in protein. The bagasse from these factories can be used for the manufacture of paper and card board in cottage industries. Feed mills to produce livestock and poultry feeds should be established in the district as also abattoirs and feed lots for developing a meat packing industry.

Provision of services:

11.73. The promotional activities fall in two board categories (I) technical and management services and (II) commercial services.

(I) Technical Services:

In addition to bench type research, a variety of technical services would have to be provided. The most critical is the effective provision of design/advisory/trouble shooting and consultative services. It would be possible to provide such services only if well equipped. Technology Transfer and Design centres are established to undertake in respect of the technologies appropriate to the Tract. The services to be provided include Technical information and current awareness services, resources survey, techno-economic studies, standards, specification, testing and quality control services. Pilot plant studies and semi-commercial development work will have to be undertaken before the industrialist would take up a new improved technology. To permorm these tasks satisfactorily it would need a highly efficient local agency to coordinate with various performing institutions. Such an agency to coordinate with various performing institutions. Such an

agency should be capable of forging strong links with appropriate provincial, national, regional and international net-works.

11.74. The institutions which provide such services include the sunivorslties, government research establishments, industrial research and development associations, S & T Information Centres and research units in industry and various governmental organizations set up for the purpose. Such services have yet to be developed on an integrated and effective bases, and proposals have been made in the Report in the chapter on Organization and Strategy for an integrated approach to be aproviaion of such services. A number of international agencies, including UNCTAD, UNIDO, UNESCO and ILO are developing strong programmes to help developing nations to establish such services and their assistance should be fully utilized.

Product Design:

11.75. Industrialization in the nation has been, by and large a simple process of factoryization, importing factories from the induystrialised countries and getting these installed on a turn-key basis. It has been a simple transfer of technology from the advanced nations regardless of the local situation and requirements. This has caused numerous difficulties and problems discussed earlier and the nation has been unable to break away from the status of a dependent country. It is necessary to build national capability for the design and manufacture locally of a variety of machinery suited to over own situation and needs.

The design must be closely related to the capability of our people to manufacture the components, the skill level of the people who would operate, maintain and repair the machinery, the nature of resources available and the type of product needed. Improved design should aim at the utilization of local raw materials. Improved design may also enable the use of materials of somewhat lower quality or to substitute entirely and less costly materials.

11.76. The stage through which a country like Pakistan embarking on programs to improvement design would have to pass through are as follows (1) adoption of foreign product design without modification (ii) adaption of foreign design to meet local conditions. (iii) improvements in the foreign design and (iv) creation of products with entirely new designs. This process will not be realized until (a) the

industrial workers are motivated to participate in the innovative work, and their creative energies are liberated (b) research and design institutions are created manned by trained creative persons for design improvements or risk loses by commercial scale manufacturing with machinery and processes evolved through research and design work in governmental institutions.

11.77. Under our conditions to begin with Government controlled centralized Design centers will have to established to work on the creation of appropriate technologies but efforts should be made to create people's own organizations as soon as possible. Amongst the institutions which have proved highly effective in many countries in working with small industries are the cooperative research development associations. Nearly 40 such associations exist in the U.K and a good number of similar groups have been established in India. In the Barani tract the sports goods industry, the

Surgical instrument industry and the electrical goods manufacturing industries at Sialkot and Gujrat are in a stage of development where cooperative research and development associations are given government grants on a matching basis.

11.78. Research development corporations have been created in many countries including the United Kingdom, Japan and India to provide the risk funds so as to enable the results of research and design to be utilized in industry. Similar institutions need to be established urgently in Pakistan.

Educational training

11.79. There is a great need to provide for life-long continuing and training of industrial workers. Under the new educational policy system of formal and non-formal education in the country is being re-oriented to technical vocational training. A great part of the Barani Tract is cut off from developed parts of the province. Training workshops should be arranged from time to time in different areas in various vocations and crafts. Peripatetic parties and mobile workshops will help introduce new tools and techniques to mistries and craftsmen in the far-flung Barani areas.

(ii) Commercial Services

11.80. The various provincial level service programs have an inadequate level coverage in most parts of the Barani Tract. The establishment of an effective Agency for Barani Areas Development is needed to undertake the integrated management of its resources including the provision of commercial services to industry. These services will perform

The following principal functions:

(i) Production facilities including common facilities centers and mobile common facilities units and small industrial estates. These production facilities may have to be started by the government but will be transferred to cooperative enterprise as soon as possible.

(ii) Supply and marketing services including sales and display centers to market small industries products and display modern designs, patterns and suitable equipment, grading and inspection to ensure standardized quality of products and supply of materials and equipment especially imported supplies which will be sold to small industries by their cooperative societies.

(iii) Credit services including loans for modernization and extension and credit for purchase of raw materials and for marketing. The cooperation of existing financial institutions will be enlisted. Government may also provide to the proposed Barani Areas Development Agency a revolving fund for the purpose. Cooperative societies should be organized for the purpose of providing an effective channel for both credit and other services.

N.B. The following statements are appendix

(i) List of factories setup / sanctioned during 1973-75 in Barani Areas.

(ii) Activities of Small industries corporation in Barani Areas.

(iii) Pakistan Small Industries corporation's additional schemes for 1975-76 in Barani Areas.

(iv) Distribution of Registered Factories District Wise.

CHAPTER –XII

SOCIAL INFRA STRUCTURE

12.1 The social-economic situation in the Tract to be viewed in the perspective of the vast new changes and comprehensive reforms introduced by the Government in every sector of society _ industry, banking, labor, rural, welfare, education, science and administration. There is a re-affirmation of the Pakistani Islet, now enshrined in the permanent constitution of creating a just social order of the participation of all people in development and of the sharing by all people of the fruits of progress

Land Reforms

12.2 The most important step taken amongst the numerous revolutionary measures flowing out of this commitment for the up-lift of mass of the people has been the land reforms announced in 1972. The basic cause of the rural malaise was the distorted productive relationship in which the farmer worked. The size of his holding was too small to be economic, three out of four acres be cultivated did not belong to him and he paid 50 percent of the produce to the owner. Apart from being deprived of the fruit of his labor, he was not given the right to take decisions concerning permanent improvements to the resource base i.e. the land he tilled. Neither did he possess the means to obtain the inputs needed for increased production. Inertia and stagnation becomes the main characteristics of the village sector. The reforms in the words of the Prime Minister would effectively breakup the iniquitous concentration of landed wealth reduce income disparities, increase production, reduce unemployment, stream-line the administration of land revenue and agricultural taxation and truly lay down the foundations of relationships of honor and mutual benefit between the land-owner and the tenant.

12.3 In economic terms the land reforms are aimed at greater efficiency in resource use and incentives for cultivators to increase agriculture outputs. The main provisions of the reforms include (1) reductions of the ceiling on individual holdings from 1000 acres to 300 acres in the case of unirrigated / Barani lands, resumption of land without compensation above the ceiling and its re-distribution by the state to land-less tenants and owners of small holdings (2) banning of arbitrary ejectment of tenants providing security of tenure. (3) shifting of costs of traditional inputs from the tenants to the land-owners

and ensuring share in produce and (4) impartibility and restrictions on alienation of holdings to check the creation of too small uneconomic holdings.

12.4 The replacement of the large land-holdings by the smaller holdings is expected to have a highly favorable impact on the production and labor utilization. Recent surveys indicate that large holdings have a lower percentage of cultivated area _ 34 percent in holdings above 150 acres as against 87 percent in holdings above 150 acres as against 87 percent in holdings below 12.5 acres. Their cropping intensity is also lower _ 77.8 percent in the case of 50 acres' holdings as against 118.3 percent in the case of holdings below 12.5 acres (data pertains to non-tube well farmers). The Labor inputs per acre is 44.8 man-days per cultivated acre for a farm size of 71 acres (average) and 93.5 man-days for a farm of 9.2 acres (data pertains to Muzaffargarh District). The small farmers apparently use land more intensively and put in more labor. The redistribution of land to small operators would thus increase output per acre per year provided the disabilities under which they function in respect of credit and input supplies are removed.

12.5 About 45 percent of the cultivated area according to the 1961 census of agriculture is cultivated by the tenants. Most of the land of the large owners are operated by tenants., the Shadab Project Data indicates that the owner-operator earns Rs. 742/- per acre, while the tenant cultivator has an income of Rs. 610/- per acre. This is very significant lower production on nearly one half of the total fam-land in the country is a problem of great complexity and an area of serious concern. The problem is particularly acute in Barani Tract as a very large number of owners of the small uneconomic holdings emigrate to work in the large cities. In the services, the army and in foreign lands. Their lands are cultivated by tenants. There are very severe constraints for improving production on these tenant-cultivated lands. Neither the tenant nor the owner would make any investments. The tenant would not invest any permanent improvement (benching terracing. Water development etc.) as he most give 50 per cent of the increased produce to the owner, which does not leave him an adequate return on investment. He can not even arrange for chemical fertilizer or other purchased in-puts as he can get no institutional credit. Some land-less tenants lack even bullocks and farm implements. The owners of such small units are similarly Uninterested in permanent improvement in land

or in purchasing in-puts, such as fertilizers because 50 per cent of increased returns would by right go to the tenant, and often much more if the owner is a little lax.

11.6. The now situation is beset still with numerous tensions which remain unresolved because the traditional system as become in-operative and the new order would take time to establish. It is not only law but the actual balance of power in a local situation which determines whether the land-lord or the tenant gets away with a larger share than his due. This was very forcefully represented to the commission in campellpur where it was alleged that the tenants deprived the land-lords or their due share, by using such stratagems as grazing the wheat crop to Livestock so that the tenant got considerable profits by the scale of animals while the share of the owner was greatly reduced due to low grain yields. Instead of a 40 per cent share, the land owners claimed they received only 10 per cent or so. The land-lord, therefore, finds no incentive to invest in any permanent improvement of land or to arrange for supplies of inputs such as fertilizers and seeds.

12.7. Such mal-adjustments can lead to very serious reduction in production from the land and in the neglect of permanent improvements to land. Settlement of such disputes in courts of law is very unsatisfactory, besides being very wasteful of money and time and energy of all concerned. Morley tinkering with it through minor palliative measures would not avail. There is infect no historical precedent for successful regulation of tenant-landlord relations in Pakistan. The only rational way out of the difficulty appears to be the organization of cooperatives so that the capital (land) and labour (Tenants) could both he recompensed fairly. The Prime Minister with un-erring perspicacity and discernment hit at the right solution when he advised: ‘Now that we have genuine Land Reforms. It has become all the more necessary, indeed indispensable to encourage the Co-operative System for the development of agriculture Please give your undivided attention to this vital subject. The reforms will be meaningless and even harmful if we are unable in strengthen them side by side. This is so axiomatic a proposition- so self-evident a truth that I do not have to delate upon it”

Cooperatives.

12.8. Building of cooperative institutions is thus a vital component of agrarian reform and reconstruction. A cooperative system is also indispensable in order to ensure the adjustment of rural society to the new functions required by economic and social growth. In their constitution and structure the cooperative institutions must not be discordant with the national ethos and must

evoke a positive response. Collectivism and commune type structures would not be in line with our genius. Our institutions cannot be compulsive and must necessarily be voluntary and cooperative. Extreme individualism and a capitalistic configuration would also run counter to our value system and the social-economic realities. The cooperative must thus emerge as the key socio-economic institution.

12.9. Cooperative effort has taken various institutional forms in different socio-economic and political systems. On one end of the scale is the capitalistic type of cooperative society, organized for example in the USA. Primarily for the larger farm owners who are attempting to keep up with the latest in modernization. On the other end is the commune in China which combines the functions of a local government and a cooperative society and is a multi-purpose political, administrative and organizational unit covering the full range of economic, social and administrative activities necessary for the integrated development of a rural community. In between are the producer/consumer cooperatives of Scandinavian countries which follow the social democratic approach, emphasis adult education, training of people for democratic option and equitable distribution of earnings and cooperatives in the East-European countries which are democratic de-centralized cooperative enterprises based on democratic socialism. They include not only farming but also small production and manufacturing co-ops and use economic and non-economic incentives and social controls not from centralized authority but from local federated institutions. They are greatly concerned about equity and justice.

12.10. The economic political system being built in Pakistan is a democratic politico-economic system with a strong accent on distributive justice. Under this system it is not possible to establish institution such as communes which are the product of a centralized state system. Neither in it desirable to encourage the capitalistic type of cooperative established by the larger farm owners for improving their individual gains. The type of cooperative which Pakistan needs must have strong component of development equitable distribution of benefits and mass participation and training of people in a mixed economy like ours with accent and emphasis on distributive justice and democratic control, the role of the cooperative is to: (1) act as an agency for change and development of people and institutions. (2) provide economic services. (3) provide citizens with experience in building institutions and human relations. (4) act as an institution of economic democracy which gives members participation and voice in social and political affairs (5) act as a partner, in a mixed economy with both the socialistic and private segments, and (6) act as a countervailing force to state bureaucracy and private profit business.

The overall objectives would include speeding up economic and social development, balancing of people building and institution building, maximizing equity and integrity, minimizing tensions and conflicts, socialization of human relations and the un-folding of democratic procedures, institutions and philosophy.

12.11. The cooperative institutional structure to be created in the Barani Tract must be such that the organization can effectively assist in the management of resource both material and hum. Such an institution should be capable of making a determined bid to change the state of technology and modernize means of production. The situation in the Barani Tract is particularly favourable to the organization of cooperative organizations. The farm sixe has become so small that a large majority of the owners have left the Tract in search of jobs outside They would welcome initiatives for organizing cooperatives. The tenants have been given a wide range of protection under the land reforms. They would find in much easier to secure their new statutory rights if they dealt with an organization such as a cooperative instead of the owners of the land.

12.12. Although there have been stray attempts at establishing many types of cooperatives, the most common type has been a very narrowly conceived cooperative credit society. Limited to the provision of credit to the more influential farmers who not infrequently use the funds for purpose other than agricultural. The type of cooperative needed at present is an institute with a more comprehensive scope. The two models in view are the comillaDaud-Zai type of cooperative and the cooperative farming Societies based on the pooling of land.

