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prepared by the

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THE UNITED STATES NATIONAL COMMITTEE FOR MAN AND THE BIOSPHERE
Department of State, IO/UCS
WASHINGTON, D. C. 20520

An Introductory Note on Draft Environmental Profiles:

The attached draft environmental report has been prepared under a contract between the U.S. Agency for International Development (A.I.D.), Office of Science and Technology (DS/ST) and the U.S. Man and the Biosphere (MAB) Program. It is a preliminary review of information available in the United States on the status of the environment and the natural resources of the identified country and is one of a series of similar studies now underway on countries which receive U.S. bilateral assistance.

This report is the first step in a process to develop better information for the A.I.D. Mission, for host country officials, and others on the environmental situation in specific countries and begins to identify the most critical areas of concern. A more comprehensive study may be undertaken in each country by Regional Bureaus and/or A.I.D. Missions. These would involve local scientists in a more detailed examination of the actual situations as well as a better definition of issues, problems and priorities. Such "Phase II" studies would provide substance for the Agency's Country Development Strategy Statements as well as justifications for program initiatives in the areas of environment and natural resources.

Comments on the attached draft report would be welcomed by USMAB and DS/ST and should be addressed to either:

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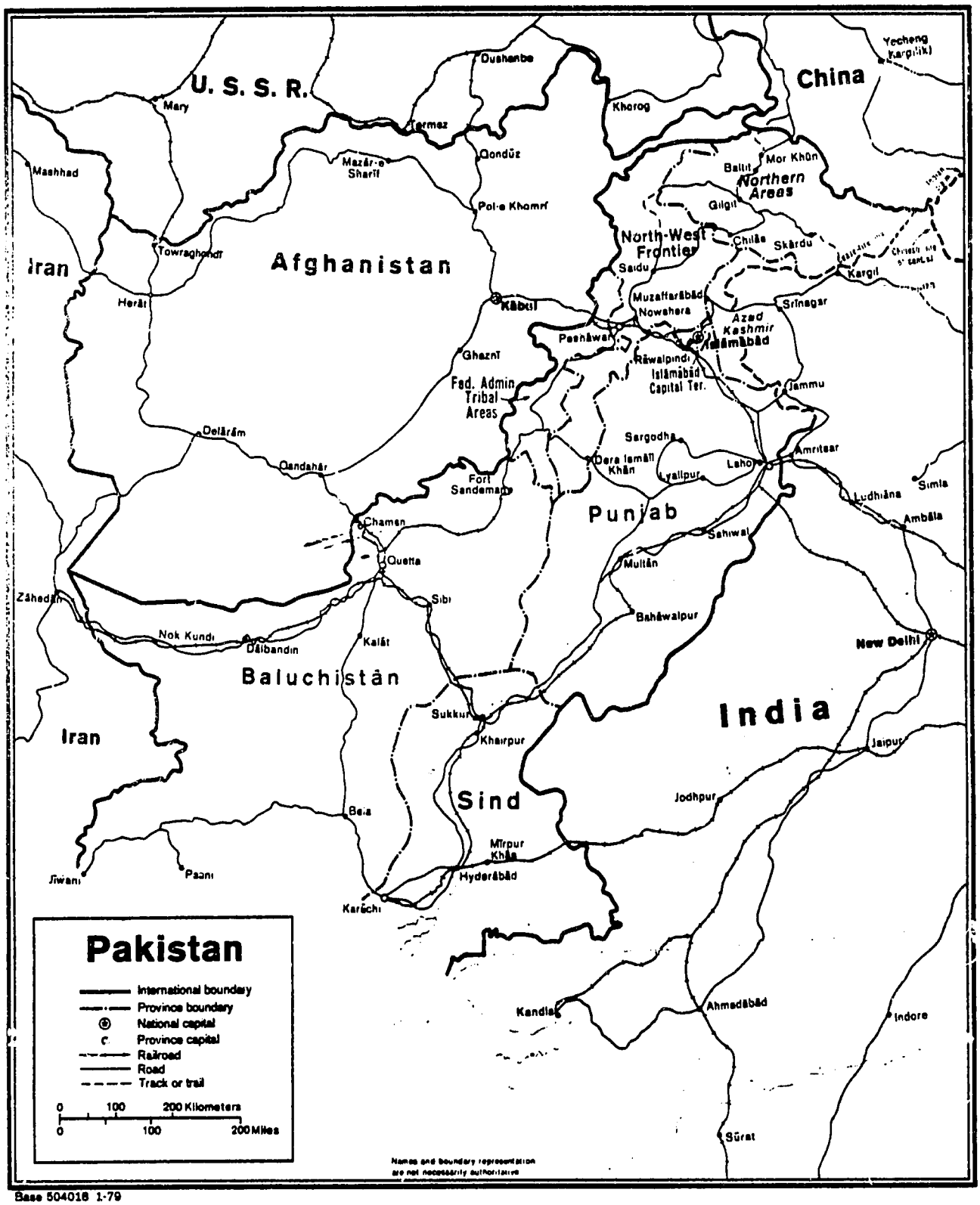

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SUMMARY

Situated in a generally arid and semi-arid region, Pakistan is a developing nation faced with many difficulties in improving the standard of living of its rapidly growing population. A majority of Pakistanis are subject to problems common to developing societies--undernourishment, infectious disease, inadequate housing, improper sanitation and water supply, and low literacy. Since colonial times, governmental efforts to raise the average standard of living have focused on such large-scale agricultural and industrial development projects as irrigation works, railways, roads, factories and power plants. However, these attempts at modernization have generally increased water, soil, and air pollution, or accelerated erosion. The saturation of the Indus basin with a network of canals has caused Pakistan's most serious and widespread environmental problems--waterlogging, salinity, and sedimentation.

The pressures of an increasing population, rapidly approaching 100 million, have further deteriorated the environment and depleted natural resources. Demands for cropland, fuel, and timber have caused widespread deforestation, leading to desertification, erosion, and flooding. Inappropriate farming practices aggravate natural and man-caused problems. Finally, livestock populations have grown to unmanageable proportions, causing the devegetation of already overused rangelands and accelerating desertification.

Pakistan's principal environmental problems are:

Waterlogging, salinity, and sedimentation. Observers agree upon the urgency of these irrigation-induced problems. In the Punjab area of the Indus basin, the water table is steadily rising, sometimes reaching the surface. The proliferation of canals, dams, and barrages has fostered the transport of large quantities of destructive mineral salts. These substances percolate from unlined canals into the soil and reduce fertility. In addition, silt builds up in rivers and threatens downstream structures and flood plain settlements by dangerously raising water levels in times of flood. The government presently devotes enormous financial resources to land reclamation even while extending irrigation and hydroelectric works.

Disease. After a period of apparent control in the late 1960s, malaria has dramatically increased. It now threatens as many as a quarter of the nation's residents and is particularly rampant in Pakistan's crowded urban areas. Insecticide use is widespread, but mosquitoes are becoming more resistent and, their breeding places are increased by irrigation projects. Inadequate drainage, sewage, and freshwater facilities permit

the spread of other infectious organisms. Human health is also endangered by growing industrialization in the major urban centers and the increasing use of agricultural fertilizers and pesticides, which introduce hazardous pollutants into both water and food.

Deforestation and desertification. Particularly in the hills enveloping the Indus plains, land is being converted to agricultural uses. Trees are cut down and insufficiently replaced by public afforestation programs. This process causes gully erosion, loss of topsoil, increased flooding downstream, destruction of faunal habitats, elimination of natural predators of pests, and eventually leads to the abandonment of land. Overgrazing in the northern mountains and on the Baluchistan plateau is rapidly reducing the potential of Pakistan's vast rangelands.

Inadequate administration. Numerous agencies within the government are charged with protecting the environment, but interagency rivalry, inefficiency, trained manpower shortages, communications problems, and public apathy all interfere with effective environmental management. Pakistan, perhaps more than most developing nations, possesses the administrative machinery to control environmental degradation, but these difficulties and the sheer magnitude of some of the problems have made progress slow.

Robert G. Varady, Compiler

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1.0 Introduction

This draft environmental profile summarizes information available in the United States on the natural resources and environment of the Islamic Republic of Pakistan. The report reviews the major environmental problems of Pakistan and the impact of the development process upon resources and the environment. This draft report represents the first step in developing an environmental profile for use by the U.S. Agency for International Development (U.S. AID) and Pakistani government officials. The next step in this process should be a field study to evaluate the information presented here, obtain additional information, and define the issues, problems, and priorities in greater detail. This entire process should help provide direction in future efforts to deal with the management, conservation, and rehabilitation of the environment and natural resources.

The information and interpretations in this report are preliminary and are not intended to attain the detail and accuracy required for development planning. The report represents a cooperative effort by the Man and the Biosphere (MAB) project staff of the Arid Lands Information Center. The primary research, writing, and analysis of the Pakistan profile were done by Robert G. Varady, through the resources of ALIC and the University of Arizona Library. Particular thanks are extended to Dr. James Silliman, who has edited the text. The cooperation of James Corson, AID/MAB Project Coordinator, and other AID personnel is gratefully acknowledged.

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2.0 General Description

2.1 Geography and Climate [1]

2.1.1 Boundaries and Administrative Divisions

The Islamic Republic of Pakistan (hereafter referred to as Pakistan), situated on the northwestern side of the Indian subcontinent, lies between 24 and 37 degrees north latitude, and between 61 and 78 degrees east longitude. Comprising an area approximately the size of California, Pakistan covers 796,099 square km (exclusive of disputed territories; another 92,000 square km including these) and is the second largest nation on the South Asian peninsula. Its land mass, stretching northward 1600 km from the Arabian Sea to the Himalayas, borders on Iran and Afghanistan to the west, China to the extreme north, and India to the west along a 2000 km long and partially contested boundary.

The boundary with India, devised in 1947 to permit the partition of British India, was disputed immediately upon emplacement. Less than two months after independence hostilities erupted between the newly-created neighboring nations. The sixteen month fighting followed by a 1949 United Nations facilitated cease-fire shifted the *de facto* boundary toward Pakistan, incorporating sizeable portions of the northern territories of Jammu, Kashmir, Gilgit, and Baltistan. Two subsequent wars--in 1965 and 1970-71--have further altered the borders, whose status has yet to be permanently resolved. The current definition of Pakistan's northeastern frontier stems from the 1972 Simla Accord.

Because the sources for Pakistan's major drainage basin, the Indus River system, pass through the contested territory, the two countries found it necessary to sign an international treaty governing the use of these waters. The Indus Waters Treaty of 1960 defined the jurisdiction and control of the Indus River and its five principal tributaries.

---

[1] Sources: Johnson. 1979.
Kureshy. 1977.
Nyrop et al. 1979.
Schwartzberg. 1978.
U.S. AID. 1979a.

Pakistan's eastern borders with Iran and Afghanistan originated in 1893, at the height of British imperial domain. This 3000 km line has remained unchanged since 1947. Afghanistan has, however, repeatedly but unsuccessfully demanded a redefinition of the northern portion of this border. The high mountainous frontier with China, also of nineteenth century origin, has not been the subject of any controversy.

Since the secession of its eastern wing (now Bangladesh) in 1971, Pakistan has consisted of an agglomeration of major administrative units (Fig. 1). Ninety-six percent of the territory within the nation's undisputed borders is divided among its four provinces--Baluchistan, the North West Frontier Province (NWFP), the Punjab, and Sind. These provinces are subdivided into divisions, districts, and *tehsils (talukas in Sind)*. As under British rule, the district forms the basic unit of local government. The remaining 4 percent of uncontested Pakistan consists of regions termed Centrally Administered Tribal Areas, lying on the nation's northwestern flank, and a small federally governed Islamabad Capital Area (Table 1)

Table 1. Areas and Headquarters of Major Administrative Divisions

Region	Administrative Headquarters	Area[a] (sq km)
Baluchistan	Quetta	348,300
NWFP	Peshawar	74,520
Punjab	Lahore	206,040
Sind	Karachi	141,380
Centrally Administered Tribal Areas	-------	27,610
Islamabad Capital Area	Islamabad	870
Pakistan (undisputed)	Islamabad	798,720

[a]Figures are weighted averages based upon different areas reported in the sources; they are rounded to the nearest 10.

Sources: GOP. 1976.
Nyrop et al. 1975.
U.S. AID. 1979a.

Administration in the disputed regions is of two types. The extreme northern territories are governed by the Gilgit and Baltistan agencies--branches of the central Ministry of Interior, States and Frontier Regions, and Kashmir Affairs. Just east of the capital of Islamabad, a narrow strip of land has been carved out of the Indian state of Jammu and Kashmir. Named Azad, or "Free," Kashmir, this region is nominally autonomous. Its government, headed by a president, is seated in its own capital at Muzaffarabad. Ultimate responsibility for Azad Kashmir's affairs, however, rests with the same ministry which oversees Gilgit and Baltistan.

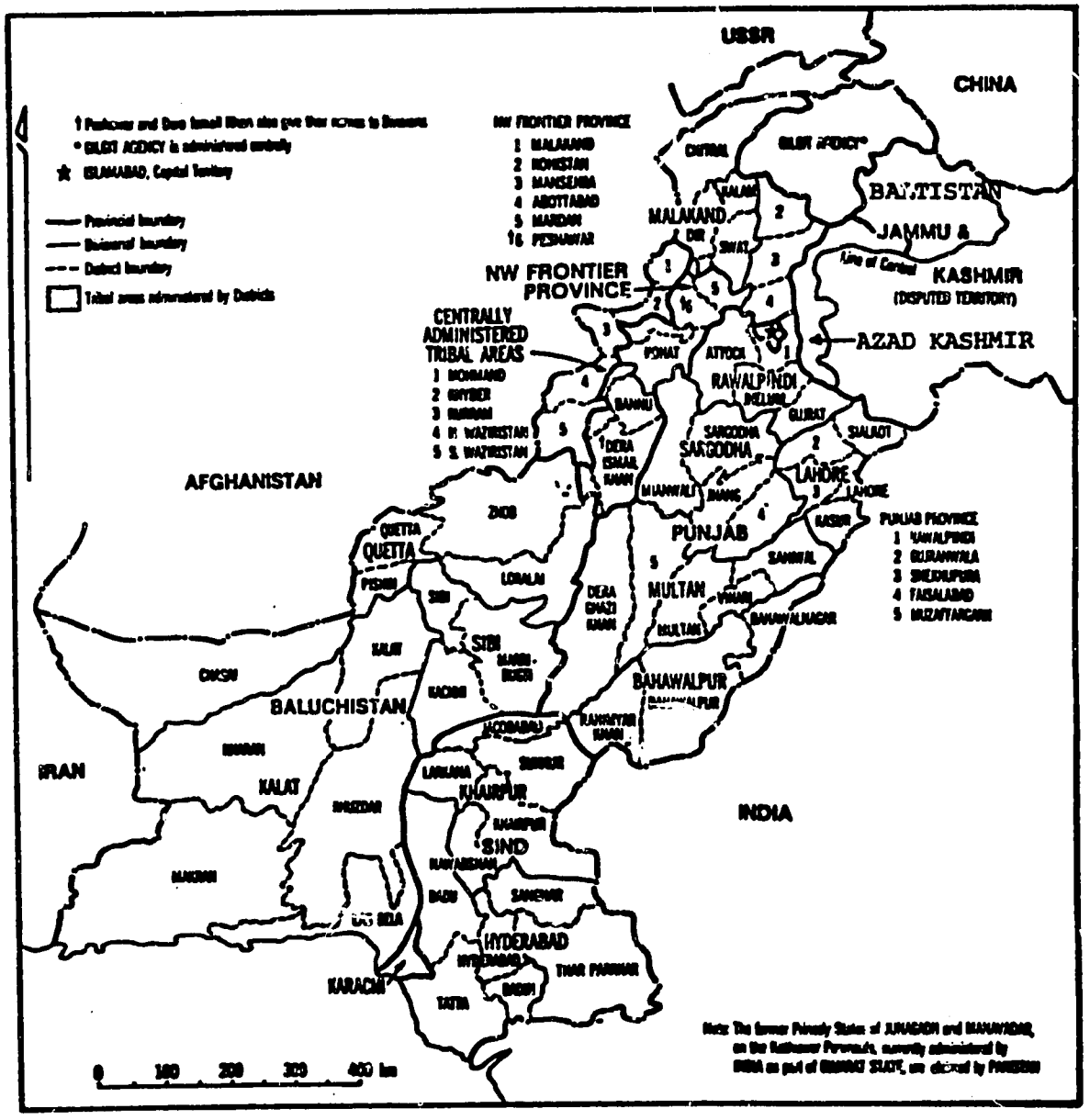


Figure 1. Administrative Divisions

Source: Adapted from Johnson. 1979.

2.1.2 Geographic Features

Nearly sixty percent of Pakistan consists of mountainous terrain and elevated plateaus. The remainder of the country is lowland, generally below 300 meters in elevation. The highlands may be divided into three geographical regions: the Himalayan Mountains and adjacent ranges in the north; the central Sulaiman Range and its southern extensions--the Ras Koh, Siahan, and Kirthar Ranges; and the western Baluchistan Plateau. The lowlands are comprised of the vast Indus River plain and a narrow stretch of coastline along the Arabian Sea (Fig. 2). Except for the latter zone, each of the above regions may be further subdivided into geographically distinct areas.

(1) <u>Northern Highlands</u>

(a) The Himalayas

The region defined by the Himalayan range stretches across Pakistan's extreme north in a southeast to northwest direction. The crest of this range averages 7000 meters above sea level and includes several of the world's highest peaks, some exceeding 8000 meters. Within this zone known as the Great Himalayas there are only scattered population centers, mostly along the lower and more temperate river valleys. Skardu, Gilgit, Nagar, and Hunza are the principal towns. To the south the Lesser Himalayas, whose average height is 3500 to 4500 m, provide a transition to the Sub-Himalayan foothills and the Potwar Plateau just above the plains. The Lesser Himalayan region is more densely populated, accommodating tribal communities and mountain resort settlements. Because of the steep gradient in elevation, several of Pakistan's largest dams are situated at the southern edge of this belt. In the sub-montane area (600 to 1000 m) the country's great rivers emerge from the hills to begin their long course through the flatlands and into the sea.

(b) The Karakoram and Hindu Kush Ranges

Beyond the crests of the Great Himalayas, along Pakistan's border with China, the Karakoram range rises to heights of more than 7000 m. In the vicinity of the nation's northernmost point, where Afghanistan's panhandle separates Pakistan from the U.S.S.R., the Karakorams turn ninety degrees to join the Hindu Kush Mountains. These mountains,

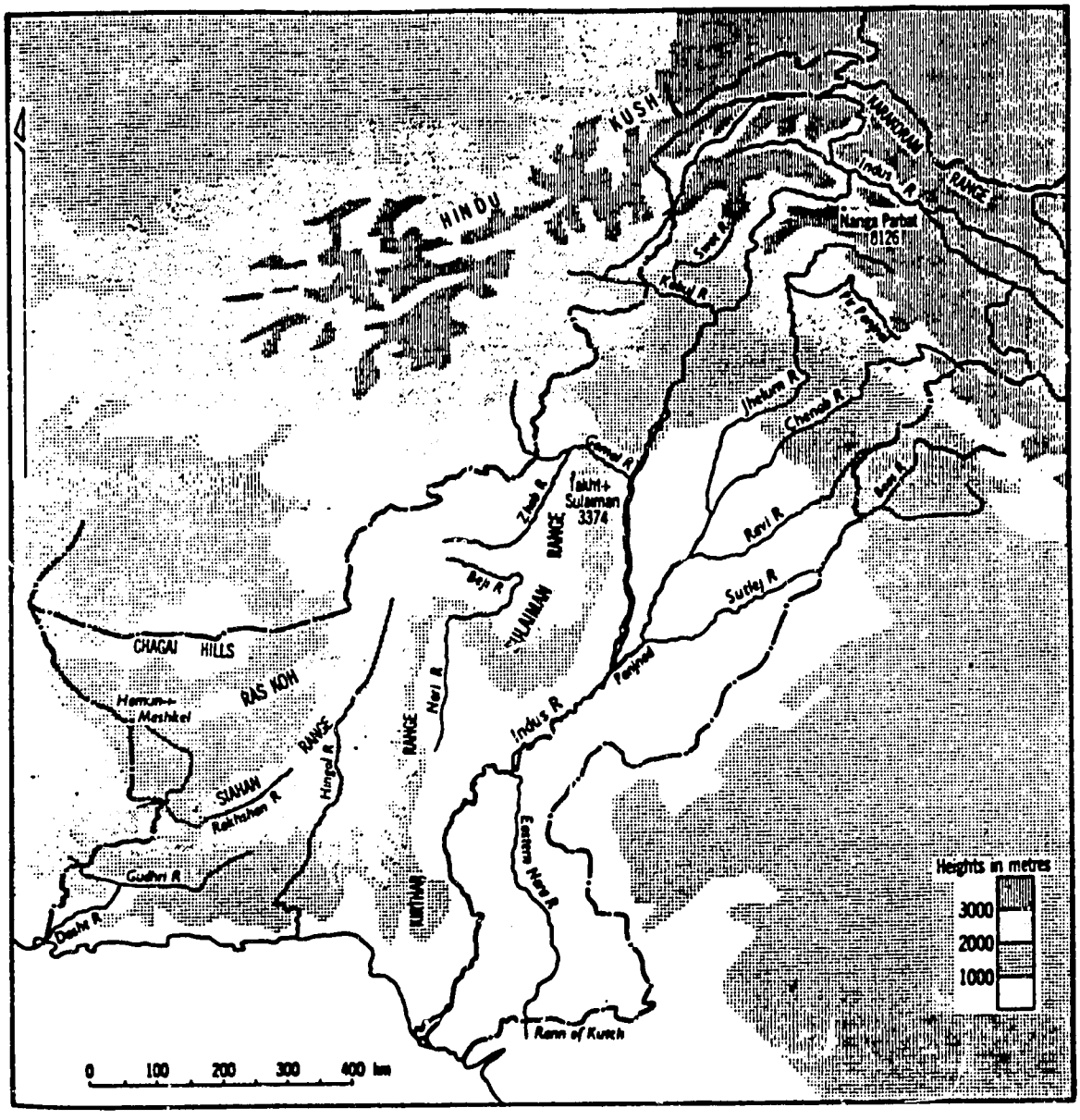


Figure 2. Relief and River Systems

Source: Adapted from Johnson. 1979.

whose peaks are nearly as high as those of the Himalayas, pass only tangentially through Pakistan. The easternmost branches of this range include the Chitral, Swat, and Dir valleys north of Peshawar.

Together, the Himalaya, Karakoram, and Hindu Kush ranges provide a formidable insulating shield for the entire subcontinent. There are few passes below 5000 m and historically the north has remained virtually impregnable.

(2) The Sulaiman Range and the Western Mountains

Like the north, the western portion of Pakistan is characterized by mountainous terrain. Though not as elevated as the northern highlands, the western hill regions are inhospitable and sparsely populated. The Kabul River delineates this area from the higher north. It enters Pakistan through the celebrated Khyber Pass (1080 m) which has traditionally channeled foreign penetration from the northwest. South of this pass the Koh-i Safed Range, with peaks rising to 4800 m, provides the boundary with Afghanistan. Further south the Waziristan Hills, the Toba Kakar Range, and the Sulaiman Range emerge, enclosing the upper reaches of the Baluchistan Plateau.

Of these chains, the Sulaimans are the largest and highest. Running nearly 500 km in a north-south direction, this range parallels the Indus River, reaching a maximum height of 3700 m. Further south, emanating from a nexus near the Bolan Pass south of Quetta, the Ras Koh, Siahan, and Kirthar Ranges descend gently to the Arabian Sea coastal plains. The western and central mountain region contains no important rivers and the barren sedimentary land formations are populated by fewer than seven persons per square kilometer.

(3) The Baluchistan Plateau

The Baluchistan Plateau of southwestern Pakistan is part of a geographic zone which extends into contiguous regions of Iran and Afghanistan. In general, the plateau (c. 350,000 sq km) corresponds to Pakistan's Baluchistan province, the nation's largest administrative unit (Table 1). At an average height of approximately 1000 meters above sea level, Baluchistan is crossed by several minor rivers which flow into the sea or into tributaries of the Indus. There are no true lakes, but several dry salt lakes *(hamuns)* and swamp-

lands are situated near the Iranian border. The tableland is traversed by a number of mountain ranges--the Chagai Hills in the west, the central Brahui, Ras Koh, Siahan, and Kirthar Ranges, and the coastal Makran Range across the southern edge of Baluchistan. The area is arid or semi-arid and the northwestern portion of the plateau is true desert land, receiving less than 125 mm of annual precipitation. Consequently the population is sparse and there are few cities--the capital, Quetta, with 156,000 inhabitants (Census of Pakistan 1972) is the largest and most important. Because of its aridity and inaccessibility Baluchistan is inhabited principally by nomadic tribesmen who herd their animals on the plateau's expansive rangelands (93% of the province's terrain).