12.13. The ComillaDaud –Zai Cooperative is basically aimed at the building up of grass-root institutions at the village, federated at the Thana (Naiqa or Market) level. It rejects the approach of servicing of individual farmers by assistants, low level government paid functionaries from various extension agencies. It envisages instead the establishment of self-governing village councils and cooperatives whose leaders are trained as responsible participants, who regularly visit the thanacentre for discussions and advice. The representatives of all government departments are posted at the Thana Centre to ensure coordination between the development departments and institutions, as also to provide for working together with representatives of village cooperatives on their regular visit to the Thana Centre.

12.14. The components of work at the Daud-Zai Centre have been as follows : (I) a centre of development administration at the Daud-ZaiMarkaz, with representatives of all departments posted at the centre, coordinated by a Project Officer. (II) The formation of two units, a cooperation unit and an engineering unit, at the markaz level on survey needs and opportunities in the project area, and consult with the local people, (III) organization of groups of farmers into village cooperatives who meet in the village and through their representatives at the Markaz level. The major objective is to anable the members to rapidly increase yield by adoption of improved methods of farming, (IV) Planning of physical infer-structure for the area – roads, drainage, irrigation, land improvements, electrification and implementation through People's works Programme etc., (V) training intensively and continuously many cadres of local leaders. The objectives of the Daud-Zai type of cooperative include broader economic, political and social objectives.

12.15. Cooperative farming: The Government of Pakistan have recently promulgated an ordinance providing for the institution of cooperative farming and setting-up of agriculture-based industries. These cooperatives would be based on the pooling of land under joint management arrangements, Land would be pooled by cooperating farmers, so that a large enough estate (minimum 500 acres) is established, which would have all the advantages of the big estate. Such as, better management, ability to negotiate loans, by farm machinery, greater production, higher profits and savings. High employment, batter bargaining strength for its produce, ability to purchase all types of in-puts and adoption of measures for farm life improvement. The benefits of modern technology would thus become available to farm lands which because of their very small size and paucity of resources have remained out of the orbit of modernization. The Ordinance ensures the individual ownership and the right of with-drawal after three years. Leven such pilot cooperative farms are to be established in the country with financial assistant from both the federal and provincial governments totaling Rs in lakh for such cooperative. It is strongly recommended that at least one of the eleven pilot cooperatives should be established in the Punjab Barani Tract. The Government have pledged many other incentives including income tax exemptions on dividends paid to members Cooperative councils at the national, provincial and district levels have been established to provide over-all supervision and assistance.

12.16. World-wide experience indicates that a village cooperative which limits itself to cooperative farming very soon reaches in celling. Unless he village society in moved towards

considerable industrial activity, there in retardation of progress. The success of the Chinese commune basically is due to the great emphasis on intermediate industry based on intermediate technology, run by people of medium-level skill. Nearly 10 per cent of the total income of a commune comes from such small scale industry, thus utilizing the labour and the local raw materials to great advantage, while bringing about self-sufficiency and self-reliance.

12.17. The challenge for the Barani Tract does not lie only in the field of crop culture. A major push will have to be in the sector of small-scale industry. In addition, there is no reason what-so-ever to restrict benefits to only farmers, the non-farming rural population (about 30 per cent) must also receive benefits of national investment in development. There must be uniform scope for the progress of all sectors of rural society. In addition to farmer's associations and cooperatives, primary cooperative societies should be established for cottage industries such as carpet making an d for agro-allied and agro-based activities. A desirable movement would be to establish primary societies in a number of sectors with the objective ultimately of amalgamating these into multipurpose cooperative societies. Such a multi-purpose cooperative society can take up responsibilities of production, consumption and exchange of goods and services including marketing and processing. The comillaDaudZai type of cooperative has a built in flexibility for under-taking a vide range of activities.

Credit

12.18. A pre-requisite to increasing agricultural production is the regular and timely availability of various agricultural inputs on credit: as these inputs are generally due at a time when the farmer does not have the necessary funds to meet such obligations. The availability of credit becomes critical when farming systems have to be modernized and production increased through the application of new technology, such as, the use of chemical fertilizers, pesticides, etc. Credit is also needed to effect permanent land improvement (levellingh. Bunding. Water development etc.) the existing institutional arrangements for providing farm credit are: (i) the Agricultural Development Bank, (ii) cooperative credit societies (iii) commercial banks. (iv) taccavi loans. These arrangements simply do not reach the small farmer, and the landless tenant. Only 15 to 20 per cent of the credit requirements of farmers are met from the above mentioned institutions, and it is generally the more affluent farmers in the more developed parts of the country who get this credit.

12.19. When institutional credit is not made available to the small operator and the tenant cultivator, they get into a serious predicament. Indebtedness to traditional sources of finance. With possibility of eventual loss of land or failure to achieve maximum production and income benefits. Even the traditional sources of capital for tenants are now not functioning due to strained relations urgency of institutional credit provision for the beneficiaries of land reforms.

12.20. It is not possible for any banking system to cater to the individual needs of hundreds of thousands of farmers scattered over a wide are, in a manner that credit and inputs would be made available in time. The only solution to the problem is, therefore. In grouping these farmers into cooperative societies. Cooperative societies have, however, been established in thousands in the past and their record is very disappointing manly because they concerned themselves narrowly with credit alone. At our stage of development, the societies should mostly be multipurpose societies emphasizing increased production, and credit should be tied up with production, marketing and supplies. When such societies obtain inputs and market their surpluses on a collective basin it becomes possible to arrange repayment of credit at harvesting time.

12.21. Commercial Bank are not likely to play in the near future any significant role in providing the credit needs of the mass of the farmers in the Barani Tract although they would continue to perform useful functions for the prosperous farmers. The Agricultural Development Bank is also unable to be of much assistance, as the policy is for the bank to refrain from giving short-term production Loans. Its activities mainly concern long and medium-term loans. The bank has become more or less an agency to administer the large foreign loans for tube-wells, tractors etc. The benefit to Barani areas has thus been minimal.

12.22. The Agricultural Development Bank has been able to set up its branches only uptomarkaz level and has no effective reach to the farmer who needs the credit. The more influential farmer alone manage to benefit from its facilities. One possibility which should be examined seriously is to arrange for joint funding by the Agricultural Development Bank and the Cooperative Banks. The Agricultural Bank has the money and the Cooperative Banks and societies the out-reach is the villages so that the two could function in a complementary way. At the least, cooperative banking should be replaced by specialized banks for cooperatives.

12.23. The village cooperative is a key institution but has limited and specified functions which are mainly economic. Its main aim should be to improve farm production or reduce production cost of member farmers. Furthermore, the cooperative is a voluntary association and does not necessarily include all or even the majority of the people resident in an area. It cannot thus be a sufficient organization for the performance of numerous developmental and management tasks that a rural community must perform Essential services, such as, the administration of justice, public works, health, roads, water supplies, education etc., have to be controlled and paid for by a body representative of all the people i.e. the local government instructions.

12.24. The biggest institutional lacuna in rural areas has been the absence of local government institutions which could provide a permanent cover to the various managerial and developmental tasks that must go on. The indigenous local institutions, which managed village affairs since times immemorial were wiped out by the often British government, which created new lines of command and power structures based on their peculiar political and administrative needs. The influence of both their revenue and judicial administrations was to destroy the solidarity and the enterprise of the village communities. The traditional system was slowly weakened by the pressures for uniformity and centralization of district administration and its often courts of law Even often the British left the sub-continent. The colonial system has furnished. It is only the present government which has now ordered a fundamental and radical change by enacting legislation for the establishment of local government institutions from the village level upward. These will be fully decentralized democratically elected local government institutions and would function with the full participation of the people.

12.25. The Punjait local government Act envisages the setting up of Dei (village) Nalqa (a group of villages with a population of about 30,000) and zela (district) councils. The functions of the local councils would include: (a) civil functions, such as public works and the management of economic resources of the area according as the government would direct them. A Dehi Council may , for example manage agricultural farms or state lands: (b) Judicial functions: (c) finances and taxation; and (d) developmental functions.

12.26. The basic change is the establishment of the government by the peoples in place of government for the people. The aim is to devise an administrative and organizational frame-work of local government which will provide for the participation of the people in planning organization, implementation, coordination and control of all matters concerned with their welfare. The main developmental functions would hopefully be delegated to the nalqa level. Since the best opportunity for the people's participation in planning, organizing coordination and controlling such activities would be available at the level.

Integrated Rural Development Programme.

12.27. The need has been long fair for an integrated approach to rural development, based on the factor endowment of each unit area. Instead of the multiplicity of centrally conceived programme developed by various government departments and agencies through vertically organized extension services. A number of integrated programme was launched earlier under the village Agricultural and Industrial Development (V-AID), the Basic Democracy System, and the Comilla Rural development academy, with varying degrees of success, based on these experiences and consciousness of the failing of a piecemeal approach, a comprehensive national Integrated Rural Development Programme was Launched by the government of Pakistan in July 1972. The central concept of the Programme has been very succinctly described as follows: -0

> "To select a production area comprising 50 to 60 villages, mostly with small and medium sized farmers, with a view to improving their socio-economic status by intensive rural development programme with initial thrust to increase productivity by providing technical guidance, supervised credit, supply of inputs, machinery on hire storage and marketing facilities, etc., based on sound physical organizational, institutional infra-structure by intensiftention, diversification and commercialization of agriculture through a social cooperative system under a total approach".

12.28. As is clear from the concept statement, the programme has an all embracing comprehensives. This purpose is to be achieved by the establishment of a network of 714 project areas during the next five years, each with a focal point name d as market (centre) to function as

the base of all types of developmental activities. The markez would have a variety of facilities, such as the offices of the various nation building departments. Banks supply of inputs machinery workshop storage marketing and agro industries. It is envisaged that there would emerge at the markaz four complementary and coordinated functional bodies (1) government nation-building Departments coordinated by an IRDP Project Manager (2) village farmer's cooperative societies federated at the markaz level. (3) private sector supplies/inputs such as fertilizers. (4) local government council (as and when elected). The basic function of the IRDP is to act as a catalyst and a coordinator for the totality of rural development.

12.29. It is too early yet to evaluate the performance of the programme. So far as the Punjab Barani Tract is concerned on the basis of the criteria developed by IRDP, there should be about 150 IRDP project areas in the tract. There are no more than 10 to 15 project areas on the ground and 90 per cent of the tract thus remains uncovered by the programme. Little infrastructure has been developed, nor have in-puts and credit supplies been significantly augmented e.g., there is at present one fertilizer depot for 200-400 villages in the Tract. No small-scale industry has been established and no water and energy development has taken place. Livestock is the mainstay of the people but little development work has been attempted in animal husbandry. The only sector attempted so far has been crop-culture confined mainly to demonstration plots in a few localities for showing the effect of HYV seeds and chemical fertilizers. No multipurpose or farming cooperatives have been established in the Tract. There are obviously resource constraints and the pressure exercised by the more favoured parts of the counry where the existing infra-structure provides a strong pull for the work of the government agencies now or old.

12.30. There are three basic short-comiage in the programme in so far as the Barani Tract is concerned. There is lack of institutional complements for (1) area resource management planning (2) creation of site-specific technologies and (3) training and education of peasants, cadres and government functionaries for production. These are briefly discussed below.

12.31. Area Resource Management plans Detailed plans based on accurate agronomic, engineering, socio-economic surveys in the field, identification of resource. Problems and opportunities have to be formulated for each Project area. The integrated plan should include crop-culture animal husbandry, forests, minerals. Industry, water, energy, social and physical infra-structure, manpower training and the creation of specific new technologies. Without such

integrated planning, there is no means to ensure integrated development. No such plan for a Project area in the Tract is within the knowledge of the Commission.

12.12. Creatin of site-specific technologies, All Programmes of modernization of development would involve the upgrading of traditional technologies or down-sealing of sophisticated technologies practiced in the advanced nations. To adapt to the local situation and requirements. Such technologies to be successful must be sito specific i.e. they should relate to the local factor endowments. For example technology valuable for Murree Hills would be irrelevant for Dera Ghazi Khan. At present, huge suns area invested in programme based on generalities and text book prescriptions which have little relevance and applicability to a given local situation. There is an almost complete lock of Field Experiment Stations in different ecological zones of the Barani Tract. A net work of modest field experiment stations in all parts of the Tract of necessary to test and adapt improved technologies. And to evaluate performance under field conditions. Without tested technologies and feed-back from field, the entire integrated programme will be one big gamble at the expense of the masses, who can ill-afford adventurism and risky new ventures.

12.33. Training and education the Integrated Rural Development Programme has not developed any component of training or re-training, of education or continuing education. The process of modernization and dynamic growth is not possible without this component as the traditional methods and skills have to be continuously replaced and newer technologies requiring newer skill. Education and training are n needed for (1) farmers and artisans i.e. the productive labour force. (2) political caders and local leaders, who have to motivate and pilot programmes of social and technical change and (3) functionaries of governmental departments and services who have only an academic back-ground and must be given production and managerial competency in a given ecological situation, resource base, and cultural setting.

People’s Works Programme.

12.34. The People’s Works Programme has its beginnings in the rural works programme. Initiated during the late sixties, when the problem of rural unemployment and under employment started assuming threatening proportions and mass drift to urban areas began. The works programme was directed to create in the rural areas infra-structure, such as, irrigation roads,

drainage, small dams, drinking water supplies, community buildings, tree plantation etc., chough labour intensive works. It was believed that this will result ultimately in increasing production, as well as solving the employment problem by engaging people in works requiring little technical skill. The Government provided the administrative, technical and financial support, while the people assisted in identifying projects to be undertaken.

12.35. The People;sWjorksProgramme was launched with greater support and expanded scope to combat unemployment by mobilizing local resource, manpower and leadership and to solve local proglems within the frame-work of national development efforts. The programme was also aimed at educating people in collective and cooperative living.

12.36. A recent government report on the people's works programme has made highly unfavourable observations on its functioning. Even the Prime Minister has felt concerned about its progress and has observed. " Instead of operating the programme on the basis of the joint participation of the people and the government agencies, the old system of PWD was resorted to resulting in colossal wastae and explettation"

12.37. There has been little genuine involvement of the people or serious planner on local resource utilization for integrated development. The whole programme has degenerated into a wayt of providing doles to be used to the advantage of a few rather than the benefits to the people at large.

12.38. The programme, if it is to serve any useful purpose, must become a part of an area resource management and production plan, otherwise the circulation of additional money-supply without pestive incremental production would inevitably lead to increased consumption, overt shortages of necessaries inflaction and general social unrest.

Coordination

12.39. Thekre is a great dealof concern at the highest political and executive levels. That the variety of social institutions and programmes described above have failed to reach the target group viz: the small farmers tenants. Land-lese laboures and village artisans. In order to ensure the realization of the ensure the realization of the important objectives of the programmes. Government have therefore set up recently a separate Ministry would activate efforts for the

achievement of balanced socio-economic development in the rural areas coordinate and evaluate the development strategies and the planning and implementation of the Provincial Governments programmes as wellas the activities of the local government institution to be set up shortly. The provincial government have also been asked to reorganize their administrative departments in such a manner that these programmes are brought under one Department and the newly created Department is placed in the charge of one Minister solely and exclusively responsible for these programmes.

12.40. I has been decided to postpone elections to the local government institutions for the time being and to make adhoc arrangements for the extablishment of local government institutions. Due care must be exercised in making the adhoc arrangements. The efficient functioning of these councils is a matter of the atmost national importance. It would need through and imaginative programmes at training the government functionaries. The local leaders and the people's representatives to shoulder their onerous responsibilities. A poorly planned disoreanised effort could could lead to a complete catastrabe and enormous waste of energy and gearce resource. Already the public morale has been very badly affected by the fiaeeo in various ventures such as the V-AID. Basic Democracy system etc. A poorly planned and disorganized effort could lead to a collapse of democratic processes and a resuscitation of the colonil type of centralized administration.

CHAPTER XIII

PHYSICAL INFRA-STRUCTURE

13.1. The Barani Tract has remained neglected, backward and out of the stream of development. This is reflectred in the lack of physical infra-structure in the region. The renewed interest and the national commitment to develop the Barani Tract has hopefully introduced now an element of repid and dynamic growth and modernization. There is also the phenomenon of an exponential growi in population and the expectation that the population of the Tract sill double y the end of the century. The infra-structural needs for maintaining and additional 10 million people ould require a redoubled effort at meeting the deficiencies. There is need for quickly developing communications and transport of identifying the poterntial growth centres for development of small towns and medium sized cities of providing buildings to house people as well as markets wate-houses processing industry and manufactuiring units and for a variety of civic needs of rural electrification and the provision of gas. Reservoirs for drinking water and irrigation drainage and irrigation channels etc. A number of these items have been dealt with in the proceding chapters. In this chapter three major areas will be discussed; (1) transport and commjunications. (2) physical planning and housing and (3) rural electrification.

Transport and Communications.

13.2. Efficient means of transportation are a pre-requisite to economic development of any area, region or country. Thgis is basically due to the fact that economic development. Which is synonymous with industrial and aghricultural development cannot be achieved without enguring an adequate system of transport for the movement of goods and people. Reliable means of transport are essential for exploiting other economic potentials etc. Development of agriculture animal husbandry and tourism are all dependent primarily on the adequaey of a transport system. Similarly provision of social services such as education and health etc. are also greatly dependent upon transport.

13.3. The Problems An idea of the tyransportation deficit in the Barani Areas can be had lby comparing the existing system with the rest of the world. It is well known that more than 90 per cent of our villages are not served by all-weather roads. Whereas some attention has been

paid to the development of main roads. Aghricultureal and rural areas have been grossly neglected. In fact this imbalance goes a long way towards explainin the poor levels of production. Unless the development of transport is made an integral part of a total strategy for development. Particularly for less developed regions and for bridging the gap between developed and under-developed areas in which more than 4/5thof our population lives, a break-through would not be possible. There is no doubt that no country has been able to resolve to universal satisfaction the many complex issue that arise in the provision of adequate transport but there can be no denying that lack of transport is the most important factor for non-achievement of targets in various failds of nationalendesvour.

13.4. In the evelopoment of transport the experience of other developing countries should serve as a guide. In the selection of an appropriate choice of transport technology for any area the comparative advantages of each mode of transport. In a given situation determine the approach to be adopted. What is needed is to avoid the use of resources to develop those modes of transport which cannot meet antisfactorily the requirements for development.

13.5. It is now accepted that reilaways have an advantage where large volume of heavy traffic has to be transported over long distances. But where ashort hauls small shipments or perishable and fragile goods are involved. Road transport has an inherent advantage. In fact it can be safety stated that there can be no revolution in agriculture without revolution in road transport. This is particularly true or our country wherein most of the population lives in villages and majority of these people have no contacts with outside would. In fact the first impression of an outsider about our rural areas is that the principal occupation of majority of our people is moving themselves and their commodities from one place to another. In the rural areas the most familiar sight is of men and women carrying loads on their heads. Animals and bullock-carts struggling to get things moved through dusjt and mud.

13.6. Present statisties indicate that one out of very four villages in our rural arteas is more than 5 miles from an improved road. The villagers move over tracks supported by animals where going is rough. The development of rads in rural areas, therefore, is a primary requirement to raisc agricultural production by increasing the availability of fertilizers and providing easy access to villages fortechnical and agricultural extension workers.

13.7. There is sample avidence available that amongst the pre-requisites of rural development are greater reliability of transport and reduced transport costs. The question. However is how to design an effective approach to deal with rural transport deficiencies. One criterion is the ratio of miles of road per squire mile of cultivated area compared to the ratio in other parts of the country. In no agriculturally advanced country, expecially in the western world. Is the ratio of the numbert of miles of farm-to-market road per sq.mile of cultivated land. Less than three to one. In Britain, France, Japan and the United States. The ratio is around 4 to 1, whereas in Denmark it is closer to 3 to 1 and in Malvasia and the Philippines around one to one in Pakistan, the present ratio is ¼ of a mile of a road to one square mile of cultivated land, which is grossly inadequate.

13.8 Existing justice of…….. Among the various mode of transportation, road transport has come to play a very important role on account of its inherent flexibility and the degree of economic mobility it affords to the users. A good system of road transport not only promotes development activity but also influences the locational asperts of various economic activities.

13.9. The Barani Areas have a very modest system of roads. There are approximately 3600 miles of metalled roads which are maintained by different agencies such as the Highway Department, People's Works Programme and Local District Councils About 3157 miles of metalled roads are maintained by the highway Department. 440 miles by Local District Councils and the rest are under the People's Works Programme.

13.10. District-wise break-up of roads maintained by the Highway Department in the Barani Tract is as follows.

Name of District	Miles.
1. Campbellpur	349.89
2. Rawalpindi	450.04
3. Jhelum	268.57
4. Gujrat	230.35
5. Sialkot	250.69
6. Mianwali	380.03

7. Muzaffargarh 388.28
8. D.G Khan 299.82

13.11. During the last year the highway Department undertook 76 schemes with a budget allocation of Rs. 729.25 lacs for construction and improvement of the existing and new roads. Budget allocation for various schemes is given below:

s.#	NAME OF DISTRICT	TOTAL NUMBER OF SCHEMES OF ROADS UNDER IMPROVEMENT/RE-CONDITIONING AND CONSTRUCTION	BUDGET ALLOTMENT (Rs in Lacs)
1.	Sialkot	6	50.00
2.	Gujrat	13	130.00
3.	Jhelum	9	69.00
4.	Rawalpindi	14	123.00
5.	Campbellpur	9	103.25
6.	Mianwali	4	50.00
7.	Muzaffargarh	23	88.00
8.	D.G. Khan	8	166.00

13.12 In 1975-76 provision has been made for the construction/improvement of 103 road schemed in the Barani Tract with a budget provision of Rs. 1196.00 lacs. The details of the number of schemes and budget allotment for the Barani area. District-wise, is a under:-

s.#	NAME OF DISTRICT	TOTAL NUMBER OF SCHEMES OF ROADS UNDER IMPROVEMENT/RE-CONDITIONING AND CONSTRUCTION	BUDGET ALLOTMENT (Rs in Lacs)
1.	Sialkot	12	163.00

2.	Gujrat	7	99.00
3.	Jhelum	13	127.00
4.	Rawalpindi	27	250.00
5.	Campbellpur	5	75.00
6.	Mianwali	10	80.00
7.	Muzaffargarh	14	176.00
8.	D.G. Khan	15	226.00

13.13. In physical terms. A target of about 13 miles for widening/improvement of the existing roads and about 10 miles for the new construction of roads in each District was fixed by the Highway Department Approximately. 104 miles of roads have been widened/improved and 80 miles of new roads constructed in Barani areas.

13.14. A significant road project word mentioning. Parts of which would serve the D.G Khan District also, is the construction of a Highway on the right bank of River Indus, Linking Peshawar- D.I Khan –D.G. Khan- Larkana – Dadu and Karachi. The present proposal is to construct this highway on any entirely new alignment by-passing the existing towns and cities. It is to be a limited-access high-speed highway. Primarily meant to cater to traffic. Even then, link roads would be provided to feed the highway.

13.15. In addition to the Highway Department. People's WjorksProgramme and Local District Councils are also improving reconditioning and constructing roads in the Barani areas. The distribution of budget allotment under People's works Programme is as follows:

i) 55 per cent allocated to the nine backward Districts.

ii) 45 percent allocated to 10 relatively more developed districts.

iii) 70 percent of the allocation for each of the above two categories distributed District-wise on pro-rata basis and the balance of 30 per cent on the basis of population.

13.16. Thus the less developed Districts in general and sparsely populated backward Districts in particular, get priority in allocation of funds.

13.17. Under the People's Works Programme, approximately 62 miles of metalled roads were constructed during 1972-73, 65 miles during 1973-74 and approximately 70 miles during 1974075, in the Barani area.

13.18. Detail of longth of the roads. District-wise, in the Barani Tract, maintained by District Councils/People's Works Programme is as under

S.#	Name of District	Miles.
1.	Sialkot	30.35
2.	Gujrat	63.31
3.	Jhelum	71.11
4.	Rawalpindi	52.62
5.	Campbellpur	62.25
6.	Mianwali	67.04
7.	Muzaffargarh	56.23
8.	D.G. Khan	40.25

13.19. The District-wise detail of construction programme and budget allotment for the road construction during the year 1975-76 for People's Works Programme/District Councils is as under:-

S.#	Name of District	Length in miles of black-topped road under construction	Budget allotment (Rs. In Lacs)
1.	Sialkot	9.75	11.00
2.	Gujrat	3.75	3.80
3.	Jhelum	2.50	25.00
4.	Rawalpindi	7.01	16.02
5.	Campbellpur	32.02	52.52
6.	Mianwali	37.01	55.362
7.	Muzaffargarh	5.33	8.84
8.	D.G. Khan	NIL	NIL

13.20. In addition, there is a large mileage of kacha roads linking the villages, towns, etc. of the Barani area with each other and with the existing truck roads. There roads are being maintained by the Local Councils through their own resources. Condition of these roads is rather poor, land width has been reduced by encroachments by the adjacent land owners. Moreover, in the rainy season water remains standing on these roads and no traffic can play on them. These need to be improved and t brought to all weather specifications by construction of culverts, demarcation of proper land width, removing encroachments and bringing the road formation in the proper camber for drainage purposes where necessary the level of kacha roads be raised to avoid water ac construction from the adjacent fields.

13.21. The Barani Tract thus has a very modest system or roads. The existing roads have mostly been constructed with obsolete specification and standards. The volume of traffic being low, their pucca width varies from 9 to 12 feet and road crust thickness is only 6 to 8 inches. The standards of road construction are general very poor.

13.22. During the last few year, volume of traffic has increased appreciably due to accelerated pace of economic development in the country. The oxle loads have also increased due to overloading. Improvement and strengthening of the existing roads, to meet the increased requirements, have lagged behind due to more intensive demandfor opening up hitherto isolated areas. This has led to extensive deterioration of the existing roads with weak payment. According to a rough estimate, approximately 80 per cent of theroadintheBarani Tract need improvement of the existing road network, but keeping in view the magnitude of the backlog, limited resources available for road construction and conditioned heavy demand for new roads, the arrears of improvement and strengthening of the existing roads can only be met on a long-term basis.

13.23. On the other hand, in spite of rapid pace of new construction in the area, the road transport system is far from adequate. The area has one of the lowest density of roads per 100,000 populations as given in the table on the next page.

TABLE –I

COMPARISON OF ROAD AVAILABILITY IN THE BARANI AREA & THE WORLD

Country	Mjid-1969 Population (Million)	Area (Thousand sq. Miles)	Paved Roads (Miles)	Gravel & Earth Roads (Miles)	Total Roads (Miles)	Road availability per 100.000 population
A. Selected Developed Countries						
France						
U.S.A	50.3	212.915	391.294	530.234	921.528	1832.06
Japan	203.2	3619.620	1574.502	2110.267	3684.769	1813.37
Germany	102.3	142.726	79.047	545.832	624.879	610.88
	60.8	95.937	180.404	77.316	257.720	423.88
B. Developing Countries						
Algreria	13.3	919.590	32.132	14.854	46.986	353.27
Morocco	15.1	173.000	12.887	19.108	31.995	211.88
India	526.0	1261.498	201.951	402.355	604.306	114.89
Philippines	35.9	115.696	7.688	31.835	39.523	110.10
Cylon	12.2	25.330	9.507	3.516	13.023	106.74
Turkey	34.5	296.477	23.617	8.079	31.696	91.87
Nigeria	64.6	356.641	9.509	44.748	53.257	23.98
Iran	28.5	636.243	6.339	15.910	22.249	78.06
Afghanistan	14.0	253.841	1.243	9.322	10.565	75.46
Pakistan	59.9	310.000	15.802	35.021	40.823	68.15
Punjab (1968-69)	34.8	79.542	8.594	10.405	18.999	54.60

13.24. According to minimum international standards, the Barani Tract Should have at least 25000 miles of roads as compared to approximately 4000 miles of roads existing at present even the existing network does not yield maximum economic benefits due to its being lopsided and imbalanced. There is too high a proportion of earth and shingle tracks to ensure an efficient and balanced system.