(4) The Indus Plain

The Indus River plain is one of the world's major drainage systems. The family of rivers springing from the Himalayas and Karakorams gave rise to one of Asia's oldest civilizations--the Indus Valley, or Harappan, culture of the second and third millenia, B.C. Throughout history the Indus flood plain has continued to sustain habitation in the northwestern corner of the Indian peninsula. The chief rivers of the system--the Indus, Jhelum, Chenab, Ravi, Sutlej, and Beas--have provided rich soil and water to the area known as the Punjab, a province which straddles Pakistan and India. Each of these watercourses, in turn, merges with another, eventually joining the Indus approximately halfway through its course to the sea. From this confluence, a single river winds its way through a flat, otherwise arid plain. During the course of the Indus and its tributaries five micro-relief landforms are identifiable: active flood plain, meander flood plain, cover flood plain, scalloped interfluves, and deltaic plain (Fig. 3).

Because of differing topographical and climatological conditions, the Indus plain may be considered as two geographic zones--the Upper Indus plain corresponding to the Punjab, and the Lower Indus plain roughly congruent with Sind. Within Pakistan, the former region is subdivided by the emerging rivers into a number of interfluvial sectors *(doabs)*. Except for the desert area between the Indus and the Jhelum-Chenab Rivers, and several tracts in the southern portion of the Upper Indus plain, most of this region is extremely fertile and cultivated. It supports a large and densely distributed population.

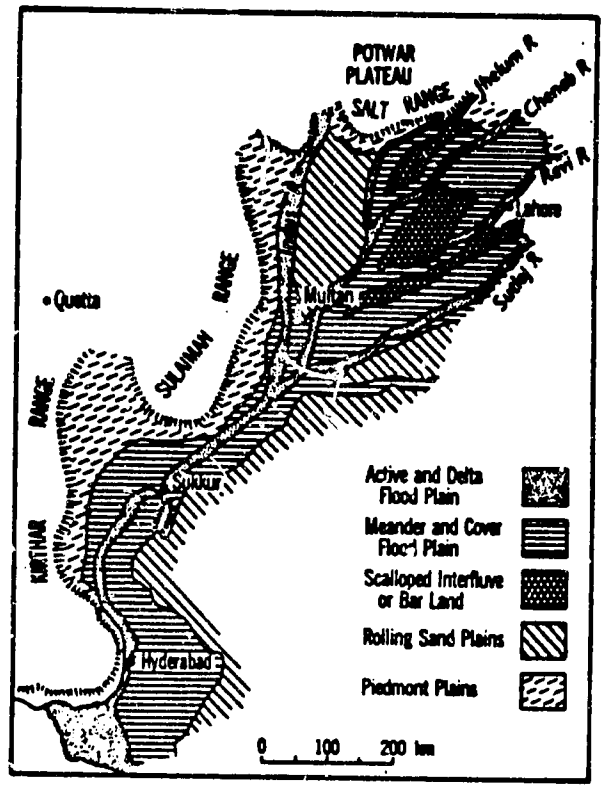


Figure 3. Landforms of the Indus Plain

Source: Johnson. 1979.

The Lower Indus plain, by contrast, consists of a single narrow flood plain, surrounded by mostly sandy soil. To the west, the river valley is bounded by the central mountain ranges; to the east, the vast Thar Desert approaches to within a few kilometers of the old flood plain. The deltaic region begins to fan out approximately 100 km from the coast. The land is low lying and often flooded or swampy.

2.1.3. Rainfall

In a country with a topography as varied as Pakistan's, climatic conditions are naturally quite diverse. At one extreme, rainfall in isolated northern mountain areas averages more than 2000 mm per year. Elsewhere, there are dry regions receiving less than 125mm of precipitation. Of the two conditions, the latter is far more prevalent. More than seventy-five percent of Pakistan is

exceedingly dry with less than 250 mm of annual rainfall (Fig. 4a). With the exception of a strip of humid subtropical terrain in the Punjab and a wet zone on the southern slopes of the northern highlands, virtually all of Pakistan is in either arid desert or semi-arid steppe land (Fig. 4b). The average distribution of rainfall at selected locations is shown in Figure 5.

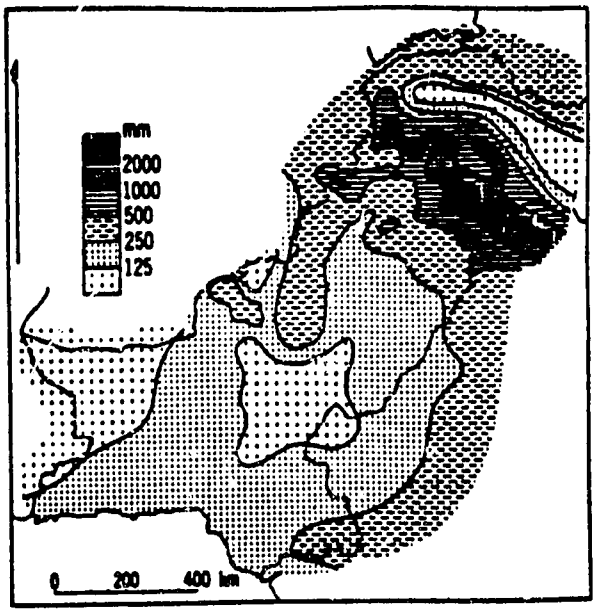
As is the rest of the subcontinent, Pakistan is dependent upon seasonal monsoons for much of its rainfall. Of the two annual rainy seasons, the one brought by the southwest monsoon from June to September is by far the most important. The Indus plain receives more than half its annual rainfall during this period. The mountains enveloping the plains serve to deflect much of the precipitation arising from the monsoon. Consequently the nation's dry periphery receives less than 30 percent of its rain during the summer months (Fig. 6a).

Pakistan's agricultural areas lie firmly within the zone receiving most of its rain from the southwest monsoon. This fact has always presented serious problems for productive and dependable cultivation. First, high variability in the onset and the amount of rainfall often endangers the seasonal crop. Lateness or sparseness of the monsoon tends to inhibit germination, while premature or excessive rainfall can cause seedlings to rot. Ever since the proliferation of artificial irrigation beginning in the late nineteenth century, the vagaries of the monsoon frequently have caused extended periods of drought or flooding. After heavy rainfall, much of the water runs off before it seeps into the soil. Moreover, the high temperatures which prevail in the plains during the summer months lead to massive losses from evaporation. In some regions evaporation of runoff and river and canal water claims ten times the annual precipitation. Virtually the entire country suffers from a net loss of water from this effect (Fig. 6b).

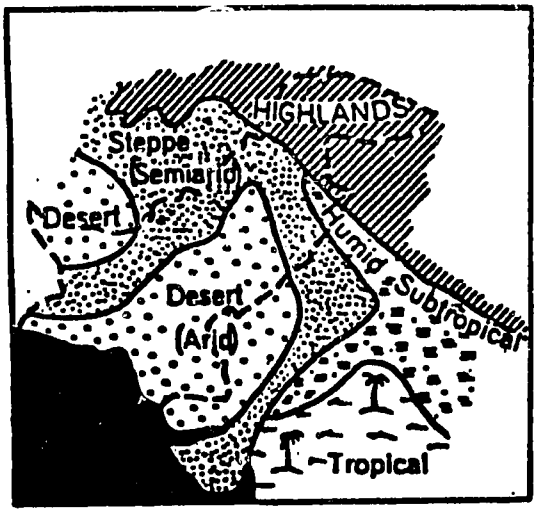
2.1.4 Temperature, Humidity, Pressure, and Wind

Except in the elevated northern zone, Pakistan's climate is characterized by four periods--the cold season (mid-December to March), the hot season (to June), the monsoon season, and the post-monsoon season (October to mid-December). Only the mountainous regions experience more than three months of relative wetness, where a month is termed relatively wet if average rainfall in mm exceeds twice the temperature in degrees Celsius (Johnson 1979). Throughout the plains the year is marked by dry weather.

Every corner of the country experiences extremes of temperature.



4a. Average Annual Rainfall



4b. Climatic Regions

Figure 4. Annual Rainfall and Climatic Regions.

Sources: a. Johnson. 1979.
b. Kingsbury. 1969.

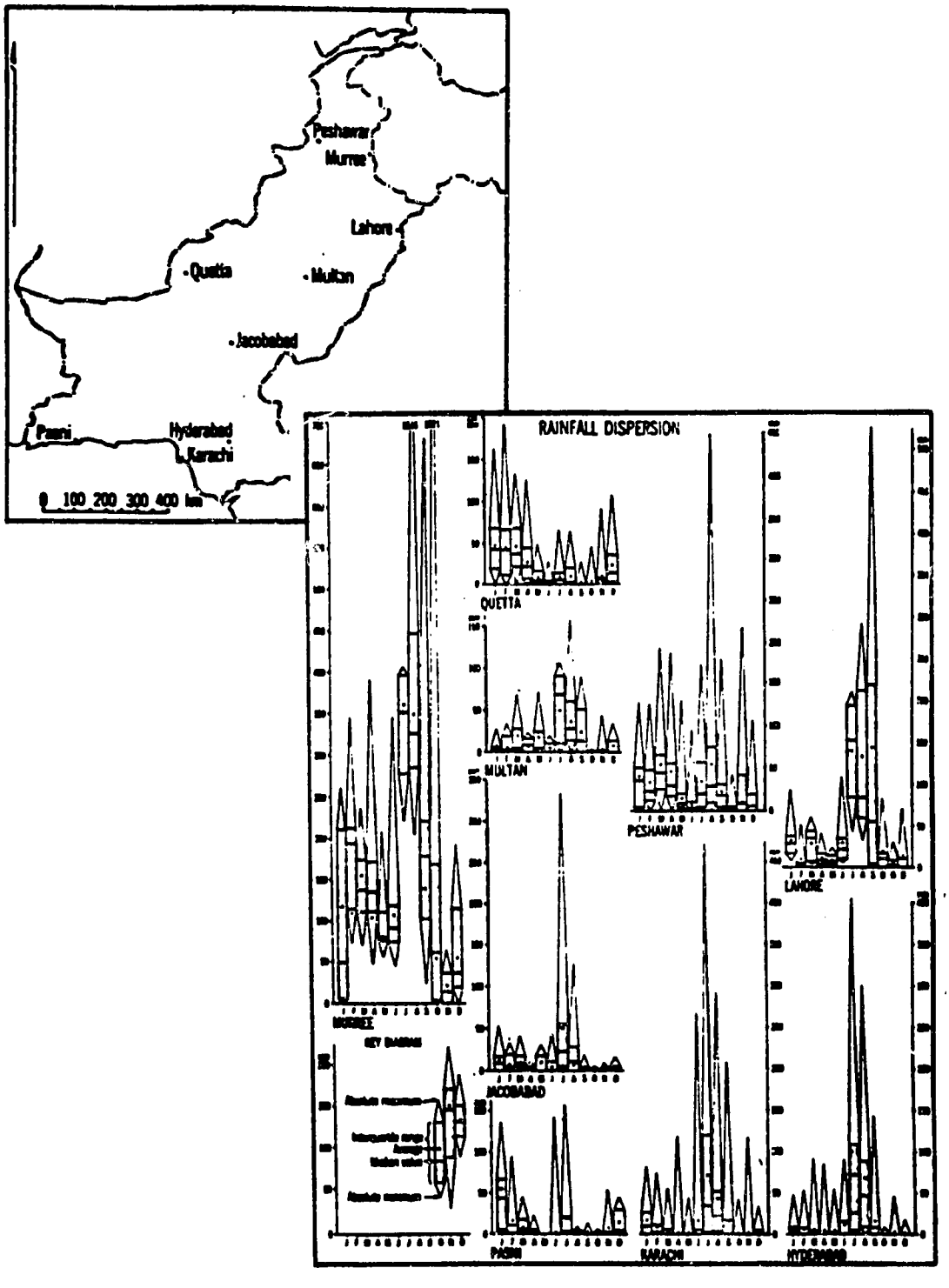
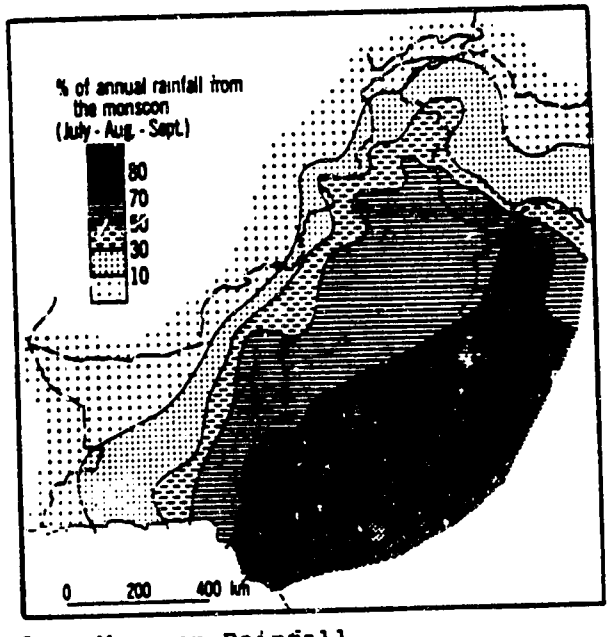
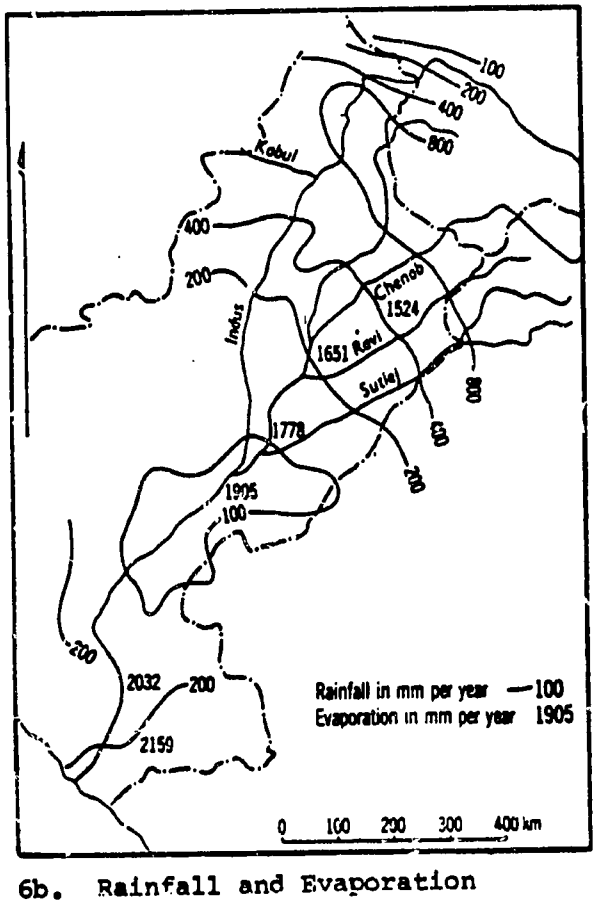