Railways: The railway system in the area which forms part of the main network of the railway in the country, was largely developed during the British days to serve their political and strategic requirements. The rail coverage in quite adequate to meet the requirement. Further extension may not be necessary except for specific cases of exploitation of lmineral and other natural resources. And minor extension to meet the industrial needs. However, the existing rail network needs improvement. Rehabilitation and renewal of track has not kept pace with the requirements. As a result, serious speed restrictions are in force over major portion of the system. Concerted efforts, therefore have to be made to clear the back-log of repairs, maintenance service to the users.

Air Transport: The Air Transport coverage in the area is quite inadequate. Only one city of the area namely Rawalpindi is on the domestic and international air network. Almost all the secondary towns and cities in the area are not linked with air service.

The Strategy: For less developed areas a broader strategy is needed to guide transport and related agricultural planning as a part of a total plan for rural development. It the resources available are to be employed to maximum advantage. It is necessary to weigh the merits of various combinations of inputs. Instead of planning transport in isolation, s systems approach to development is essential to link transport with the jpoals that transport is called upon to serve- in this case to increase the production and marketing of food and development of the areas. Success will call for closer collaboration of transport and other fields.

13.28. The basic Transportation infrastructure required in Barani Areas would revolve around a sound system of roads. In planning the system, consideration must be given to the fact that the intensity of traffic on roads in Barani Areas in expected to be comparatively less than in areas where irrigation facilities have been developed. Another factor, which warrants consideration is the fact that there is normally a lower water table in the Barani areas than in the

agricultural areas and most of the BaraniAreas form part of highlands and extensions of mountain ridges which result in better soil condition for the construction of roads. As a consequence, roads with lower specifications would suffice as opposed to the same type of roads in the irrigated areas.

13.29. In Barani Areas. However, the major problem would remain the opening up of these areas to the influence of progressive force by providing basic transport facilities to them. It would therefore, be appropriate to adopt stage construction for the development of roads in these areas which assumes several forms. It applies, for example, to all the roads which have grown without planning: from early trails to cart tracks. Paving and improving these old roads has made it possible to adopt them to the changing conditions.

13.30. Modern planned stage construction aims at providing the maximum mileage of roads with the limited funds available by deferring certain items the construction if which will be needed at a later stage. It is a scientific and rational approach towards the optimal utilization of these resources. In the case of roads stage construction can be accomplished in two ways. There is stage construction in depth, and stage construction in width.

13.31. Stage construction in depth involves the construction of a shingled road or the sub-base course and the traffic intensity. In most of the Barani and mountainous areas where the subgrade bearing capacity is high and the intensity of traffic is low, stage construction can be resorted to by making stabilized or shingled roads in the first phase on the other hand. In the plains. Where the subgrade bearing capacity is low, the sub-base course can be Laid out as the first phase of stage construction Another advantage of this approach is that the passing wheels of the trucks and automobiles will complete the consolidation process, exposing the weak spots in the subgrade and foundation courses. The temporary travelling surface will adjust to settlement in the foundation soils, settlement which always accurse in any road-ded. These faults, the cause of much distress in the pavements, will be developed under traffic, permitting correction before the final surface courses are laid.

13.32. The second form of stage construction concerns the payment width. Like stage construction in depth, it is an optimal combination of engineering logic and economic necessity. It provides for the immediate construction of the stabilized base only. At a later stage, when the

trafficintensity so warrants, the central portion can be improved and additional lanes provided to accommodate the desired capacity. In this case, adequate right of way would need to be purchased and provision for futureexpansion made, in the first in sconce. Changing times changing residential and commercial patterns, changing, vehicular patterns demand they do not find these in the small cities nearer home, they would inevitably shift to the large city canters, which are already bursting at the seams.

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13.37. There is also the great necessity of developing the Barani Tract itself. The population drift is not mechanical. It is highly selective. The most skilled and the enterprising are the first ones to leave the Tract in search of opportunities for better living. It is a great set-back to the development of the Tract if the more vigorous and the more intelligent keep continuously moving out. The only way to hold them in the Tract and utilize their skill and enterprise for local development is to create the small towns where they may find better economic opportunities and more congenial living conditions.

13.38. It is with this purpose in view that the present Government have developed the program of establishing Agrovilles and developing Markaz town Broadly defined. Agrovilles refer to small towns located in rural areas, conceived tobe self-contained urban settlement plan to offer the inhabitants a balances range of essential public services and social and cultural facilitation. They provide jobs as well as education, health cover, clean water supply, waste disposal, transport and other facilities characteristic of city living.

13.39 If the optimum population size of an agroville is taken at 30 to 40 thousand people, about five hundred small towns or agrovilles will have to be developed in the Tract by the end of the century. This is indeed a gigantic undertaking. Interms of housing units, if the size of a family is taken to be 6 to 7 percent, then about 1 ½ million new houses will have to be provided for the additional ten million people in the next two decades or so. The task involved is so colossal that very careful and detailed planning will have to be undertaken to meet the crisis that is developing, apart from the improvement of the very poor and sub-standard housing in which the population lives.

13.40 Besides residential buildings, there will be needed, in additional, buildings for all types of productive work social and economic activities-farms and factories, markets and

workshops, school and hospital buildings, stores and ware-houses and civic and administrative buildings.

13.41 Faced with this grim situation, energetic steps were taken by the present Government, soon after assuming office, to create an institutional structure to grapple with the problem. A town Planning and Agroville Division was created by the Federal Government, which has now been renamed as the Environment and Urban Affairs Division. The new Federal Ministry of Social Welfare, Local Government and Rural Development has been assigned functions pertaining to Physical planning and Housing has been created in the Planning Division. The Government of the Punjab have similarly established a Housing and Physical Planning Department and legislated the land acquisition for housing act 1973. A number of projects and programs have been started. Regional planning efforts are directed at identifying potential growth centres for development as maraakaz, agrovilles, small towns, and medium-sized cities.

13.42. Agrovilleswhould also serve as growth contres into which development is directed and through which the rural areas trade and interact with the outside word. The official strategy of concentrating public and private investment in selected centres will promote the development of small towns in the rural areas. As these towns grow, they will attain thresholds large enough to be able to support urban services and facilitis. Once a centre has its basic infra-structural facilities, it will tend to attract commercial and industrial development which will enrich the lives of the people and provide improved services and employment opportunities to its inhabitants and to people in its countryside.

13.43. The growth of the small towns will ultimately depend on the implementation of the policy of dispersal of industry. The shortcomings of agglomerating industries within a few metropolitan areas are now widely realized. A well planned program of selective decentralization of industries to smaller centers should be launched as early as possible. In order to effect this policy in an orderly manner, a list of designated centers in the country forming an hierarchy of centers from the big centers of industry to small village centers should be prepared. Subsequently, rural development investments should be guided, both in the public and the private sectors into these designated growth centers.

13.44 The location of a new city of a new industry would have a multiplier effect on the local economy by providing an immediate base for the development of increased economic

activity. The rationale of locating industries in any center is really based upon the policy of utilizing locations that afford the industry, the local people and the economy in general, the highest returns in terms of employment opportunities, creation of income and consequent allied economic growth, and of course, utilization of resource.

13.45 One of the first tasks facing the regional planners in the Barani Tract would be to complete the necessary surveys needed for the identification of the future sites fir the location of growth points of the small towns so that comprehensive planning in terms of physical infrastructure could be undertaken.

13.46 In the rural areas, the Government will not find it possible to make extensive direct monetary investment in housing. It must however, induce the development of better shelter through technical advice, demonstration projects and the promotion of house-buildings cooperatives. At the same time, it is expected that the economic spin-off from increasing Government investment of rural shelters.

13.47 Model Villages: To improve the layout and overall physical condition of villages in order to make them attractive for habitation of a program of model villages has been initiated. The villages, under this program of model villages has been initiated. The villages, under this program, will be carefully planned using latest town planning methods and necessary infra-structure, civic servicesand amenities will be provided. The villages this created will be used as models for the improvement of rural settlements. The program is under implementation in Sind and other provinces are expected to initiate it soon.

13.48 Construction Industry: The gigantic building program involved in the creation of 500 new townships, and the vast numbers of residential houses etc. during a limited period would demand the establishment of an organized construction industry. The creation of a vigorous construction industry would indeed be one of the best.

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13.55 Gypsum is another mineral which is available in very large quantities all over the Tract Plaster of Paris can be produced from gypsum using small roasting kilns and grinding

mills. The Plaster of Pariscan be used as a wall plaster in place of cement. It could also be used in the manufacture of Plaster Boards to be used as partition walls and ceilings.

13.56 A very large variety of clays is found in the Tract. Some of these could be tested for their bloating properties when subject to heating. Clays with this quality be utilized for producing light weight aggregates for use in building construction. Light-weight aggregates of this type can be used with advantage in building construction for affecting saving in steel use.

13.57 There are many types of building stones available in the Tract which should be quarried and used in building construction.

RURAL ELECTRIFICATION:

13.58 Along with the development of the Agroville, Markets towns or growth points, other facilities will have to be developed, such as, the provision of electricity, gas, water supplies and sewerage. A properly prepared physical plan would take care of all these but it would not be out of place to briefly discusselectricity as it is amongst the most critical inputs for rapid development.

13.59 Electricity has become the lifeline of modern civilization and a major element in socioeconomic progress. Invariably the electricity supply in any country starts with the provision of supply to the complex of domestic, commercial and industrial consumers with the local confines of cities without any responsibility towards the surrounding rural areas. Giant-sized electric towers stand in the fields conveying enormous loads of electricity hundreds of miles to the cities, while the villages in their shadow do not get a little of it to light the thick blankets of darkness that descend on them with the fall of dusk. Electric light is not merely a utility: it is reading books and viewing televisions to learn about the world; it is running a tube-well to increase production. It is regarded as a luxury for the villagers, while it is considered the most elementary of needs for the city man. There could be no greater proof of the two cultures and of the dichotomy and duality which is perpetuated on so-called economic grounds. Both the towns-man and the country-man, however, suffer grievously for this injustice. The troubles of the city start when the villagers attracted by the city lights, leave the country-side and the flock to settle in city slums. They only relocate their misery and the city begins to decay and die along with the swelling in the number of such immigrants.

13.60 So far the country side has not been able to articulate its need and quantify the total benefits accruable from the village electrification program. Electricity is one of the few inputs which combine intensive production with achievements of social value. It can run water pumps and tube wells, it can help run numerous small-scale industries and helps process the produce. It contributes towards improved health and education facilities by providing purer drinking water from wells and providing purer drinking water from wells, and providing lighting in homes and community centers to aid literacy projects and making possible the use of mass communication media, radio and television. The UNESCO and the U.S have been participating in a program using an educational satellite for an experimental program in adult education through television in 5,000 Indian Villages. It was made possible because the villages had been electrified.

13.61 Power in any form, whether human, animal or mechanical, can be considered as an agricultural input. Power tills the soil, pumps the water, harvests the crops, processed the food and fiber and generally is involved in all aspects of agricultural production. With the progress of agricultural economy,the demand for more power will increase proportionally which in great part would have to be supplied by electricity which is a most efficient and convenient form of power for the farmer and villager to use. It is a most powerful adjunct to programs of industrialization and mineral development.

13.62 Outside the agro-industry sector, there are the cottage industries or villages handicrafts centers. These centers are particularly important in areas which are extremely poor and lacking in agricultural resources. They necessarily contain a high component of hand labor. The addition of electrical power to their facilities would make them productive and competitive with similar institutions established in industrial areas.

13.63 Until now only about 2000 villages in the whole pf Punjab been electrified. The share of the Barani Tract is very little as the first priority has gone to irrigated area villages which have tube-wells for irrigation and drainage.

13.64 For the development of the Tract there is an urgent need to assist governmental efforts for rural electrification. One method by which rural electrification can be promoted is

through owned cooperatives or consumer-owned associations. Through citizen awareness and participation, the members of the community could decide among themselves what they need and then work together to acquire it. The ability to do for oneself and the proof of it creates a healthy self respect that can begin to tackle self-defeating cycles of poverty, despair and isolation.

13.65. There is also the need for a financing agency for rural electrification. Currently, there is no separate financing mechanism for rural electrification other than the regular grants and loans provided by the federal budget to WAPDA. A financial institution devoted exclusively to rural electrification could mobilize and channel resources for the purpose and make explicit the subsidies to rural electrification cooperatives, required in the early years. To start the programme, the Planning Division has recommended that the Government should try a few pilot projects which would test a methodology incorporating local organization or local co-ops. The exercise can then be further implemented. From the experience of rural electrification through cooperatives in Philippine and India it is clear that a single village co-op., will not be feasible. The area to be selected for a successful pilot project will have to be of a farily large size and must have the potential to create enough power demand to prove economically feasible. The second and the most important factor to be considered is that the people in potential co-op. A study on social and economic impact of electrification of an area would need to be conducted before hand. It can be part of a resource management plan involving establishment of rural industry and intensification of agriculture in a Unit area.

13.66. Once the areas are selected for pilot study where co-ops are chosen as the local distributing entity, the special organizational plans, producers and capability required for effective operation under the local condition must be developed with local representatives. Vast rural areas have been electrified under such carefully worked out plans, not the least being the communes in rural China.

13.67. Electricity is introduced into rural areas in three waves through (1) autogenerators serving single consumers, (2) autogenerators serving several consumers on a local network, and (3) public supplies from the main grid system. The term autogeneration refers to isolated generators powered by diesel engines, small steam turbines, or microhydro turbines. They range in size from about 5 kilowatts sufficient to meet the motive power needs of a large processing

plant. Public supplies from for roughly 30 per cent and subtransmission and distribution network cost for about 70 per cent of the total investment.

13.68. A decision must be taken as to whether to provide electricity from the grid or from local autogenerators. This decision depends upon a number of factors, including the expected level of growth and demand, the expected utilization of the investment, the distance from the main network, and the difficulty of terrain (which can affect costs enormously). The capital costs of supplies from the grid are much higher than those of autogeneration but the fuel, operation and maintenance costs are much less. It has been seen that generally in the early stages of such projects, generation and transmission cost from public supply accounts for roughly 30 per cent and subtransmission and distribution network cost for about 70 per cent of the total investment.

13.69. It is recommended, however, that in the beginning for small loads in remote localities, it is cheaper to meet electricity needs by installing small autogenerators. Where no public supplies exist, shops, farms and agro-industries can install their own autogenerators to meet their particular needs for lighting, heating and motive power. Wherever possible, they can also supply electricity to local consumers and provide public lighting rather than keeping their equipment idle. Therefore, autogeneration serving single or several consumers, should be encouraged. As the demand develops and as local factor improves, public supplies from the grid become cheaper. It is then economical to replace autogeneration in the main demand centres by extending public network to them.

13.70. A thorough study of the local resources and situation of the projects area is also necessary in order to understand the factors which would affect economic returns from various types of in-puts such as electricity. The study should involve an appreciation of the living conditions in an area, its local infra-structure, housing quality, and the growth of local agriculture, agro-industries and incomes. This electricity should be a component of the total package of developmental in-puts.

13.71. The rural sector of the Barani Tract is very much under-developed. Some kind of solidity or permanence in house structure is an important determining factor in the feasibility of electrification. Therefore, alongwith the plans of rural electrification road and rail links must be

established for transportation and communication and a housing policy scheme based on the use of indigenous materials should also be implemented.

13.72. A recent technical development of great importance, introducing an element of practicality in the supply of electricity to villages is the bio-gas plant which is inexpensive and would produce electricity for local use from cattle dung fermentation. Bio-gas energy generation can be immediately started on a community basis as well as for individual farms in most villages. The initial investment for the installation of the bio-gas plants is much less compared to the other forms of installations mentioned before and not much technical know-how is required. Besides, there are no running costs of the plant at all. Bio-gas can directly be used in cooking and lighting for domestic purposes. Electricity could also be generated from it for community viewing of T.V. for adult-education work, for motive power, water pumps and cottage industries. In addition to fuel, light and motive power, Bio-gas plants would provide extremely valueable dung slurry which could be returned to the fields as manure for increasing soil fertility.

13.73. Other important sources are inferior local coals for thermal plants, solar and wind energy and small turbines for hydro-electric generation. A variety of intermediate technologies are being developed and there must be a determined push to capitalize on every little resource. There has to be strong political will and social support for programmes such as rural electrification. Countries like the U.S.S.R. wherein the founder of the revolution himself equated happiness with: socialism plus electricity, thereby setting clear goals, which the nation has steadfastly pursued ever since, have reached a stage where the farthest hamlet has success to electricity.

CHAPTER-XIV

TRAINING AND TECHNOLOGY

14.1. The title of this chapter has been deliberately chosen to emphasis the necessity to utilize the education and science systems for providing training to people for their life-work and for site-specific appropriate technology to ensure efficient management of resources. At the time when the world saw the industrial revolution, the country was unfortunately under an alien rule. Both education and science were purely academic pursuits and remained de-linked with production. They continued to be an elitist privilege un-related to the life of the peasant and the worker. The mass of the people were never provided with the means for education and the type of science cultivated was not designed to produce any technology for the optimum utilization of resources. The country was used by the colonial rulers to produce the raw materials and processing was done in the industry in their own country. Technology remained irrelevant to the local situation. The study of science was primarily a cultural pursuit of the upper class. All efforts made since independence to alter this vicious pattern have met with very little success, for technology and industry have been mainly imported.

TRAINING

14.2. In so far as the Punjab Barani Tract is concerned, ninety nine per cent of the productive labour force- the peasants and the artisans have had little benefit of institutional training for practicing their vocation. Education wise, the vast majority of the workers are illiterate. The few who go through school study mainly non-vocational subjects and get a general education. The technology, the peasants and the artisans use is primitive and traditional and their productivity is amongst the lowest in the world. In fact the use of inappropriate exploitative technologies has caused great damage to environment and depletion of the resource base.

14.3. The new Education Policy announced in March, ---------- to a massive shift from general ---------- to a purposeful agro-technical education, the ---------- technical subjects at the ---------- and college levels, a crash programme in primary ---------- massive literacy programme, and the provision ----- in the farthest corners of the -----

14.4. ----- of money spent on education by the ----- increased from Rs. 583 million in 1969-70 to ----- million in 1974-75, an almost 900 per cent ----- . This is indeed a very impressive increase in investment and is an earnest of the government's deep ----- education, but the gains have not been proportionate to the spending. A number of factors have ----- full

benefits to be derived from this investment ----- include: (1) the increase in population and larger and larger number of children to educate (2) nationalization of educational institutions, necessary for equalization of educational opportunity and raising of standards, thereby increasing the total burden (3) inflation and the rising cost of school buildings, equipment, wages of staff etc., and (4) the inflexibility of the formal educational system and the socio-cultural resistance to change. There are still as many as 40 million illiterates in the population. No reduction in the absolute number of illiterates in 1970. Only about 47 per cent of the age group are in the primary school and the drop-out ratio is nearly 50 per cent; three quarters of the next generation is thus growing up without the benefit of even a primary education, at the Secondary level only about 17 per cent of the age-group is in the schools and at the degree level only about 2 per cent. The table given below shows the overall stagnation:-

TABLE I

Enrolment of Students During 1970-75

	No. of Students (in 000 0)			**Percentage**		
Level	**Bench Mark 1969-70**	**Target 1974-75**	**Likely achievement 1974-75**	**Bench Mark 1969-70**	**Target 1974-75**	**Likely achievement 1974-75**
Primary (I-V)	3820	6500	4731	42	65	47
Middle (VI-VIII)	906	1400	1116	19.5	25	20.3
High (IX-X)	341	550	393	11.7	16	11.6
Intermediate (XI-XII)	140	195	156	4.9	6.3	5.0
Degree (XIII-XIV)	60	78	66	2.2	2.7	2.3

14.5. A very little structural change has been accomplished. The science and the agro-technical component is as weak as before. The educational system has made no improvement in the skill or knowledge of the peasants and the workers and their ability to increase production.

14.6. A shift in enrolment in technical subjects from 5 per cent in 1972 to 33 per cent in 1980 was envisaged. The public expenditure on education and training during 1970-75 on technical education however, still remains at about 5 per cent. The New Education Policy envisaged the establishment of 9,300 factory and farm schools and special women's education centres. As many as 2.7 lakh literacy centres were to provide training to illiterates. It has not been possible to do very much about any of these things, because the formal school system, heavily urban baised, has gobbled up the bulk of the funds and resources provided to the educational sector.

14.7. If the vicious cycle of backwardness, low production and low income levels is to be broken in the Punjab Barani Tract, there is no other choice except to break away from the colonial educational model which was designed essentially to produce second level civil servants. If the present generation of workers and farmers is not to be written off and is to benefit at all from the Education and Science systems, if it is to make a positive contribution to economic development and national prosperity, then a determined approach will have to be made to link education and science with production and give a high priority to the training of the mass of the people, the farmers and the workers and the creation of technologies which will increase the productivity of the peasant and the artisan.

14.8. Our resources for training the peasants and workers are not inconsiderable. We have a huge and by and large well organized infra-structure of formal education which has so far resisted any involvement with the achievement of developmental goals of the community. The facilities of the school buildings are hardly utilized for the essential purpose of training the people and the youth for their life-work. We have a large reserve of educated manpower which has so far only drifted away from the rural areas. We possess a well-developed base of mass media which has operated generally as class-media and has yet to be geared to train the peasants and workers. Our major liability is that the imperial legacy has tended to with-stand too well the encroachment of innovation.

14.9. It has been erroneously assumed that quantitative extension of the formal system of education with suitable qualitative improvements would be sufficient to take care of the needs of both economic development and social transformation. It is now quite apparent that the vast mass of people will continue to be deprived of the benefits of training from such a system of

education. A radical departure has to be made from the historic pattern of education as well as of science as it is cultivated today.

14.10. Education and Science must be made key in-puts in an integrated programme of rural development. In the last analysis, the success in achieving balanced growth in the Tract will depend upon the nature of our educational programmes and their intimate integration with other developmental in-puts, such as, the HYV seed and chemical fertilizer technology, the establishment of processed feed mill, the organization of a farming cooperative etc. The integrated package approach must be extended, beyond the physical in-puts of agriculture and industry, to include all of the essential educational and human resources as well.

14.11. A recent World Bank study of 17 countries indicates that the greatest success of the educational system has been achieved: (1) where there was a clear and over-powering national ideology and strong leadership committed to this ideology, and (2) where education has been developed as an essential element in a whole package of developmental in-puts, during a period when economic initiatives were central. The most favourable situation exists where there is a state of exaltedness in the community, and the people are striving for the glory of the nation, rather than petty personal gains. People then learn willingly and utilize the knowledge and skills acquired, for increasing production and improving environment and quality of life. Education also functions best when economic activity is vigorous and the pace of development rapid. It is deployed as one element in the whole package of developmental in-puts for achieving economic goals that the community considers relevant. Education in such a situation comes alive and becomes a key element in development. It is only when the people reap the benefits of applying knowledge that they are motivated to acquire new knowledge and skills.

14.12. The Mass Line approach: Alongside of a high level of motivation for which the people must be continuously sustained through the various mass-media and personal encouragement by the political leadership, there has to be accomplished a fundamental change in the attitude of the governmental functionaries towards the educability of the common man. The elitist authoritarian structure of our society has tended to make the so-called experts and the governmental functionaries, regard the farmers and the workers as passive recipients of their wisdom and expertise.

14.13. The experience in the USA and China has very clearly demonstrated the fallacy of this approach. In the USA the extension worker has traditionally maintained a working camaraderie with the farmer and the flow of information has been always a two-way channel. In China the expert was sent out to work in the fields and the factories, not to teach but to learn from the peasants and the workers basic virtues of political morality, social consciousness and socialist production. He learnt from the wisdom and experience of the farmer who has a very intimate knowledge of his surroundings and is continuously interacting with his environment. It was while working in the field and the factory that the expert jointly with the peasant made the necessary improvements and and innovations in techniques and approach. Such technology was not entombed in a research report. It was immediately used by the producers to increase national production. The farmer was as much adept at it as his comrade, the scientific worker, for he shared in the excitement of innovation.

14.14. The farmer must be treated as an equal and he must be enabled to share and participate in the processes of modernization and change as a full partner. In the field of public health. China has used this approach to provide the world with a major social and intellectual experiment of human history. The extensive development of the peasants and workers trained as bare-foot doctors who undertook extensive vaccination and other measures for the control and prevention of infections and parasitic diseases, and the treatment of common ailments with local herbs has made it possible to provide health cover to 810 million people. It has made it possible to eradicate major infectious diseases from the country, such as, small-pox cholera, plague and schistosomiasis.

14.15. In every commune (population 50 to 70 thousand) there are 500 to 1,000 farmers who have been trained as pest watchers and combine their usual farm work with plant protection. At the time of independence. China had only a few dozen university-level geologists and geo-technicians. In less than 3 decades China today has hundreds of thousands of workers trained in geological work. In the Tai-chain Oil Field alone China used as many as one hundred thousand drillers, skilled workers and intermediate-level technicians. Most of this training was done on the job in the field. The programme of education is essentially non-formal: groups of workers take every opportunity to sit together, study, discuss and learn while doing the work.

14.16. Formal education, faced with mounting unit costs, growing financial constraints, rising youth population and other disabilities, simply cannot satisfy more than a fractional part of the urgent educational needs of rural dwellers. It has, however, consumed the lion's share of scarce educational resources, brainpower, and funds, whereas non-formal education has suffered seriously from lack of attention.

14.17. In the Barani Tract, it will be very unwise to depend on any formal system of education to educate the large number of persons for performing the numerous tasks in crop production, animal husbandry, drainage, water management, public health and resource mapping and utilization. These persons will have to be trained by the non-formal system and approach. It will require, however, a great deal of supporting work in the proposed Education and Training Institute to prepare the materials for such a non-formal training programme, in terms of the printed word, the radio broadcast material, the video tapes etc.

14.18. A major root cause of low educational productivity is the inflexibility of the educational system and its resistance to change. This helps to explain why it has only grown quantitatively over the past three decades and its disappointing progress in adapting itself qualitatively to the changed situation. The demands of a politically independent country, wanting desperately to throw off the yolk of economic and cultural domination necessitates a radical change in focus and strategy of its educational system. Although the present highly perceptive leadership has sought to introduce changes, it has encountered formidable resistance, from both within and outside the educational system. If the system is to contribute fully to national progress, and to sweeping rural transformation, it must undergo its own internalrevolution and change the emphasis to the education of the workers and the increase in production.

14.19. Adult education will bring immediate returns. The adult, unlike the child, already possesses a knowledge of production and experience. His education can, therefore, be much simplified and geared to production so that he may apply what he learns at once and boost his output. In helping to increase production and the farmer's income the educational system would operate as an instrument of equality, and not, as formerly, a device for perpetuation of social inequality.

MAN-POWER TRAINING:

14.20. Man-power training is needed at four levels: (1) high level or professional manpower i.e. engineers, agronomists, geologists etc. (2) intermediate-level or technician and sub-professional staff i.e. agricultural field assistants, veterinary stock-assistants, overseers etc. (3) skilled-level workers i.e. plumbers, carpenters, masons etc. and (4) farmers and women.

14.21. High Level or Professional Training: This includes specialization in various scientific and technological disciplines, such as, agriculture, forestry, animal husbandry, engineering, mining, medicine, etc. The number of professional level personnel required in the Tract for the 150 or so project areas of about 50-60 village size is estimated at 1500 at an average of 10 professional staff per project area. At present there are no facilities existing in the Barani Tract for high-level training of manpower and in the initial phases, special programmes will have to be mounted in such institutions as the University of Agriculture, Lyallpur, and the Engineering University, Lahore, for meeting these needs. This would be, however, only an interim arrangement. In order to meet the growing requirements of professionally qualified manpower with the correct orientation and requisite competence, it is proposed to establish, as soon as possible, a Rural University located in the Barani Tract.