Figure 5. Rainfall at Selected Locations

Source: Johnson. 1979.



6a. Monsoon Rainfall



6b. Rainfall and Evaporation

Figure 6. Moonsoon Rainfall and Evaporation

Source: Johnson. 1979.

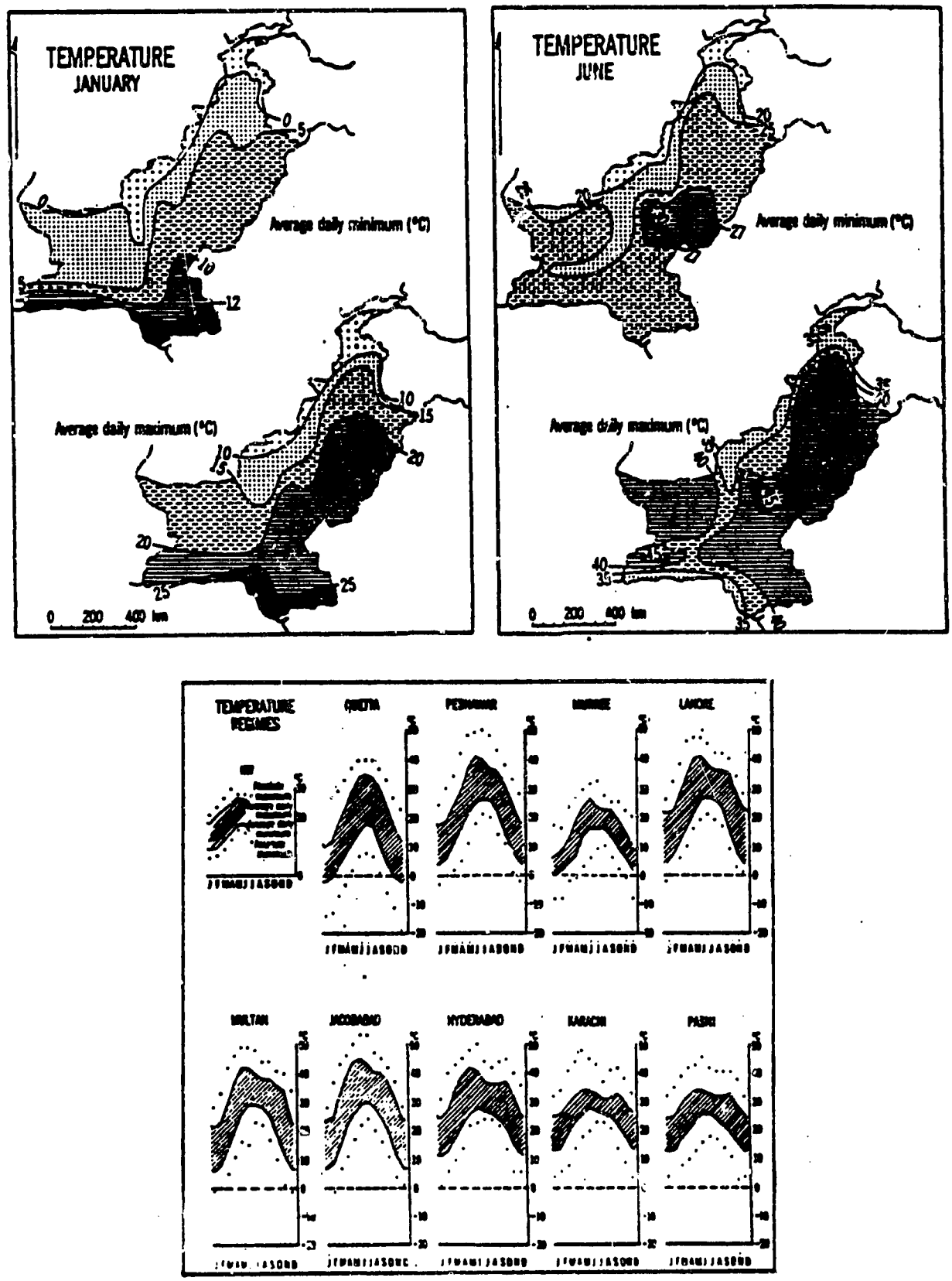


Figure 7. Temperature Variation

Source: Johnson. 1979.

During the cold period average minimum temperatures range from -5° C in the hills and even colder in the Great Himalayas to 12° C along the coast. Just prior to the monsoon average temperatures reach 45° C in the deserts and 35-40° C in the central plains. The summer rains relieve the heat and temperatures gradually drop to their annual minima (Fig. 7).

As temperatures rise from January to the onset of the rains, the heated land mass creates a low pressure area west of the Indus, below its confluence. This low pressure attracts winds from the Indian Ocean across the subcontinent. These moisture-laden winds produce the yearly monsoons. During the cold season the pressure tends to decline linearly from north to south. The winds generated by this gradient are generally dry and do not bring rains. Wind erosion is not a serious problem in Pakistan.

2.2 Population

2.2.1 Historical and Cultural Background [2/]

Pakistan has been a politically independent entity since 1947. The territory which lies within the nation's present borders has been populated since at least the neolithic age. What is believed to be the Indian subcontinent's first true civilization arose in the heartland of this area, in the valleys of the Indus River and its tributaries. The Harappan culture extended perhaps a thousand kilometers from the Arabian Sea coast to the Punjab. This widespread and seemingly well-coordinated civilization appears to have flourished between 2500 and 1700 B.C. Principally a series of settled communities, the culture subsisted by means of cultivation along the flood plain and grazing along the nearby slopes.

The Indus Valley civilization met a sudden and yet to be explained end and no current ethnic groups are known to be their descendants. In spite of its early disappearance, the culture contributed not only to the region's religious and artistic development, but also to its traditional patterns of land use, water management, and animal husbandry. Recent scholarship has also partly attributed the origins of man-caused desertification in this region to the large-scale deforestation practiced by the Harappans.

---

[2] Sources: Gankovsky. 1973.
Johnson. 1979.
Nyrop et al. 1975.

The disappearance of the Indus Valley civilization was approximately coincident with the emergence of the Indo-European speaking Vedic peoples from beyond the Himalayas. Organized along tribal lines, these nomads found the Indo-Gangetic plains to their liking and remained. In the process, they gradually subdued and absorbed the populations they encountered. By 1500 B.C. these tribes had prevailed and imposed their political control. The amalgam of Vedic and indigenous cultures, languages, and practices formed the antecedents of Hindu-Indian civilization. As the Vedic peoples moved southeastward along the Gangetic plain, they consolidated and established their capital at Pataliputra (now Patna). The area constituting Pakistan was the northwesternmost province of what came to be known as the Mauryan Empire (c.320-180 B.C.).

During the centuries which followed, this region was penetrated by a succession of nomadic Central Asian tribes, each of which eventually merged with the existing population. The fourth century B.C. witnessed the entry of Greek influence via the armies of Alexander the Great who advanced as far as the Indus River. A Greek contingent remained in the area and established the Greco-Bactrian dynasty whose center was at Taxila, 200 km east of the modern city of Peshawar. Within a hundred years of Alexander's departure the Greek rulers, impressed by Buddhism, adopted that religion. Until well into the Christian era this area remained a Buddhist stronghold and sustained Buddhist culture until the Muslim incursions of the tenth century.

The arrival of Islamic political and cultural influence from the west marks a watershed in the evolution of the area which is now Pakistan. In A.D. 711 an Arab general, Muhammad ibn Qasim, claimed the territories of Sind and Baluchistan in the name of the caliphate. The majority of the populace soon accepted Islam and those areas have remained overwhelmingly Muslim ever since.

To the north, in the Punjab, Islam did not arrive until later. Filtered through Iran, Afghanistan, and Turkish Central Asia, it was carried to the plains by recently converted tribal chieftains *(khans)*. By the close of the tenth century an Afghan, Mahmud of Ghazni, established the first Muslim state in the Punjab. The Ghaznavid dynasty was succeeded by competing clans of Turks and Afghans who dominated the region for the next four centuries. In 1526 another Turkish khan, Babur, established his supremacy throughout northern India. His descendants, the Mughals, extended their hegemony through much of the peninsula during the next two hundred and fifty years.

The entire area which is now Pakistan was, in fact, ruled continuously by Muslim dynasties for more than eight hundred years. This historical development has contributed perhaps more than any other factor to the identity of the modern nation of Pakistan. Carved out of the predominantly Muslim western fringe of British India, the country was created specifically in response to the demands of many members of India's largest minority. Accustomed, if only from memory, to political dominance, influential Muslims feared a permanently inferior role in a Hindu-controlled independent India. In spite of the objections and assurances of the Indian National Congress, India's principal separatist movement, Muslim leaders insisted upon the creation of an Islamic state.

In August 1947, amid religious violence of unprecedented proportions, Great Britain ended its colonial rule in India. In addition to the western fringe, mostly Muslim East Bengal was included in the new nation of Pakistan. The two wings of the nation were separated by fifteen hundred kilometers of hostile Indian territory and by innumerable cultural and economic differences. After less than twenty-five years of strained co-existence, the two severed their ties in the wake of the December 1971 war. The former province of East Pakistan emerged as the independent nation of Bangladesh. [3/]

2.2.2 Ethnicity and Language

The variety of Pakistan's ethnic communities reflects the accretions from millenia of continual migrations. Up to independence these nationalities had remained relatively stably distributed. Partition, however, upset the previous balance and permanently altered Pakistan's composition. Within a few months of British withdrawal thirteen million persons crossed the newly-formed borders during one of the world's largest population exchanges.

This phenomenon effectively removed Hindus from the fabric of Pakistani society. With minor exceptions near Karachi, Pakistan's western wing (now Pakistan) began life populated almost entirely by Muslims. Though professing the Islamic faith, the various elements comprising Pakistan's population are far from homogeneous either religiously, ethnically, or linguistically.

The majority of Pakistanis adhere to the orthodox *(Sunni)* branch of Islam. Several important communities, however, are

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[3] Sources: Abdulla. 1973.
Gankovsky. 1973.
Johnson. 1979.

practicing *Shi^{c}ites* . In addition, as in most of southern Asia, many Muslims are associated with *sufi* teaching and practices. The traditional clergy *(^{c}ulama)* exert strong influence upon government, education, and urban institutions. In the more populous countryside, descendants of Islamic holy men *(pirs)* command deep respect and have large local followings.

Pakistan's provincial boundaries approximate the dividing lines between its various nationalities. Because each of these groupings possesses its own tongue, moreover, the borders also serve to delineate regional languages. Pakistan has five principal languages, a half dozen minor ones, and a superimposed national language, Urdu.

The province of Baluchistan is inhabited predominantly by Balochi tribesmen whose kinsmen also reside across the borders in Iran and Afghanistan. These mountain and plateau dwellers speak Balochi, an Indo-European language of the Iranian family. Central Baluchistan contains a pocket of speakers of an entirely different language--Brahui, a member of the Dravidian group otherwise found exclusively in south India. Because of their unique language, Brahui tribesmen are thought to descend from the original inhabitants of the area.

North of Baluchistan the NWFP is inhabited by dozens of tribal clans classed under the rubric of a single Afghan nationality. These tribes are variously called Afghans, Pathans, Pashtuns, or Pakhtuns. Ranging from the Zhob River in the south to the Hindu Kush Mountains in the north, the Pathans share varying dialects of a common language--Pashto, another member of the Iranian group. Like the Balochis, the Pathans' traditional homeland transcends modern boundaries; related tribes reside in neighboring Afghanistan.

In the extreme north, in the disputed territories, the population is sparse. Nevertheless, the peoples speak languages belonging to three different families. Dardic languages are spoken in Chitral, Gilgit, and the neighboring areas. To the east, Balti, a Sino-Tibetan tongue is spoken around Skardu. In Azad Kashmir the population speaks Kashmiri, an admixture of a Sanskrit-derived north Indian language and Dardic.

In the plains the languages are lineal descendants of the medieval Prakrits, or Sankrit-based vernaculars. Punjabi in the Punjab and Sindhi in Sind are the official languages of those provinces. The ethnic origins of the residents of these areas are vague and are the result of millenia of

intermarriage. As the first regions encountered by invading foreigners, these areas bear the imprint of each of the succeeding nationalities. The ethnic backgrounds of modern Punjabis and Sindhis are further obscured by the deep social stratifications upon which the societies are based. Despite centuries of agricultural settled existence, both groups retain distinctly tribal features.

When Pakistan was created, its leaders recognized the need for a single language to be used by administrators and educators. English had performed this function since the mid-nineteenth century. In 1947 the new government decided to reintroduce Urdu, the common language of much of northern India and the official language of the Mughals. Prior to partition there were few Pakistanis for whom Urdu was a mother tongue. The large influx of immigrants from the Gangetic Valley, however, brought millions of Urdu speakers, many of them members of the intelligentsia. Official promotion of Urdu has swelled the number of speakers, but even now many of these persons are in the eastern regions and in the cities. In spite of these efforts, English has remained the language of university and technical instruction and it is widely spoken by administrators and military personnel.

2.2.3 Population Size, Growth, and Distribution[4/]

According to projections based upon the adjusted 1972 census, the estimated population of Pakistan in 1980 was 86.5 million (U.S. AID 1980a) making it the world's tenth most populous nation. Pakistan's growth rate of approximately 2.85 percent in 1978 ranks among the world's highest (U.S. Dept. of Commerce 1980).

This rate appears to have stabilized after having risen to an average of 3.1 percent from 1970 to 1978 (World Bank 1980). Because Pakistan has experienced only insignificant international migration over the past two decades, the growth

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[4] Sources: Johnson. 1979.
U.S. AID. 1979a.
U.S. AID. 1980a.
U.S. Dept. of Commerce. 1979a.
U.S. Dept. of Commerce. 1980a.
World Bank. 1979.
World Bank. 1980.

rate has remained equal to the rate of natural increase. In 1978 the crude birth rate and death rate were estimated at 44.5 and 15.0 per one thousand, respectively (World Bank 1980). According to one projection, Pakistan's population is expected to reach 139 million by the end of the century (World Bank 1980).

A steadily shrinking, but nevertheless still substantial majority of Pakistan's population (72.0 percent in 1978) reside in rural areas (World Bank 1980). Urbanization has grown at an average rate of 4.3 percent over the past decade and most observers expect this rate to accelerate over the remainder of the century. The urban population, furthermore, is heavily concentrated; 52 percent of city dwellers now inhabit the nation's seven locales of more than 500,000 persons--Karachi, Lahore, Faisalabad, Hyderabad, Rawalpindi, Multan, and Gujranwala. These cities are growing at an annual rate of 6.6 percent.

As in most developing countries, Pakistan's population is young. In 1979, 43.1 percent of the inhabitants were below the age of fifteen (Fig. 8). Less characteristically, the census counts nearly 12 percent more males than females. The disparity is due neither to widely differing infant mortality rates--2.8 percent higher among females--nor to significantly different life expectancies--4 percent lower among females (U.S. Dept. of Commerce 1980). Rather, this disparity most likely reflects the difficulty of enumerating females in an orthodox Islamic environment.

The regional distribution of population mirrors the country's topographical and climatological conditions. The arid flatlands and barren mountains are sparsely inhabited. More than half of Pakistan's population is in the Punjab, though that province accounts for only a quarter of the nation's area. By contrast, Baluchistan's meager population is scattered across nearly half of the area (Table 2). The density is highest in the intensely irrigated northeastern corner of the Punjab and in the deltaic regions surrounding Karachi.

In some zones, population density exceeds 400 persons per square kilometer, well above the national average of 96.0. Nearly all of the cities whose population exceeds 100,000 are situated within the flood plains of the Indus and its northern tributaries.

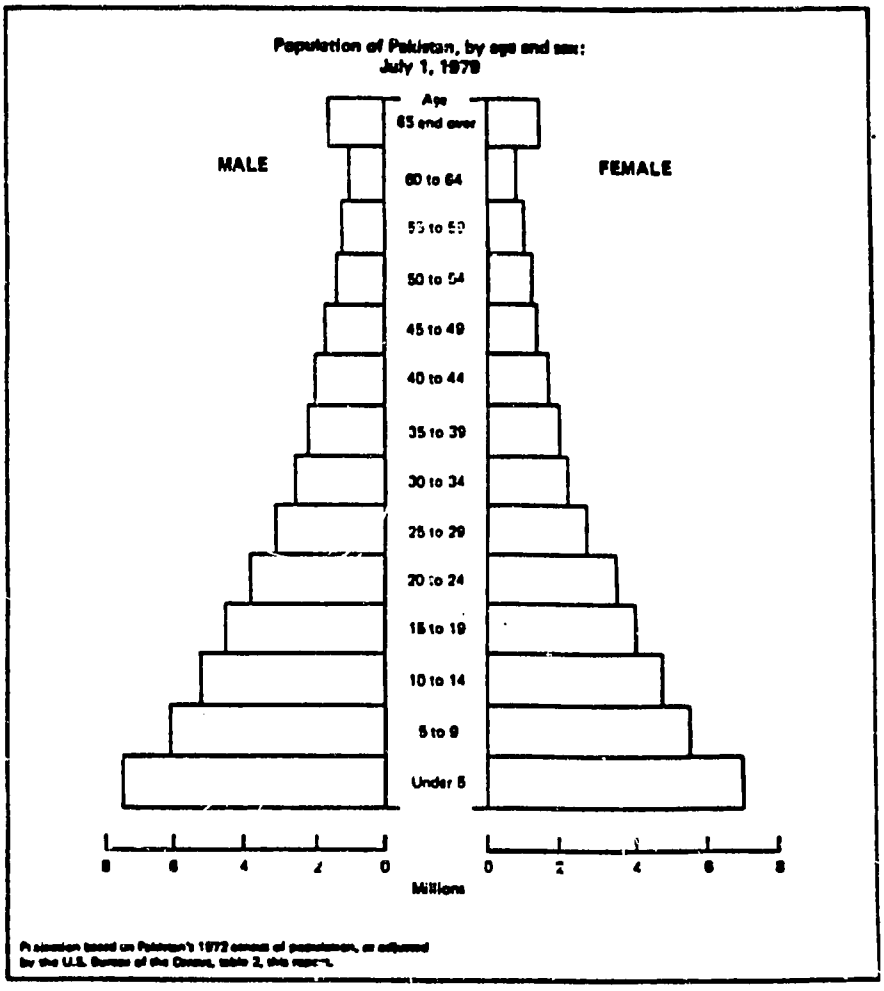

Figure 8. Population Distribution by Age and Sex

Source: U.S. Dept. of Commerce. 1980.

Table 2. Regional Population Distribution

Region	Area (sq. mi.)	Area[a] (sq. km.)	Area (% of total)	Pop. (1000's)	Pop. (% of total)	Ratio of % Pop. to % Area	Pop. density (#/sq. km.)
Baluchistan	134,478	348,300	43.6	2,420	3.7	0.08	7.0
NWFP	28,773	74,520	9.3	8,380	12.9	1.31	112.5
Punjab	79,551	206,040	25.8	37,400	57.6	2.23	181.5
Sind	54,588	141,380	17.7	14,050	21.6	1.22	99.4
Centrally Administrated Tribal Areas	10,659	27,610	3.5	2,500	3.8	1.09	90.5
Islamabad Capital Area	337	870	0.1	235	0.4	4.00	270.1
Pakistan (undisputed)	308,386	798,720	100.0	64,985	100.0	1.00	81.4

[a] From Table 1

Sources: GOP. 1976.
Nyrop. 1975.
U.S. AID. 1979a.

2.2.4 Health and Nutrition[5]

Because Pakistan ranks among the world's low-income countries (World Bank 1980), it's not surprising that health conditions have been generally poor. The past decade, however, has witnessed improvements in many areas. Life expectancy, at an estimated 52 years in 1978, has been rising steadily since independence; in 1960, the average Pakistani's life span was only 44 years. A continuous drop in the infant mortality rate is among the chief factors contributing to the rise in life expectancy. An estimated 20 percent reduction in infant mortality between 1960 and 1973 nevertheless leaves Pakistan with a rate of perhaps 113 mortalities per 1000 live births (U.S. AID 1980). This is still an alarming figure which mirrors the prevalence of unsanitary conditions and resultant infectious disease.

These diseases, principally malaria, tuberculosis, cholera, parasitic disorders, and influenzas, have remained virtually ineradicable. Their widespread occurrence keeps Pakistan's crude death rate at 15 per 1000, slightly lower than in other less developed countries, whose average death rate is 18.5 per 1000 (World Bank 1980). Control of these diseases is particularly difficult due to problems with water supply and sewage, the chief breeding grounds of infectious carriers.

Table 3. Water Treatment and Disposal Facilities

	Rural Pop.	Urban Pop.	Total Pop.
Access to safe water (% of pop.)	5.0	75.0	25.0
Access to sewage disposal (% of pop.)	n.a.	21.0	6.0

Source: U.S. AID. 1980a.

As Table 3 illustrates, only a quarter of the population is provided with treated drinking water. Only six percent are served by sewage disposal systems. In both cases, these

[5] Sources: U. S. AID. 1979a.
U. S. AID. 1980.
U. S. Dept. of Commerce. 1980.
World Bank. 1980.

facilities are scarcer in the villages and countryside, precisely the locales which afford the least medical care and health services. Only 5 percent of rural residents are within reach of minimum medical care. Overall, it is estimated that between 15 percent and 20 percent of the population has access to such services (U. S. AID 1979a). Low literacy contributes further to Pakistan's chronic health problems. In 1975 only 21 percent of the adult population was considered literate (World Bank 1980); in rural areas, the percentage is considerably lower. Because school attendance is not universal, educational programs designed to improve personal and public hygienic practices are difficult to implement. Attempts to enlighten the public via the mass media have begun to bear fruit, but efforts to introduce western medical and sanitary practices are frequently perceived as deviations from established norms. Consequently, they encounter stiff opposition and inertia among the traditionally oriented segments of society.

Pakistan's low per capita GNP (c.$230 in 1978; World Bank 1980) is manifested in the general insufficiency of nutrition. The population barely meets the FAO's recommendation for minimum daily intake of 2232 calories; the World Bank estimates the average daily caloric supply at 2281. Scarcity of food supplies and improperly balanced diets lead to long-term deficiencies in protein, other nutrients, minerals, and vitamins. Women tend to be more undernourished than men. This cultural factor adds to the high rates of miscarriage and infant mortality. The generally inadequate diet--50 percent of the population is considered malnourished (U.S. AID 1979a)--leaves much of the population susceptible to infectious disease.

Malaria, bred in the numerous watercourses of the Punjab and Sind, is the most serious health concern. Eradication programs have been sporadic and over the past decade resistant strains of mosquitoes have spread the disease more vigorously than ever. The summer monsoon brings an annual upsurge not only of malaria, but of all epidemic illnesses. Tuberculosis, trachoma, polio, cholera, typhoid, dysentery, meningitis, hepatitis, typhus, leprosy, and bubonic plague are chronic menaces to the general welfare. In spite of vaccination campaigns and other public health efforts, Pakistan has had little success in containing the spread of disease.

From British times the government has played a role in the administration of public health. A central Ministry of Health and Social Welfare oversees matters relating to health, medical services, research, and training. Over the past two decades

government expenditures within this sector have risen more than seventy-fold (GOP 1976). Simultaneously, the number of hospitals, dispensaries, and hospital beds have increased dramatically since 1971. The government has also periodically sponsored programs in population planning. Birth control measures were vigorously pursued during the Bhutto regime (1971-77). Between 1971-72 and 1975-76 government support of population planning grew nearly eight-fold (GOP 1976). By 1978 the annual growth rate dropped to less than 3 percent. Since then, however, an increasing desire to promote Islamic values has caused an easing of official support for population control.