14.22. Rural University: The ideal location for the Rural University would perhaps be near Taxila. It would have a historic significance and would be a symbol of the renaissance in the region of the art and science which once made this region the locale of a mighty empire and civilization. It would be near the Heavy Mechanical and Electric Complexes and hence in close proximity to the new technological base of Pakistan. It would be in the heart of the Barani Tract. It would have easy access. It will be attractive for the scientists and scholars in terms of intellectual stimulus as it would be flanked by two great University centres – Peshawar and Islamabad/Rawalpindi, Medical, educational and recreational facilities for the families of the scientific workers would also be nearby. The climate is salubrious and the area has much scenic beauty.

14.23. The University may be modelled on the pattern of the great U.S land-grant universities established about a hundred years back, in almost every State of the Union. Started as colleges of Agriculture and Mechanical Arts, for the education of the sons and daughters of the farmers and artisans, they have grown into great seats of learning and have been the main

source of light and learning for the people providing all levels of trained man-power, tested, proven site-specific improved technologies and a programme of non-formal education which has few parallels.

14.24. These universities have been traditionally organized into three complementary units for: (1) Teaching (2) Experiment and (3) Extension, ensuring a three-way flow of information: from the farmers-problems and feed back, from the experiment station technology and solutions of problems, and from the faculty education and extension based on the local factor endowment. They have established centres of continuing education and institutes of short courses e.g. at the Michigan State University, more than 100000 people-farmers, rural pastors, nurses, cooperators, poultry-men, doctors, engineers and home-makers benefit annually from short courses, conference courses, seminars etc. The University has its own farm broadcasting station and television centre.

14.25. The orientation of the Rural University should basically be Rural Resource Management and it must be linked with the production work in the Barani Tract Resource Management Areas. The core programme should be located in a Faculty/ Institute/Department for Resource Management which should be interdisciplinary in character, with a strong component of both the social and natural sciences. The important departments to be established should be agricultural technology, zoo-technology, earth sciences and technology, ecology and environment, production economics and management, cooperation and local government institutions, non-formal education and extension. The phasing should be: (1) research and post graduate diploma and degree work (2) field area development work including surveys and planning. The University should be given charge of one pilot project area for resource management in each of the ecological zones of the Barani Tract. (3) In-service management training for various levels. (4) first degree and diploma-level work. Besides the experiment station and the sub-stations, the university should establish its own farms, workshop and pilot plant facilities for small-scale rural industry. It should be strongly production-linked and production oriented.

14.26. Intermediate or Technician Level: It will need about five people at the sub-professional level per university level professional worker, or 50 men trained at the intermediate level, for each Resource Management Area. For 150 such areas in the Tract, approximately 7,500

technician-level workers will be required to assist the 1,500 professional-level man-power. Some of the important fields in which the category of manpower will be needed, based upon the development projects envisaged in this Report, are: electrical technology, mechanical technology, civil technology, auto and diesel technology, mining technology, agricultural technology, animal husbandry technology, and medical technology.

14.27. The normal technician-level training is conducted in institutes known as polytechnics, which provide 3-years full-time courses in various technologies to students having passed the matriculation examination. There are four polytechnics in the Barani Tract, one each at Rawalpindi, Gujrat, Sialkot, and Leiah. These polytechnics, by and large, possess facilities only in industrial fields and none in agriculture, animal husbandry, and mining. By using the facilities of existing polytechnics, which have an enrolment capacity of about 3,600, the requirement of technicians in the industrial fields can be met through specially tailored programmes of shorter duration, run in the evenings and during vacations.

14.28. To meet the needs of other disciplines viz: agriculture, animal husbandry, and mining, new facilities shall have to be created in the Tract. As provided in the organizational set up of ABAD (Chapter XV), the Education and Training Institute, which will also be responsible for middle-level worker's training should establish facilities. In the first instance in those fields which are not being catered for in the existing polytechnical institutes.

14.29. Skilled Level Worker's Training: At this level are included a large variety of skilled workmen, such as, carpenters, black smiths, masons, malis, budders, etc. Crash programmes have to be launched, through a radically modified approach and un-orthodox strategy. It will be necessary to train a large number of skilled workers to undertake the numerous tasks in agriculture, construction, public health, maintenance of electrical and mechanical equipment etc.

14.30. A limited number of vocational institutes, offering training in various industrial fields exist in the Barani Tract, offering skilled level training in trades such as machinists, turners, carpenters, electricians, auto-mechanics. There are 3 vocational institutes, one each at Jhelum, Gujrat, and D.G. Khan with a total enrolment of 300. The facilities of these institutes can be made use of for training skilled workers in electrical/mechanical fields through short

duration programmes. Nevertheless, there are almost no facilities for training of workers in trades related to the construction, mining, agriculture and animal husbandry. Whereas training in agriculture and animal husbandry is possible in the villages, by using team-training approach, training in other fields will, by and large, have to rely on the creation of physical facilities, such as workshops. Turkey has a successfully functioning programme of imparting training in villages through visiting Training Teams which put up camps for extended periods in the villages. This approach should be carefully studied and used.

14.31. Special attention shall have to be paid to the training of construction workers (such as building artisans, etc) in view of the extremely large programme envisaged for providing new townships and roads. A number of new centres of training for this level of workers would have ----------ted or alternatively mobile teams constituted ----------pattern. It should also be possible to ---------- multiple workshops in each of the ----------so as to impart intensive on- the-job-skill ----------fields.

----------the village people can be----------trained for many skills, such as, crop---------- and vaccination of men and animals, as ----------scale in China, through a variety----------formal education programmes. The short and ----------the peasants and workers in specific ----------scientific operations and creating in them self-reliance ---------- consciousness, must remain central to the type of self-sustaining development which alone would bring about the issue transformation in the Tract. The core content ----------and attitude building must, however, be activity based and should be linked with production and management work in the villages. Without such specificity and links, the training would remain academic and an ----------in futility. The training has to be provided in the rural setting and preferably in the farmer's fields and work-places through peripatetic training teams and groups activity.

14.33. Such training has been given to the villagers in the Northern Areas in Pakistan, in the field of public health and veterinary disease control. Another successful approach for such training was evolved at the Comills Rural Development Academy. The conception of rural development work at Comilla put training at the heart of the processes of change. The people themselves were regarded as agents of change and development. Training opportunities were to

be provided to them through regular fortnightly.meetingsand though short graded courses at the Thana Centre. The skills skills for achieving higher out-put from the farms were to be developed in action programmes in their own villages. Like-wise, the capacity to plan and carry out projects had to be based on a considerable degree of autonomy they exercised in developing local plants.

14.34. Besides the peasants and artisans who need to provided with such skills, there are other key people who need training- the local leaders, the motivators and the organisers, who will pilot the processes of technical and social change in the villages. These would also include the political cadres who should be trained and educated to identify themselves with the peasants and workers in their style of work and living. They must learn to avoid acting as if they belonged to an exploiting managerial class. They would need to acquire: (i) a deep commitment to national ideals and a superior level of political morality and social consciousness, (ii) skill in democratic procedures and group actionfor change and development and behavior appropriate to the new egalitarian social order and (iii) actual participation in productive work, using improved technology.

14.35. Women: Women constitute 47 per cent of the population of Pakistan. Biologically, girls have greater survival rater than boys and in societies where there is no discrimination against females, the population of women is larger. It is, thus a very sad commentary on the conduct of our people that inspite of protestations to the contrary we provide less favorable conditions to women. Nutritional surveys have indicated that the boy child is given more of the protective foods such as milk than the girl child.

14.36. The Prophet of Islam (peace be upon him) made it obligatory on both Muslim men and women to acquire knowledge. With us, therefore, it is not a question of the right of women to education, which has to be conceded, it is a question of preventing a citizen from doing her duty when we deny her the opportunity to acquire knowledge. Nearly 97 per cent of the rural women in the nation are illiterate, the figure would probably be higher in the Barani Tract in view of the wider dispersal of the population and the lesser number of educational institutions.

14.37. There is an enormous amount of drudgery that the women are made to go through in the Tract, in many parts women have to daily carry water home from as far away as 2 to 5

miles, and gathering of wood and dung and making dung- cakes for fuel use up more than half the day. The natural distribution of intellect and talent amongst the male and the female children is the same. While the men from this part of the country have occupied the most distinguished places in national life, particularly in the army and the civil services, women have essentially been deprived of making their full contribution. The discrimination is tantamount to denying the nation the intellectual, artistic, scientific and leadership qualities of 5 million people of the Barani Tract and just because they happen to belong to a depressed sex Equality of right and opportunity irrespective of sex is guaranteed in the permanent constitution o: Pakistan in common with the rest of the world, we are celebrating the women's decade in the Barani Tract. Nothing, however, is in evidence to show that we are doing very much beyond lip service to a most neglected cause.

14.38. Given the necessary training in a variety of cottage crafts and farming such as, carpet making, of culture, poultry keeping, etc. women can greatly add in the wealth of the nation, if such activities can be organized on neighborhood group basis, there will be the opportunity for greater social interaction and education and attribute building on such aspects as family planning, child nutrition and house-hold based production such as poultry and rabbit keeping sericulture etc. Institutions and programmes should be built to provide the present generation of women access to education and training Programes developed at concilli provide an excellent model for increasing the skill of women. The village AID Programme had a significant element of work with women. The Women's Centre developed at the University of Agriculture, Lyallpur, is another useful model. Perhaps the single most important step would be the creation of an institute of Rural Home Economics on the proposed Rural University. There is a complete lack of serious scientific studies and research on problems in the field of Rural Home Economics. The city home is a consumer home and so is the city woman a consumer. The rural woman on the other hand, is a part-time farmer and the rural household is a part of the farm enterprise. The rural woman helps her mate in numerous chores such as cotton picking or transplanting rice and is responsible for poultry dairy work etc. She needs training and knowledge to be an efficient partner in the enterprise and to use her influence, which is considerable, In favour of improved practices. There must be trained a corps of correctly educated women workers who can serve in the rural areas both in extension education and in the formal school System so teach rural home economics, resources – soil, sunlight and water, and of

the man-made in-puts such as chemical fertilizers and pesticides for increasing production and reducing losses.

14.42. Apart from the best utilization of material resources, science and technology can immensely increase the capability of man himself. He can, with the tools provided by science and technology, extend his reach and accomplish tasks which he has no means to achieve otherwise. New technologies of great significance which have a multiplier effect on man's capability, such as digital computers, are available which have been only marginally used. Satellite based Remote Sensing techniques have identified the extensive copper deposits in an inaccessible remote part of Baluchistan. The most important task is to draw the greatest benefit from our existing human resources by providing them with the new tools of science and technology to convert sunlight, soil, water, minerals, plants and animals and other resources into wealth, meaningful to our people. There is vast unexplored and unexploited wealth awaiting scientific work to bring within the reach of the people to improve their incomes and living standards. Only a marriage between intellect and labour could lead to rural regeneration. Science should be harnessed to improve rural economy and living.

14.43. Scientific Community: Science does not move in any society on its own. Men of Science with requisite caliber and vision are needed to accomplish the difficult task of achieving widespread application of science in society. There is today a veritable race amongst the leading countries of the world for producing scientists and technologists. Pakistan is amongst those countries which have the lowest ratio of scientists/ technologists to population e.g. in agriculture it is a little over four per 100,000 persons engaged in agriculture as compared to 113 in the Netherlands. Today, the measure of a country's strength is the size and competence of its scientific community. The Barani Tract has not even the vestige of a scientific community; it is literally an intellectual desert. Areas, such as Uzbekistan, which were similar to the Tract in terms of scientific development a few decades ago, now have more scientists to the square mile than many European countries, Great universities, academies and institutions of science and technology have been established and the sons of nomads are working on space and nuclear technology.

14.44. Grass-root Science: There is no reason to fear that the people of the Barani Tract would not be able to bridge the gap with advanced societies but it is only realistic to recognize that the present challenge lies in grass-root level science. Science in the nation has come to

acquire an academic connotation and the image of the scientist is of a person who works in expensively built laboratories, equipped with complicated foreign built gadgets. He searches learned treatises and scientific journals for problems to research on. The type of science needed at our stage of development is one with a deep concern for the improvement of human condition and with the optimum use of resources. The scientist must identify himself with the people and set about earnestly to solve the problems faced by them. This does not mean that he isolates himself from world science: he must indeed benefit fully from the advances of science and technology all over the world. Benefitting from out-side sources, is not contrary to, but is complementary to, his efforts to help his people solve their scientific and technological problems. He must study and learn but he must continuously seek to apply this knowledge to serve the people. He should identify and arrange to transfer a superior technology but he must strive to adapt it to the local situation and ultimately innovate and evolve technologies entirely appropriate to the local situation.

14.45. Science Linked with Production: In our situation where we have yet to provide the elementary needs of food, clothing and shelter to our people, we cannot practice a style of science which suits the affluent societies who have solved such problems. Science with us must be linked with production. The development of the natural sciences is basically determined by the requirement of actual production goals. Separated from social requirements the natural sciences would have little relevance and significance, it is only when science helps increase production that it would receive the public and political support for its nurture and in turn make a real contribution to the progress of the people. A planned action programme to link science with production instead of merely academic pursuits would be a key factor in creating a widespread appreciation and awareness of the value of science to society.

14.46. Rural Orientation of Science: Our science must be given a rural bias as the overwhelming majority of our people live in the villages. The concern of science in affluent societies is with the demands of the city man and his greater comfort, for only about 5 to 10 per cent of their population is engaged in agriculture. Our science must serve the mass of our people who are mainly rural. This orientation is essential because of the innate differences with the situation in the advanced nations. There is needed urgently a comprehensive rural- oriented science system with a massive political commitment to the cause of the backward and rural poor, involving adequate resource allocations, both human and physical and appropriate changes in the

structure and functioning of the research establishments. All aspects of natural resource development, biotic and physical, must receive a very high priority. Agriculture, water and energy must be maximizing Local mineral resources must be fully exploited and utilized, technologies developed for establishing small and medium scale rural industry, appropriate to the local situation.