2.3 Land Use[6/]

Pakistan is predominantly an agricultural nation. The agricultural sector of the economy employs nearly 60 percent of the labor force, accounts for two-fifths of the country's national income, and supplies nearly two-thirds of its exports (U.S. AID 1980a; Kureshy 1977). To sustain its agriculture, Pakistan has the world's most extensive integrated irrigation network; 71 percent of land under crops is served by this system (U. S. AID 1979a). Yet, remarkably, only 38.4 percent of the total territory (57 percent of total reported area) is agricultural area (Table 4). The remainder consists of forests, grazing lands, and barren terrain unsuitable for any productive use.

Pakistan's nearly 80 million hectares of land are not readily categorized by land use types. The chief problem appears to be that a large portion of territory remains unreported. Since independence this figure has declined from 42 percent of the total to 32.5 percent in 1972-73 (Table 4). During this period both the amount of forest land and agricultural land have increased.

Between 1958 and 1973 forest lands doubled, increasing at an annual rate of 8.4 percent (GOP 1976). Yet in spite of this apparent growth, desertification and deforestation are simultaneously eliminating woodlands (Johnson 1979; Eckholm 1979). The government has attempted to counter these losses by promoting several important afforestation projects. Nevertheless, it is likely that the large growth of forest lands reflects the corresponding rise in reported area and similar changes in classification rather than an actual increase in acreage.

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[6] Sources: Johnson. 1979.
Kureshy. 1977.
GOP. 1976.
GOP. 1977.
GOP. 1978.

Cultivated area has grown at a more moderate pace, increasing by 33 percent between 1947 and 1973. In gross amount, however, there were 4.8 million more hectares of cultivated area in 1972-73 than in 1947-48. This is too large an amount to be attributed merely to changes in reporting. It may be assumed, moreover, that valuable agricultural land has always been fully reported. The gains in cultivated area are the result of a 39 percent increase in the net area sown and a 17 percent rise in the amount of fallow land. These increases were not likely obtained by cultivating lands previously classified as culturable waste. In addition, Table 4 points to a tendency to make better use of available croplands; by 1972-73 about 2.5 million hectares were sown more than once annually--an increase of 156 percent in twenty-five years.

During the same period, terrain classified as cultivable waste increased by 21 percent to 11.1 million hectares. A large part of this increase may be attributed to the reclassification of land previously regarded as unavailable for cultivation or unreported. There are indications that at least some of this increase is due to loss of cropland (Brown 1978). Nonetheless, Table 4 shows that up to 1973 the growth of cultivated area had more than offset any losses of cropland.

Estimates of the size of Pakistan's rangelands vary considerably and remain unreliable. It appears that about 70 percent of the total geographical area, or approximately 57 million hectares, is comprised of rangelands (Johnson 1979; GOP 1978). This vast area includes terrain variously classified as culturable waste, area not available for cultivation, and unreported area. Baluchistan, with more than 32.4 million hectares of rangelands, is almost entirely (93 percent) devoted to pastoral grazing. The extent of these pastures and the magnitude and growth rate of Pakistan's foraging livestock population present formidable problems for the nation's range management programs.

Traditionally, Pakistan's farming land has been managed in a relatively small segment of the population. The distribution of land in 1960 is illustrated by Table 5. According to the data in this tabulation, while more than three-quarters of Pakistan's farms were smaller than 5 ha, these accounted for less than a third of the total farmland. Recent land reform measures creating ceilings of 40 ha of irrigated and 81 ha of unirrigated terrain per farm have begun to alter the pattern of consolidation among wealthy landowners.

Table 4. Land Use

Land Type	1947-48 10^6 ha	1947-48 Percent reptd. area	1959-60 10^6 ha	1959-60 Percent reptd. area	1972-73 10^6 ha	1972-73 Percent reptd. area
A. Forest Area	1.38	3.0	1.34	2.8	2.80	5.2
1. Pine Forest[a]	0.63	1.4	0.61	1.3	NA[c]	NA
2. Hill Scrub[a]	0.57	1.2	0.55	1.1	NA	NA
3. Riverain Forest[a]	0.19	0.4	0.18	0.4	NA	NA
B. Agricultural Area	23.87	51.8	26.53	54.7	30.60	57.0
1. Cultivated Area	14.69	31.9	16.52	34.1	19.49	36.2
a. Net area sown	10.68	23.2	13.08	27.0	14.79	27.5
b. Area sown more than once[b]	0.96	2.1	1.60	3.3	2.46	4.6
c. Fallow land	4.01	8.7	3.44	7.1	4.70	8.7
2. Culturable waste	9.18	9.9	10.01	20.07	11.11	20.7
C. Area Unavailable for Cultivation	20.83	45.2	20.60	42.5	20.30	37.8
D. Total Geographical Area	79.60	-	79.60	-	70.60	-
1. Total Reported Area	46.08	100.0	48.47	100.0	53.70	100.0
2. Unreported Area	33.52	-	31.13	-	25.90	-

[a]Estimate based upon 1968 figures in Champion et al. 1968?

[b]Part of the net area sown.

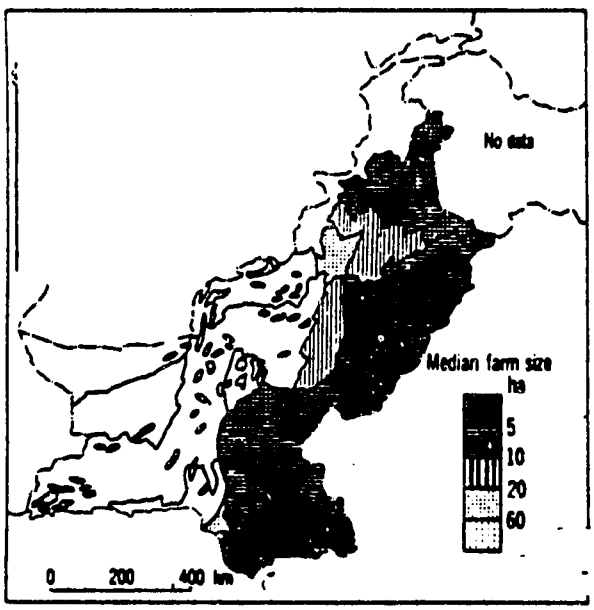
[c]NA= not available

Source: GOP. 1976. Originally from Planning Unit, Food and Agriculture Division.

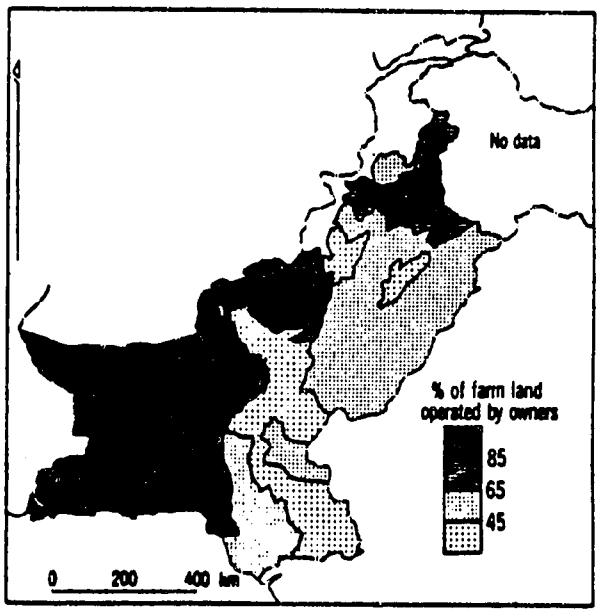
Table 5. Land Distribution in Pakistan, 1960

Farm Size	Number of farms (million)	% of total	Area of farms (million ha)	% of total
0-5 ha	3.75	76.5	6.4	31.8
5-10	0.75	15.3	5.1	25.3
10-20	0.30	6.1	3.8	18.9
20-60	0.09	1.8	2.8	13.9
Greater than 60	0.01	0.2	2.0	10.0
Total	4.90	100.0	20.1	100.0

Source: S. M. Akhtar. 1978.



9a. Median Farm Size, 1972



9b. Land ownership, 1972

Figure 9. Median Farm Size and Land Ownership

Source: Adapted from Johnson. 1979.

Figure 9a, which employs 1972 data, confirms that in most regions farms are less than 10 hectares in area. Figure 9b reveals that most Pakistani farms are now generally operated by their owners. Previously, such conditions were relatively rare as most wealthy landlords left day-to-day operations to retainers. This phenomenon indicates that reforms are beginning to reduce the average size of farms and increase the number of landlords.

2.3.1 Crops

The distribution of crops grown on Pakistan's farmlands is shown in Table 6. Although the total areas sown each year differ somewhat from the corresponding amounts shown in Table 4, this table presents a generally accurate picture of the proportions of acreage allocated to various crops. Grains have consistently been the major crop, though there has been a gradual decline in their prominence. In 1947-48, 70.1 percent of land was assigned to grain; by 1983, the government expects to reduce that portion to 64.9 percent. Among grains, wheat has remained the leading crop. However, rice,which formerly grew on only 12 percent of land reserved for grain, now accounts for 18 percent. There appears to have been a de-emphasis in cultivation of inferior cereals such as millet and sorghum and a corresponding rise in the prominence of maize.

Cash crops, first introduced by the British in the nineteenth century, have commanded an increasing share of available farmland. Including oil-bearing seeds, cash crops now cover a third of the sown area. Cotton is the principal of these crops, alone accounting for an eighth of the planted acreage.

Fertilizer use was negligible during Pakistan's early years. Beginning in the 1960s fertilized cropping became increasingly popular among farmers. By 1972-73, consumption averaged 22 kg per hectare, spurring large increases both in domestic production and in imports. At present the demand is far in excess of the nation's output. Throughout the Indus River basin, fertilizer is used on more than half the cropped area.

2.3.2 Livestock and Rangeland

In Pakistan's rural economy, cattle and other livestock play a central role. These animals provide energy in the form of drawing power and fuel, organic fertilizer, meat, dairy products, leather, and wool. Table 7 shows the number of quadruped livestock in 1976-77.

Table 6. Areas of Important Crops, Past and Future (10^6 ha)

	1947-48[a]	1959-60[a]	1972-73[a]	1976-77[b]	1982-83[c] (Projected)
Grains	6.51	8.04	9.37	10.03	11.18
Wheat	3.95	4.88	5.97	6.39	7.16
Rice	0.79	1.20	1.48	1.75	1.98
Bajra (Millet)	0.81	0.81	0.61	0.65	0.69
Jowar (Sorghum)	0.43	0.46	0.50	0.45	0.47
Maize	0.36	0.48	0.65	0.62	0.67
Barley	0.17	0.22	0.16	0.17	0.21
Pulses				1.53	1.75
Gram (*Cicer arietinum*)	0.88	1.14	1.02	1.09	1.21
Mash (*Phaseclus radiatus*)				0.05	0.07
Masoor (*Lens esculenta*)				0.08	0.10
Mung (*Phaseolus mungo*)				0.06	0.11
Other				0.24	0.25
Vegetables & Fruits				0.38	0.48
Potatoes				0.03	0.05
Fruits				0.24	0.27
Other				0.11	0.16
Cash Crops	1.44	1.78	2.59	2.70	2.86
Cotton[d]	1.24	1.34	2.01	1.86	2.02
Sugarcane	0.19	0.40	0.53	0.79	0.77
Tobacco	0.01	0.04	0.04	0.05	0.06
Condiments & Spices				0.08	
Onions				0.03	0.04
Garlic				0.002	
Chillies				0.05	
Oil Seeds	1.69	1.94	2.60	2.46	2.93
Rape & Mustard	0.43	0.56	0.53	0.52	0.65
Sesamum	0.03	0.03	0.03	0.03	0.03
Cotton[d]	1.24	1.34	2.01	1.86	2.02
Groundnuts		0.003	0.03	0.04	0.06
Other					0.16
Total	9.28[e]	11.56[e]	13.57[e]	15.32[e]	17.22

a. GOP. 1976.
b. U.S. AID. 1979a.
c. GOP. 1978.
d. Cotton acreage is listed both under cash crops and oil seeds, but is only counted once in the totals.
e. Totals do not include pulses other than gram, vegetables and fruits, and condiments and spices. For 1976-77 and 1982-83 these products accounted for about 5 to 6 percent of total acreage.

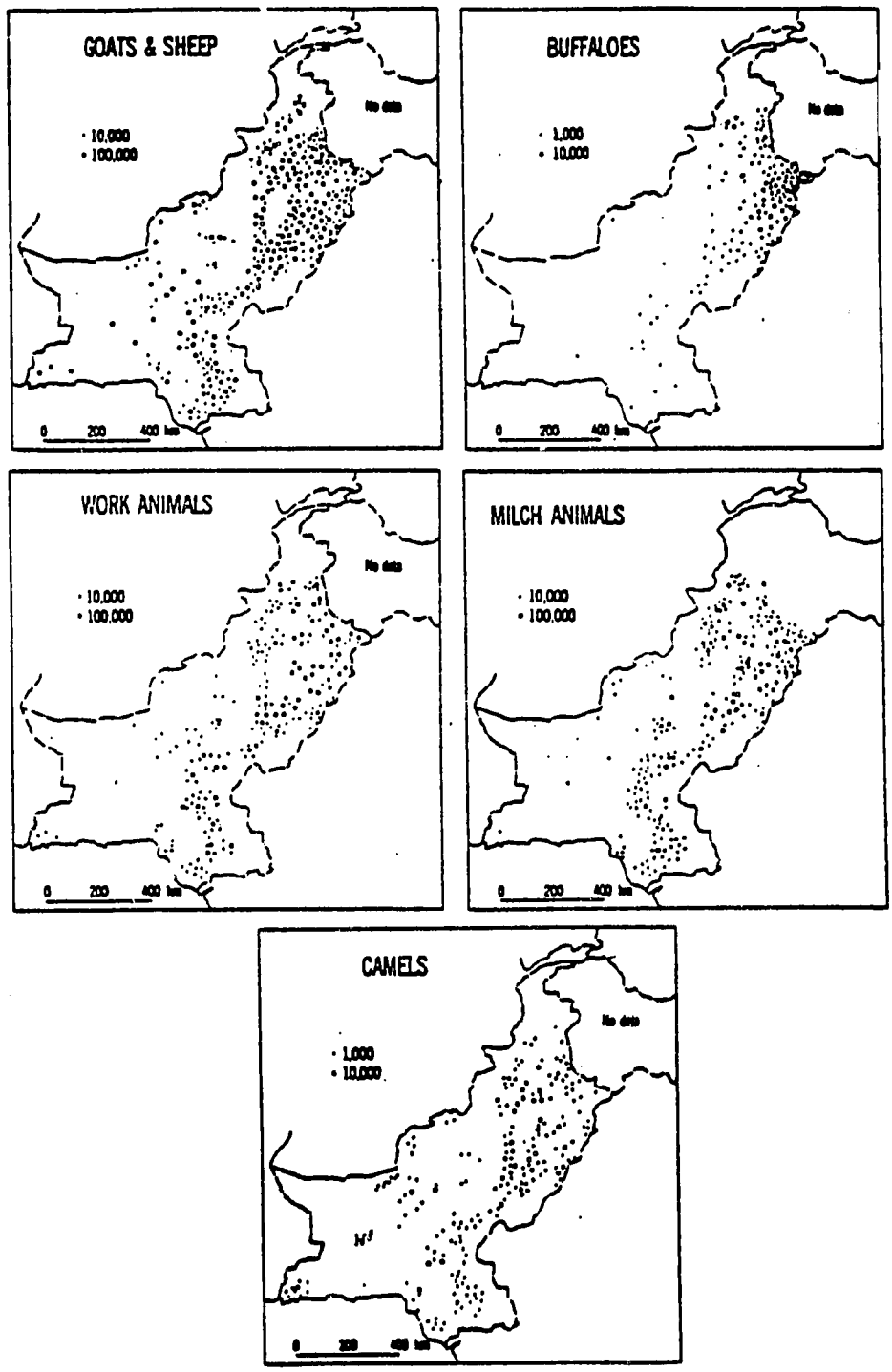


Figure 10. Distribution of Livestock, 1972

Source: Johnson. 1979.

Table 7. Livestock, 1976-77

Goats	20,881,000
Sheep	18,131,000
Cattle	14,372,000
Buffaloes	10,418,000
Donkeys	1,939,000
Camels	694,000
Horses	382,000

Source: Johnson. 1979. Originally from Livestock Division. Ministry of Agriculture, GOP.

These animals are raised throughout the country except in the most arid and rugged tract of Baluchistan. Figure 10 illustrates the geographical distribution of Pakistan's livestock. Goats and sheep are the hardiest of breeds and are naturally the most widely distributed. They graze extensively in the irrigated plains in the Himalayan foothills, and to a lesser degree in the less hospitable western mountains. Cattle and buffaloes are more concentrated in the eastern sections of the country.

Most commonly, livestock is grazed in the extensive rangelands. The estimated 57 million hectares of rangeland are normally capable of producing forage to support a large part of the grazing, especially by sheep and goats. However, in the past, ineffective management of range resources has led to serious overgrazing. The mobility of the herds, kept by nomadic peoples, has devastated a very large portion of Pakistan's natural pastures. Goats, in particular, have eliminated entire species of edible plants. The resulting desertification is usually irreversible. Many of the pastures thus currently produce only 10 to 15 percent of their potential forage (GOP 1978). The shortage of feed is partly offset by devoting a growing portion of the nation's cropped area to raising fodder crops. Currently, 15 percent of the nation's sown acreage produces clover, guar seed (*gyamopsis psoralioides*, or field vetch), and other fodders. Straw, stalks, and other byproducts of grain and produce are widely used to supplement fodder. The government is currently taking steps to further increase the production of such crops by introducing high-yielding varieties of seeds.

As a rule, very few of Pakistan's domesticated herds are raised on farms or ranches set aside for their exclusive use. Recent projects have introduced urban dairy farms, but these remain purely experimental. Most cattle continue to be bred by individual owners within city limits, on small farms, or on open lands.

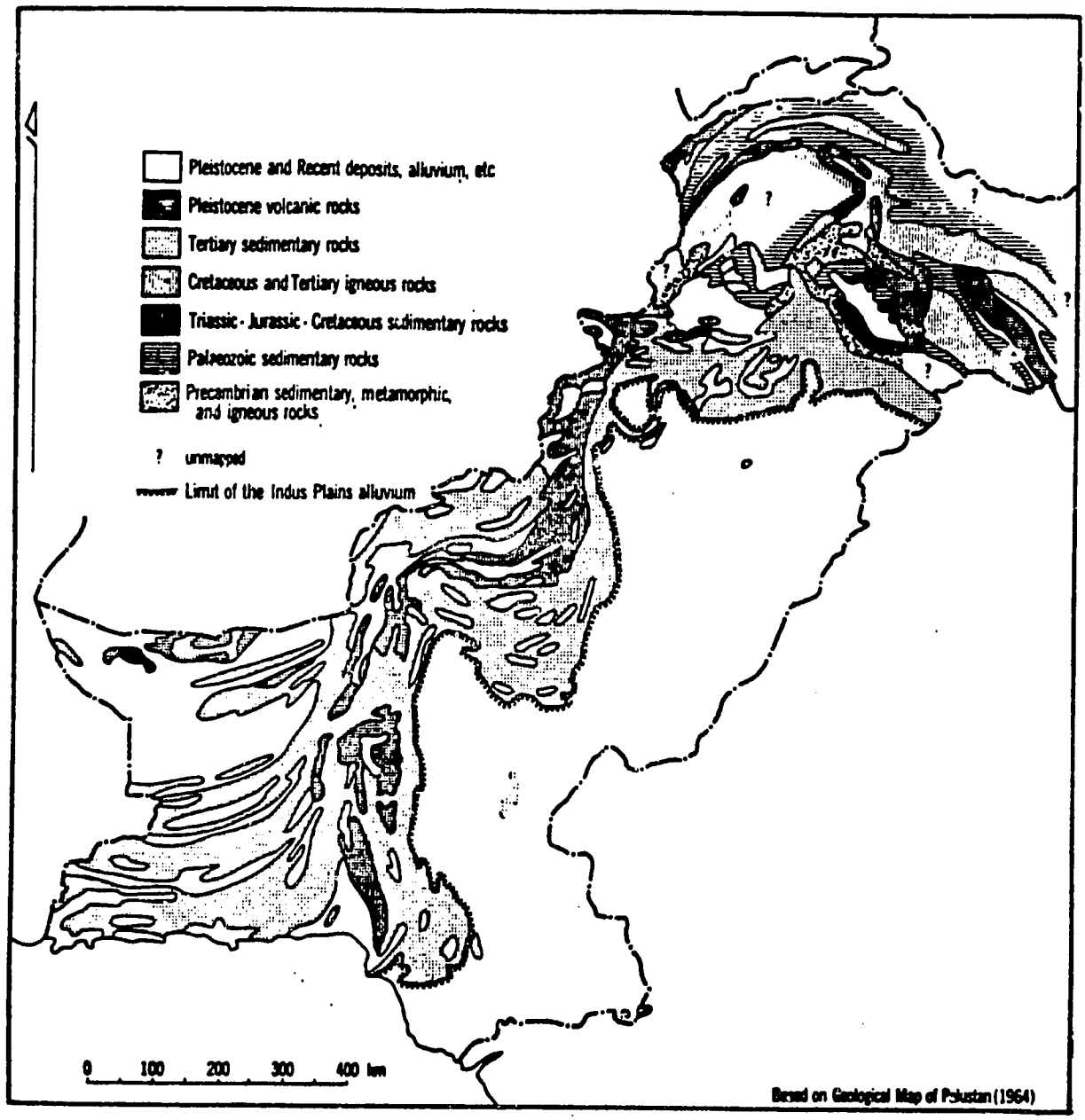


Figure 11. Solid Geology

Source: Johnson. 1979.

3.0 Environmental Resources and Policy

3.1 Mineral Resources, Energy, and Soils[7/]

3.1.1 Geologic Formations

Pakistan's solid geology is mapped in Figure 11. The northern flank of the country represents the farthest extent of the Indian continental plate whose northward movement has formed the Himalayan range. These mountains as well as the ranges west of the Indus plain are primarily composed of folded sedimentary rock formations. Zones of igneous rocks are rare and are confined to the upper reaches of the Himalayas and Hindu Kush. Volcanic rocks are even more unusual; their only occurrence is in the Chagai Hills of western Baluchistan.

Alluvial deposits cover the entire Indus plain and thus account for virtually all of Pakistan's arable land. Within the Indus plain are three groups of morphological elements:

a. The bare bedrock slopes of the mountain faces which gradually turn to gravel and then sand as they meet the piedmont plains.

b. The terraced flood plains of the Indus and its tributaries.

c. Eolian, or windblown, deposits scattered throughout the plains.

The northern plains are characterized by scalloped interfluves and meander scars. The southern plains, which result from a more recent phase of fluvial activity, are flatter and covered with very fine alluvium. Figure 12a shows Pakistan's alluvial formations and Figure 12b illustrates the morphology of the Indus plains.