14.47. Appropriate Technology: Striking changes are visible in different parts of the country in farming system. Our farmers have shown their readiness to adopt new technology provided it was economically viable, was low risk in character, and appropriate packages of services and public policies were made available to ensure a reasonable return for labour and investment. Most of these technologies have been, howeve, developed in the irrigated areas. No such package of tested and proven technologies is available for the Barani Tract.

14.48. The Barani Tract comprising 18 million acres of land and one crore of people does not have a single well equipped and well staffed research establishment devoted to the survey and study of natural resources or the creation of new knowledge and site-specific and appropriate technologies for maximized resources. There is a number of isolated agricultural research sub- stations mostly linked with the agricultural research institutions at Lyallpur, and some research- cum- demonstration farms. These units, due to their sub-critical size, lack of qualified research personnel, laboratories and library facilities have not been able to produce much meaningful research nor have contributed significantly to increased productivity of the area. Furthermore, they mainly concern crop culture. Other important sectors were without the benefit of any research studies and investigations which could provide an objective basis for integrateddevelopment. A list of these research stations is attached. The extent of the Barani Tract, its vast resource base, the size of its population, and the complexity of the problems, all demand the establishment of a first class well equipped and well staffed Technology Development Institute, for producing site-specific technologies encompassing not only crop culture but animal husbandry and forestry, climate, water and soil, minerals, industry and works. This institute should continuously undertake economic feasibility and social acceptance of such technologies.

14.49. The establishment of a Barani Agriculture Research Institute by the Central Government would not provide the type of service needed by the Punjab Barani Tract. Firstly, it

would be a single field institution viz: crop culture, while there is need for an interested approach encompassing the entire resource base of the Barani Tract. Secondly, the institute, by its very nature, would not be able to address itself to the problems of one province and would essentially become an apex institute to handle a few of the long-term problems faced by all Barani areas ranging from Chitral to Tharparkar. Since the Institute would have no specific responsibility to a particular unit are, it would tend to generalize and its researchers would inevitably look to international professional recognition rather than serve a specific community of farmers and workers.

14.50. The Technology Development Provincial Institute would, however, be a multidiscipline technology institute, mainly concerned with adaptive research and aimed at creating site specific technologies for the different ecological zones in the Tract. It will have to work through at least six field stations. The entire style of work will be different, most of the time of the researcher will be spent on field type research. The research workers would work closely with the farmers and workers and would be responsive to their problems. The central government institute would thus be complementary to the provincial institution but would not be its substitute.

14.51. The existing provincial government agricultural research sub-stations in the Tract could all be amalgamated to from the nucleas of the proposed Technology Development Institute avoiding the necessity of immediately investing in a new laboratory complex. Work could thus be started rightaway with the recruitment of an additional 20 or so first class research men under a vigorous Director. These sub-stations and farms have an area of about 1800 acres and an annual budget of about nine lakh rupees.

14.52. At least about 30 per cent of the rural labour force would have to be employed in non-agricultural work to ensure productive employment near the village and improve their purchasing power. A programme of diversification of the rural economy based on variety of intermediate technologies must, therefore, be initiated as early as possible.

14.53. Pending the establishment of the Barani Technology Development institute, the provincial government universities and research institutes should set up a consortium to plan and organize a research development and extension centre towards developing economically viable

rural industries for the Barani Tract, without such an R D & E Centre for creating appropriate technology in rural areas, it will be difficult to generate and spread technologies suited to the local conditions.

14.54. Efforts should be made to interest the scientific community and the non-governmental science organizations, such as, the Pakistan Academy of Sciences and the Pakistan Association for the Promotion of Science and Appropriate Technologies to develop vigorous programmes of study and surveys to assist in the identification and transfer of technologies appropriate for such backward regions as the Punjab Barani Tract. Provincial Government should give a much higher level of support to such voluntary non-governmental scientific organizations.

RESEARCH SUB-STATIONS IN BARANI TRACT

Figs. In Rupees

Subject	Location	Technical Staff provided	Annual Budget
			1974-75
Entomology	Murree	Assistant Entomologist Research Assistants (2)Fieldmen (4)	53,000.00
Sugarcane	"	Assistant Botanist (Genetic) Research Assistants (4) Field Assistants (4)	81,120.00
Horticulture	"	Assistant Horticulturist Research Assistants (2) Budders (6)	1,24,860.00
Potato	"	Research Assistant Fieldmen	28,000.00
Wheat	Rawalpindi	Wheat Botanist Assistant Botanist Research Assistants (2) Field Assistants (2)	2,10,000.00
Entomology	"	Research Assistant Fieldmen (2)	38,110.00
Oil Seeds	"	Assistant Botanist Research Assistants (2) Field Assistants (2)	66,860.00
Agronomy	"	Assistant Agronomist Research Assistant Field Assistants (2)	25,000.00
Gram	Campbellpur	Research Assistant	11,480.00
Maize	"	Assistant Agronomist (Maize)	10,000.00
Fodder	Charrapani	Plant Observer	10,000.00
Entomology	Hasan Abdal	Assistant Entomologist Fieldmen (2)	31,840.00

Entomology	Sialkot	Research Assistant	30,000.00
		Field Assistant	
		Fieldmen (2)	
Potato	Sialkot	Potato Botantist	1,45,000.00
		Assistant Plant Pathologist	
		Research Assistants (2)	
		Field Assistants (2)	

RESEARCH-CUM-DEMONSTRATION FARMS

Name of the Farm	Area in Acres
Research-cum-Demonstration Farm, Rawalpindi	276
Research-cum-Demonstration Farm, Cambellpur	92
Research-cum-Demonstration Farm, Distt: Gujrat	249
Research-cum-Demonstration Farm, Distt: Sialkot	78
District Demonstration Farm, Rawalpindi	118
Seed Farm, Piplan.	86
Seed Farm Piplan (with PADSC)	775

CHAPTER XV

ORGANIZATION AND STRATEGY

15.1. Basically, the Commission's task is to recommend measures for the study, conservation, and utilization of the natural resources of the Barani Tract. This implies firstly a broad survey to ascertain what resources exist, leading ultimately to a deeper examination of particular resources and areas to provide an objective basis for development planning.

Resources

15.2. Natural resources in a broad sense include everything that is derivable or adaptable for the use of man from any part of the universe. In the physical sphere they include gravity, rain and water, and energy from sunshine, as well as, mineral deposits. In the biological sphere they include domesticated and wild plants and animals, as well as, human resources. Their inter-relationships are brought out in the Chart on page opposite. There are also the resources, productive enterprises and infra-structure. An attempt has been made in the earlier chapter of the report to present an over-view of the resource base.

15.3. Resource surveys frequently turn out to be quite complicated and time-consuming. Topographic and geographic mapping, soil and forest surveys, hydrographic measurements, and other kinds of basic resource knowledge require trained scientists and technicians, organization and funds. Further specialized knowledge and competence are needed for the immediate utilization of such data to innovate and improve practices in agronomy, stock – husbandry, silviculture, mining and other applied fields. Ultimately, economic studies or markets, sources of supply, transportation, and the like are needed to obtain full benefits.

15.4. Conservation of resources involves decisions as to on what scale and with what intensity the resource should be developed, taking a long-term view both of the resource itself and of the national needs. Only after adequate study and a proper understanding of the conservation aspects does utilization come to the fore: the object being maximum and sustained economic and social benefits-not forgetting the aesthetic and recreational needs of the people.

15.5. The human resources enter into consideration in that people are needed to study, conserve and through their labour and enterprise, utilize the natural resources. People, in the last analysis, not only exploit the known resources, they discover and create new sources of wealth. This implies education, training and the study of human and social organizations and of social and economic development. The people's welfare is also the ultimate objective of all

development and all plans and programmes of resource development must necessarily relate to the well-being of man, the improvement of the quality of his life and environment.

Strategy for Development

15.6. The principal aim of resource development is the continued well-being of the people through the development of land, water, energy, minerals, and the related natural resources. The various natural resources have to be regarded as inter-related, one with another, and with social and economic development generally. A well-planned programme of resource development would aim at developing resources: (a) at the lowest cost, (b) on a sustained basis, bearing in mind the conservation of existing supplies, the discovery of new sources, and the development of cheaper or more plentiful substitutes, (c) with a high multiplying effect on further economic development. All this should be accomplished so as to minimize or offset the difficulties of adjustment in particular regions and among particular groups and so to encourage a wide and equitable sharing of benefits and costs. An attempt has been made in the earlier chapters to out-line measures for the maximization of resources and their just distribution.

15.7. Ecological Balances: The balance of nature in the Barani Tract has been seriously upset and there is widespread environmental degradation and resource depletion. The quality of life and living of the people has been very badly affected. In nature, there is a continuous inter-play between man and every item of human environment, between climate, soils, vegetation and animals. The scientific approach to recovery and development of resources can thus be only an integrated approach.

15.8. Even though a beginning is made in a given locality by identifying one valuable resource e.g. a mineral deposit, rich soil, a high value crop or a superior livestock breed, and using the opportunity to develop a thrust programme around such a single resource, the processes of development would attain a dynamic equilibrium only if all related areas receive due attention. It should also involve careful studies of the ecosystem and trials to make sure that the technologydeployed for development is appropriate to local conditions, with a special eye to conservation and sustained use.

15.9. For example, there is incontestable proof from world experience that reliance on technology to the exclusion of the social setting in which this technology was deployed for achieving the green revolution justice and the social cost has been very great. The benefits have gone mainly to the more favoured areas and the move affluent farmers resulting in a too early ceiling on production. It would need an efficient, scientifically based organization and team work amongst natural and social scientists to adopt a holistic, integrated inter-social disciplinary

approach to the management of resources. Such an approach would have to be 'area based' instead of based on isolated individual enterprises. The essential purpose of the area-based approach is that the benefit of development must reach to as many or a large majority of the people in every unit area. The achievement of this purpose, however, will require both understanding and correct approach. Even when a unit area is selected in an undeveloped part of say D.G. Khan district, the benefit would not reach the common people unless a cooperative base is created in the villages comprising the Unit. It would be the few more intelligent and aggressive farmers who would monopolise the benefits Simple physical location of a programme of development would not be enough.

15.10. In regard to the optimum size of the unit area selected for management it should be small enough for the local people to identify themselves with the area and think of it as being theirs but large enough to justify its design and management. It should have an economic base sufficiently large to support both a diversified agriculture and small-scale industry.

15.11. In the selected areas, development shall have to be balanced development of people, of social institutional physical infra-structure, farming, mining and industry Lop-sided development may achieve limited economic objectives but would inevitably lead to disturbances in the ecological balance and cause grave set-backs in terms of sustained and optimum use and conservation of the resource base.

15.12. Inspite of numerous governmental initiatives to secure coordination of developmental efforts, the development process in the field has been traditionally conceived of as being the responsibility of individual government departments and agencies. By and large, each department has gone about pursuing isolated tasks. If one department is engaged in establishing energy plantations in an area another is pursuing programmes of sheep and goat rearing and a third is introducing new horticultural crops. The policies and programmes have been sometimes conflicting and contradictory. Attempts have been made from time to time, under a variety of programmes from rural reconstruction to integrated Rural Development, to coordinate the functioning of different governmental agencies. Such attempts are always viewed by existing vertically-oriented technical departments and services as a threat to their power structure. The success would thus remain limited unless the right kind of educational job is undertaken at requisite political levels and the need to serve the people the small people, is firmly established as the prior national goal, above all departmental/technical goals.

15.13. In fact, for any permanent gains the emphasis must shift from the government departments and the paid governmental functionaries to the people's Institutions and the Local

communities, motivating and organizing them for an integrated development of resources. The people should be encouraged and assisted to organize themselves into an effective community, such as cooperatives and Resource Management Areas each unit area to plan its own integrated development – both human and material, on the basis of self-financing and self-reliant growth with the least amount of outside interference.

15.14. The strategy for area development has therefore, been based on the involvement and participation of people in the management of their resources. Development would be planned on : (1) a unit area basis so that every part of the Barani Tract receives its due share for development and not the more favoured parts only, (2) resource management basis involving agricultural, industrial and social development so as to obtain maximum benefit from all local resources including human resources and (3) a self-sustaining basis, through full employment, increased production, savings and re-investment, for securing self-reliant growth and environmental improvement, instead of dependence on outside help.

15.15. In planning resource development, the accent must be shifted from advisory functions to management processes. All programming and project planning is in essence a part of management which includes identification, preparation, evaluation, implementation, and reappraisal. The essential steps in integrated resource management on a unit area basis are depicted schematically on page opposite. These would be: (1) organization for planning and management, (2) more productive farming, (3) creation of physical infra-structure, engineering and minings. (4) establishment of rural industry, and (5) social welfare. The step-by-step managemental process indicates areas of emphasis in phasing, for example, while social welfare is considered as an essential element, it would be emphasized after enough savings are generated from agricultural/ industrial development. Similarly, more productive farming is put as an earlier step than the works type of programme as increased earnings from labour without increased food production would only result in inflation. The steps out-lined above are briefly discussed below:-

15.16. Organization for Management: This essential first step would include (a) the building-up of appropriate grass-root social institutions, such as, cooperatives, (b) mass training of the peasants and workers, their motivation and mobilization for development, and (c) organization of Resource Management Areas (REMARS) based on natural resources, surveys, bench mark surveys etc.

15.17. More Productive Farming: so as to (a) increase availability of food and the purchasing power of the people. (b) make the nation self-sufficient in its basic requirements, and (c) generate funds and savings for undertaking the creation of physical infra-structure etc. The

initial thrust programmes would, in the main, involve the use of chemical fertilizers, HYV seeds, intensive multiple cropping, horticulture, improvements in livestock and poultry husbandry depending upon location.

15.18. Physical infra-structure, engineering & mining: involving the construction of water harvesting structures, exploration and exploitation of minerals, developing energy resources, such as, bio-gas, local coal to produce electricity and building of roads and communications. This would provide employment to people, inputs for bothagricultural and industrial production and the base for supplies, marketing etc.

15.19. Rural Industry: this world include a determined push to establish a variety of small scale, appropriate, rural industry, such as, farm machinery and implements manufacturing and repairs, mineral based industries, agro-based industries, small fertilizers and pesticide plants etc. nearly 30 per cent of the income of the Unit Area should come from such small-scale industries. This would ultimately lead to the training of man-power, the building-up of local entrepreneurship and the base for full industrialization.

15.20. Social Welfare: the increased resources and saving generated from the steps discussed above should be utilized for the provision of a variety of social welfare facilities such as, nurseries and schools, clinics and health-cover, water supplies and sanitation, community centres and libraries, family planning and other activities.

15.21. This phasing of developmental activities is geared to the growth process being self-reliant and self-sustained. The prevailing practice has been quite contrary to such phasing and the emphasis generally is on providing doles and welfare type facilities and services through the agency of governmental departments. These facilities are provided at quit inadequate levels e.g. schools are built but science equipment and trained teachers are not available, hospitals and dispensaries are built but most such rural centres function without doctors and medicines. There is rarely an emphasis on the involvement of the people and the generation of wealth in the community to sustain the up-keep of such facilities on a permanent basis. Work programmes have been launched which have provided money to the communities without any corresponding increase in production so that only inflationary pressures have been built up.

15.22. The programme envisaged is thus comprehensive, involving multi-sectoral activity-agricultural and industrial development, creation of physical and social infra-structure, and provision of essential services, such as, disease control, improved nutrition, widening ------ literacy, family planning etc. Depending upon the local situation, the approach would be appropriately phased so as to retain the self-sustaining character of the developmental process.

ORGANIZATION

15.23. In order to launch a planned and adequately supported programme of development in the Tract it would be necessary to provide for an effective agency. Such as agency may be named the 'Agency ForBarani Areas Development' (ABAD). As mentioned earlier it will not be ordinarily possible for the Barani Tract to obtain its due share of the developmental expenditure, if the Tract has to compete with the more favorably placed areas. It will only receive a marginal share of the developmental expenditure from various departments, who would always see brighter chances for returns on investments in the more developed areas and only greater risks and lesser returns on investments in the Barani areas. The Barani areas would continue to grow poorer and less and less able to share in development and the gap would grow wider and socio-political tensions more and more unbearable.

15.24. The Barani Tract has nearly on fourth of the total population of the province. These people and communities are undergoing untold sufferings because of their continuous deprivation from the developmental allocations and processes and due to the poor and indifferent planning and use of whatever is invested it is strongly felt that all development in the Barani Tract should be through the proposed Agency for Barani Areas Development (ABAD) which should be charged with the responsibility to create the institutional infra-structure and plan and development projects and programmes based on scientific studies undertaken locally.

15.25. So far, the projects and programmes in the Barani Tract have been simple extensions of programmes and project conceived essentially for the more developed irrigated areas. It is in the irrigated areas where all the major scientific research stations and universities are located. All methodologies and technologies have been evolved and adapted to the situation in such areas. The application of in-appropriate programmes, developed out of context of the Barani areas, based many a time on subjective notions of persons who belong generally to the more developed irrigated areas, have resulted in numerous failures and wastages. It is necessary to create inadequate and effective organization with its base in the Barani Areas, to undertake the difficult task of evolving programmes and projects based on the ------- needs of the area. It is indeed a world-wide experience that special agencies are needed to effectively manage resources on an integrated basis in regions with special problems or which have suffered long neglect, as

conventional departmental approaches are rarely effective to meet special requirements through normal structures and procedures.

15.26. The chart on page opposite gives the outline of such an organization (ABAD) which, in order to besuccessful, must be structured to solve the special problem of the Barani areas. Central to the organization would be a Resource Management Division but ABAD would in addition, have two important ancillary facilities (1) a Technology Development Institute and (2) an Education and Training Institute.

15.27. The Technology Development Institute : This institute will comprise of a complex of laboratories Field stations and working groups engaged primarily in : (a) identification of problems and opportunities, (b) adaptive research in the four broad fields of (i) animal and plants culture, (ii) climate, water and soil, (iii) institutions in order to evolve appropriate methodologies and technologies. There would be field stations attached to the various wings of the institute for the study of problems specific to different ecological zones and for evolving technologies site-specific to different ecological conditions. The institute may be located on the campus of the proposed Rural University.

15.28. In view of the fact that the approach to development would be based on the integrated development of all resources mineral, biotic, agricultural, industrial social and human, it is considered necessary that the Technology institute should have working together on one campus, scientific workers trained in all four broad fields mentioned above so that they can undertake coordinated inter-disciplinary programmes of research and development and develop a holistic approach to the problem of Unit area development. It is not uncommon that even in one broad field such as agriculture, the specialist workers in, for example, crop-husbandry, forestry, animal husbandry etc, pass on conflicting and contradictory advice to people because these experts work in the specialized institutes of their own disciplines and have never been faced with the challenge to come to grips with the totality of the problem as faced by a community. The social scientists, economists, engineers, technologists and the agricultural specialists must all work together as a team in the institute and in the field for finding solution of problems facing the people. Special institutes for fundamental and oriented fundamental or applied research in different fields have their own place and may be established in their respective organizations such as the Agricultural Research Council, the Irrigation Research Council, the Council of

Scientific and Industrial Research etc , but for evolving technologies to be deployed in integrated programmes of area development, a much more down- to –earth and grass – root level institute is needed, in short a technology development and not called 'research institute'

15.29. The Education and Training Institute: The second ancillary facility considered basic to Barani areas development is an Education and Training Institute structured to train people for managemental tasks. The approach to the training of the people in farming, rural development, welfare etc, has been based on the creation of extension services manned by paid government functionaries who are graduates of professional colleges and are assisted by indifferently trained intermediate level workers. These functionaries are trained in institutions located in irrigated areas where conditions are completely different from the Barani areas and they have, by and large, little expertise in the motivation, education and training of the people or in the management of resources. Besides, it is not realistic, under the prevailing conditions, no expect any large number of doctors, veterinarians, agriculturists and other specialists to be available to work in the un-attractive Barani areas : these are considered punishment stations and even when posted, most resourceful persons soon arrange to get themselves transferred. Few remain long enough to get acquainted with the problems of the area and establish meaningful contacts with the people. Even when it is possible to retain a functionary with professional level training long enough in the area, he manages to reach only about five per cent of people, the more affluent in the community, whose cultural affinities are similar to his own. The vast mass of the poor peasants have rarely an access to his services. There has thus to be revolutionary change in the approach to education and training. The emphasis should shift from the paid government functionaries to the training of the peasants and the workers themselves so as to change the out-look behavior, motivation and the level of skill of the mass of the people.

15.30. It has been demonstrated in a number of programmes all over the world as also in Pakistan that villagers can be trained during short periods to undertake scientific tasks such as crop pest control, public health work. When motivated they easily learn about and use of fertilizers, pesticides, improved farm implements, water harvesting techniques etc..for the improvement of their condition China has provided a highly successful model in terms of such a revolutionary approach to the provision of essential services by the training of the people themselves as auxiliaries. At the time of independence in 1949 they had only about two dozen university level geologists. Two decades later, they were able to deploy more than a 100,000

geo-technicians on one oilfield. They were mostly trained on the job or given short courses for acquiring specific skills. These workers claim 35,000 innovations to their credit, 50 of which are said to be of world standard. There are similarly millions of pest- watchers – peasants who have been trained to look for and light plant diseases. The work of the bare – foot doctors has become legendry in a period of a few decades.

15.31. The proposed Education and Training institute would arrange to train the teacher-trainers who would undertake the education of the peasants and workers for specific tasks required in the Tract. The institute would also undertake special programees for the training of middle- level workers and for management training of supervisory staff and extension workers required for work in the area and for preparation of educational materials, in particular, for mass communication media.

15.32. ABAD's main task i.e. area resource development, would be the responsibility of its Resource Management Division which would have two wings : (1) a Project Planning Wing and (2) a Project Implementation Wing. The Project Planning Wing would undertake natural resources surveys, bench mark and situation analysis surveys, maintenance of data-banks and statistics, planning and project formulation. The central task of the Project Implementation Wing would be the organization of the Resource Management Areas (REMARS) projects when fully functioning, this unit will have about 150 Resource Management Area projects (REMARS) in the Barani Tract. There will be three apecinlised sections for (i) Agriculture, (ii) Engineering and (iii) Rural Industry, to provide expert assistance to REMARS when required and also to develop and implement special projects in the respective fields. There will be another three supporting sections : (i) for pre-project preparation, (ii) on social economic and technical institutions and (iii) to provide marketing, supplies and credit services.

15.33. Stages of Developmental Process : A causal model depicting the various stages of the developmental process to be initiated by (ABAD) is given on page opposite. As will be noticed, there are four pre-requisites to the developmental processes (1) education and training, (2) research and technology, (3) planning and data collection, and (4) social institutions. The social institutions would provide the base for development work. The most critical role, amongst social institutions, would be that of cooperatives, which are the logical institutions for implementing the resource management activities on a self-help basis. The overall cover would

be provided by the local government councils. The three other activities would provide on a continuing basis, the scientific and technical knowledge and competence for the identification and utilization of resources which would be the means for modifying the behavior of the target population.

15.34. The success of the projects undertaken is finally dependent on the involvement of local people in planning as well as the implementation of the projects. The knowledge and skill as well as the enthusiasm and the will of the people would be utilized to manipulate : (1) available natural resources, (2) labour, (3) capital, and (4) technologies, for the preparation and planning and implementation of projects and programmes of development and welfare of people, in particular for the efficient management of Resource Management Areas (REMARS). The grand objective will be to provide the benefits of development to all the people and the subsidiary intermediate objectives will include, (a) the building of social, economic, technical and welfare institutions, (b) exploration, utilization and conservation of natural resources, and (c) man-power training and full employment.

15.35. Resource Management Areas (REMARS) : It would be necessary to carefully delineate and delimit the Resource Management Areas. REMARS, and identify a growth point in each REMAR to serve as the focal point for launching the development process. The approach to the delimitation of the area and the identification of the growth point would be as far as possible, scientific and objective. The chart on the opposite page rivesa sequential model of REMAR.

13.36. There are seven ecological zones in the Barani Tract, each having distinctive challenges, opportunities and needs. The approach would be to carefully survey each ecological zone in terms of : (i) resources, and (2) human settlements.

15.37. The survey of resources would include (1) physical resources: (a) physiographic, (b) hydrographic, (c) climatic, (d) bioticand (e) minerals, and (ii) human resources : (a) social, (b) cultural, (c) administrative and (d) institutional. Based on a multivariate analysis of the resources survey data, both quantitative andcartographic, with respect to a given population size and area, it would be possible to demarcate the Resource Management Areas (REMARS) Tentatively it is estimated that there would be about 150 REMARS, each with about 50-70 villages and a population of about 50,000 to 70,000. The surveys of human settlement would

include : (i) centrality surveys with respect to availability of facilities such as (a) education, (b) health, (c) retail, (d) civil and administrative, (e) industry, (f) credit and marketing, (ii) accessibility surveys of : (a) connectivity matrix, roads, railways, etc and (b) frequency of public transport. By a multivariate analysis of the data with respect to specific size of population and area, it would be possible to identify a growth point in each REMAR.

15.38. The frame-work for the establishment of REMARS would be provided by the Local Self- Government Ordinance recently promulgated by the Government of the Punjab, This provides for the building up of community institutions, participation of the people in the management of their resources for development and an itegration of the work of the various nation building departments and agencies of government.

Financial Implications

15.39. It is not possible at this stage to estimate the funds required for the development of the Punjab Barani Tract except notionally for the purpose of securing block allocations for the proposed Organization and the broad sectoralprogrammes suggested.

15.40. A logical basis for determining the share of the Barani Tract, out of the total development expenditure of the province, is the population of the Tract. The population of the Tract is about 25 per cent of the total population ofPunjab. The area of the Tract could be another basis the Tract in area is about 36per cent of the province. Since the Tract has long been neglected, a larger share could be legitimately claimed in order to bring it at par with the irrigated parts of the province. Based, however, on the percentage of population, the share of the tract would be about 3,000 million rupees for five years, assuming that the share of Punjab in developmental out-lay would be about Rs. 12,000 million during the next 5 years.

15.41. The following is the break up of the proposed developmental expenditure for the next 5 years:

DEVELOPMENTAL EXPENDITURE ON THE
PUNJAB BARANI TRACT FOR FIVE YEARS

Item	Amount
1. Agency for Barani Area Development (ABAD), including Resource Management Division, Trading and Technology Institute and Field sub-stations.	Rs. 200 Million
2. 150 Resource Management Areas	Rs. 1,000 Million
3. Engineering and Works Projects (mainly Water and communication development)	Rs. 500 Million
4. Agriculture- projects	Rs. 300 Million
5. Rural Industries – projects	Rs. 300 Million
6. Energy – projects	Rs. 300 Million
7. Miscellaneous projects (Rural University, other unforeseen)	Rs. 400 Million
Total	**Rs. 3,000 Million**

15.42. A brief explanatory memorandum on the proposed allocation is given below:

Agency for Barani Areas Development (ABAD): An expenditure of Rs. 200 million has been estimated on the establishment of the Agency, including the Resources Management Division, the Training and Technology Institutes.

Resource Management Areas (REHARS) ; An amount of Rs. 1,000 million has been estimated to be spent for the establishment of 150 Resource Management Areas in the Tract. The amount will be utilized mainly for creating social and physical infra-structure in the resource Management Area Units, which will consit roughly of 50 to 70 villages each.

The estimates cover both recurring and non-recurring expenditure.

Development projects in the sectors of engineering and works, agriculture rural industries and energy. There are estimates to cost about 1400 million rupees in order to create a significant impact. It would be necessary that integrated development of the sectors mentioned above is undertaken under a balanced approach Building up of the necessary physical infra-structure like roads, markets, industries, and provision of dependable sources of energy are a necessary pre-requisite. This will be accomplished in close cooperation with the people themselves with an ever-increasing question of local contribution on self-help.

Miscellaneous Projects: There will be projects such as the proposed Rural University and other unforeseen projects arising out of detailed surveys of resources, opportunities and needs, as identified by the people. An amount of Rs.400 million has been provided for such projects.