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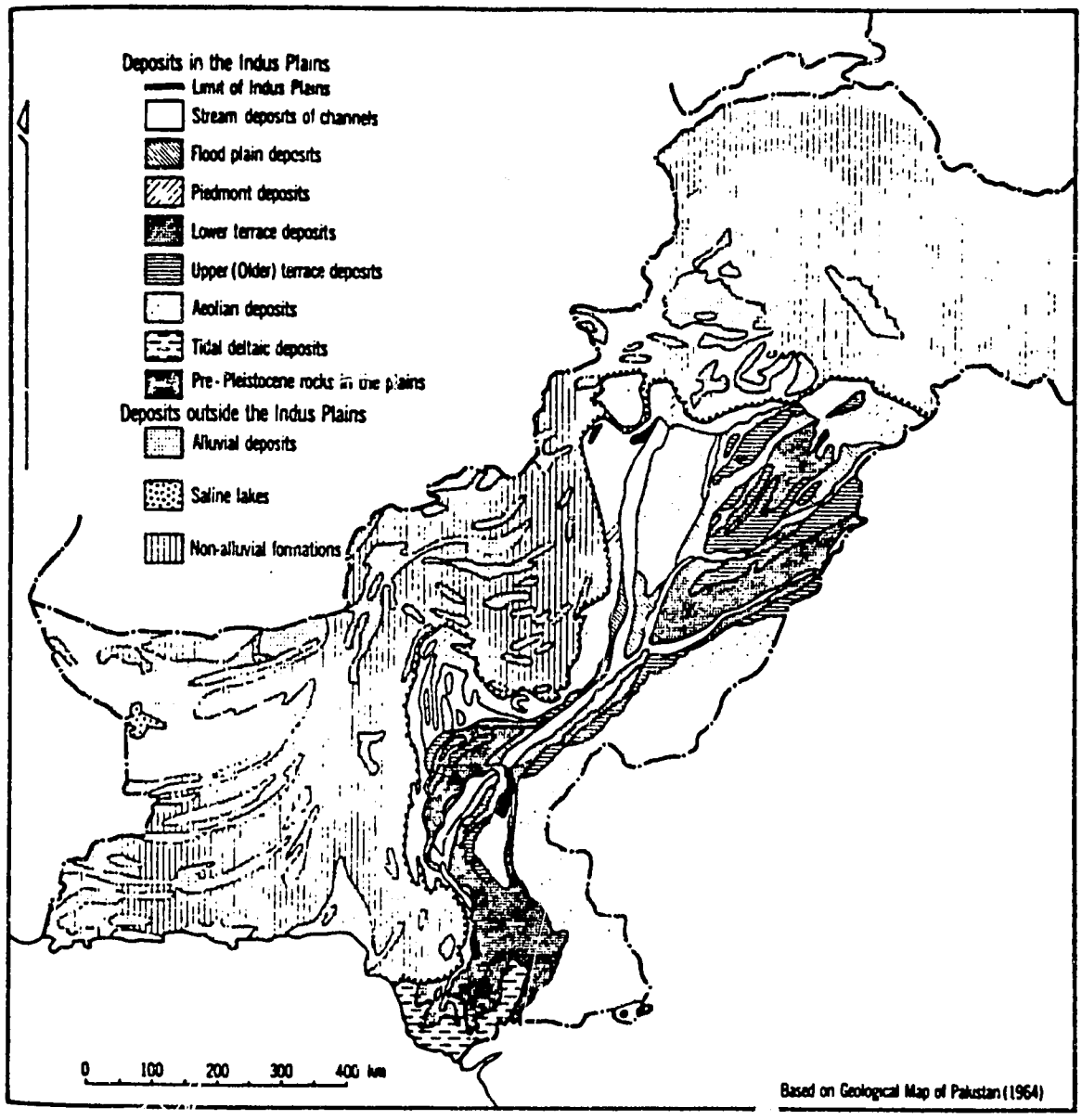
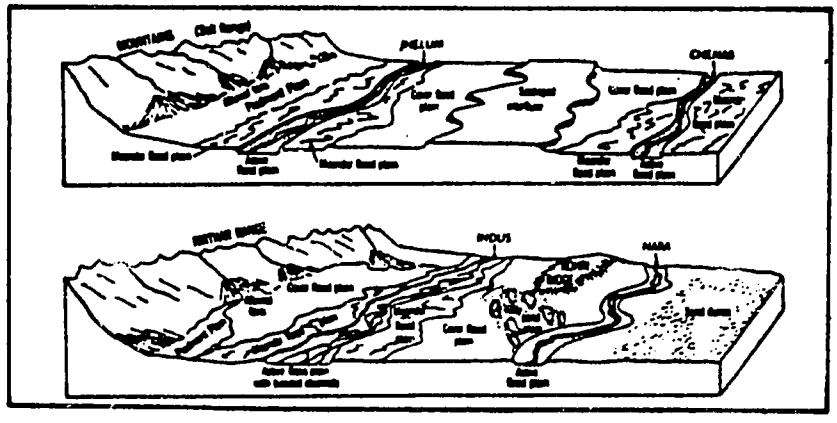
[7] Sources: Z. Ahmad. 1975.
R. Akhtar. 1975.
Dregne. 1976.
GOP. 1976.
GOP. 1977.
GOP. 1978.
Johnson. 1979.
Kureshy. 1977.
Nyrop et al. 1975.



12a. Alluvial and Eolian Deposits



12b. Indus Plains Morphology

Figure 12. Alluvial Geology and Indus Plains Morphology

Source: Johnson. 1979.

3.1.2 Mineral Deposits

The value of mineral resources discovered in Pakistan to date has been relatively insignificant. As recently as 1977-78 mining and quarrying contributed just 0.5 percent of the GNP (Johnson 1979). Among minerals having export value, only chromite, baryte, magnesite, and aragonite (marble) are presently mined (Table 8). In addition the Geological Survey of Pakistan estimates that there are large deposits of low grade iron ore (c. 450 million metric tons), copper ore (c. 360 million metric tons), and bauxite (c. 21 million metric tons). Recent efforts have uncovered some gold deposits in the northern Gilgit, Hunza, and Chitral areas, but thus far mining has remained uneconomical (Z. Ahmad et al. 1975).

Table 8. Output of Minerals, 1976-77

Mineral	Amount Produced[a] (metric tons)
Antomany	245
Barytes	15,715
Bauxite	980
China clay	6,875
Chromite	9,820
Dolomite	20,625
Fire clay	39,285
Fluorite	490
Fuller's earth	13,750
Gypsum	414,465
Limestone	3,928,570
Magnesite	2,945
Marble	50,090
Rock phosphate	5,890
Rock salt	404,640
Silica sand	68,750
Soapstone	19,640
Sulphur	1,965

[a]Figures in Johnson (1979) are somewhat lower.

Source: GOP. 1978.

Less valuable minerals are prevalent and are currently being exploited. Fire clay and rock salt deposits exceed 100 million metric tons, and reserves of limestone and gypsum remain inestimably large. Most mineral deposits are concentrated in the mountainous northern and western sections of the country (Fig. 13).

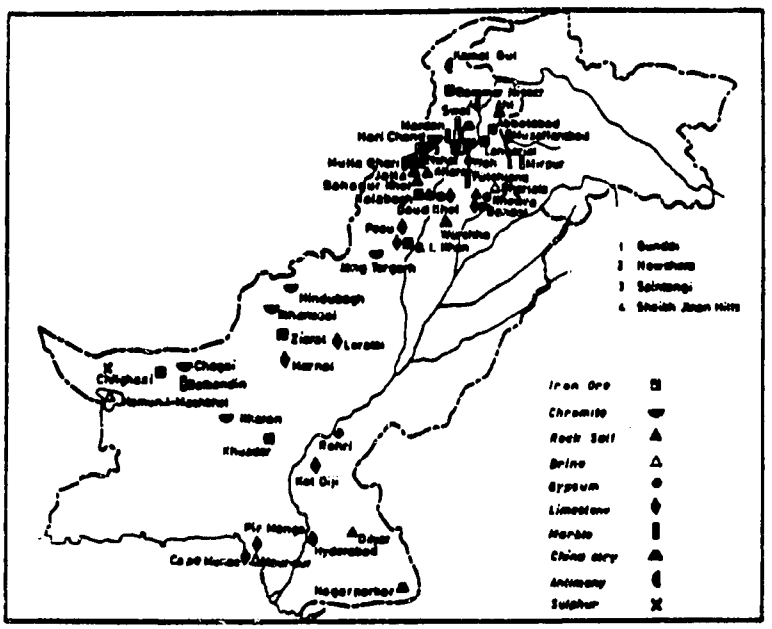


Figure 13. Distribution of Minerals

Source: Kureshy. 1977.

3.1.3 Energy Reserves

Oil. In 1976-77 Pakistan relied upon petroleum for 37 percent of its energy needs. That year 15 percent of the oil employed was imported. Recent discoveries in the Potwar plateau have generated some optimism that the nation can eventually become self-reliant in petroleum. Domestic production in 1976-77 totaled 13,000 barrels per day, a figure which was expected to climb to 80,000 by the current year. The nation's total crude oil reserves remain unestimated.

Gas. Natural gas, which twenty-five years ago supplied barely one percent of domestic energy, now accounts for 38 percent and production is slated to continue to increase. Gas was first discovered at Sui, at the

southern edge of the Sulaiman Range. Production from this field alone amounted to approximately 4.5 billion cubic meters in 1976-77. There are other natural gas production sites within the oil-yielding region of Potwar, near Karachi, and across the Indus from Sui (Fig. 14). Together these sources yield another 1.1 billion cubic meters of methane. Still other gas fields have been discovered but remain untapped. In all, the nation's known reserves are estimated to approach 17 trillion cubic meters (GOP 1978).

Coal. Coal supplies 5 percent of Pakistan's energy. A large portion of the amount consumed is obtained from domestic supplies. Only high quality coal employed in steel production needs to be imported. Most of the indigenous coal is of inferior quality and is thus employed by light industry for use in kilns and foundries. Mining operations are also small-scale and remain inefficient. In 1976-77 the nation's coal output was approximately 1.1 million metric tons (GOP 1978). There are modestly large deposits of lignitic to sub-bituminous coal, mostly in Baluchistan, Sind, and the Punjab (Fig. 14). The Geological Survey estimates the coal reserves at 460 million metric tons (GOP 1976). For the near future coal will continue to provide only marginal energy supply in spite of targeted increases in production.

Hydroelectricity. Water power is one of Pakistan's important energy sources. Since the 1950s, aided by sizeable foreign grants, the nation has set out to develop its abundant hydroelectric resources. In spite of its general aridity, Pakistan benefits from its geographical situation beneath the well-watered Himalayas. The steep gradient of the southern slopes affords enormous potential for hydroelectric power, estimated at 25-30,000 megawatts. By 1976-77, 18 percent of domestic energy use was supplied by the various dams on the Indus and its tributaries (Johnson 1979).

By 1978 about 1600 MW, or 15 percent of Pakistan's utilizable hydroelectric potential (estimated at 10,000 megawatts, or approximately a third of the total potential) was being tapped. This figure was expected to grow by 60 percent to about 2500 MW by 1980. With the full development of Pakistan's newest and largest dam, Tarbela, hydroelectric output is set to rise by another 42 percent by 1983. Since initial work on Tarbela in 1960 most of the funding has been supplied by the Indus-Tarbela

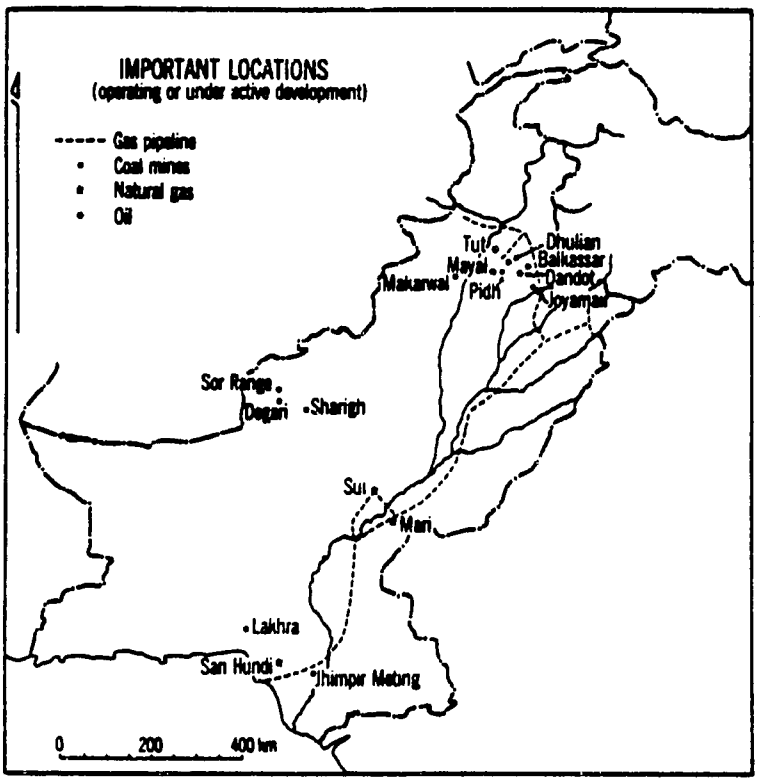


Figure 14. Distribution of Mineral Energy Sources

Source: Adapted from Johnson. 1979.

Development Fund (ITDF), a consortium consisting of Australia, Canada, Germany (BRD), India, New Zealand, the U.K., and the U.S.A. Up to 1976-77 the ITDF had contributed a total of $914.3 million (GOP 1977). The ultimate capacity of this project is expected to reach 2000 MW. Two other major hydroelectric dams are at Mangla on the Jhelum and Warsak on the Kabul River. These are expected to generate 800 MW and 240 MW, respectively. Smaller dams at Dargai (20MW), Malakand (19.6 MW), Nandipur (13.8 MW , Shadiwal (13.5 MW), Chichoki Mallian (13.2 MW), Rasul 12 MW), Kurram Garhi (4 MW), Renala (1.1 MW), and numerous installations of less than 1 MW capacity add to the country's hydroelectric power production (Fig. 15).

Nuclear Power. In 1976-77 nuclear power met 1.7 percent of Pakistan's energy requirements (Johnson 1979). Upon the opening of the first installation near Karachi in 1971, the nation's nuclear output was 125 MW.

A new facility at Chasma in western Punjab will generate an additional 600 MW (Fig. 15). Recent explorations have uncovered some sandstone uranium deposits in the foothills of the Sulaiman Range and there may be uranium and vanadium in the Himalayas (Basham 1977). As of 1975, however, no commercial deposits of uranium ore had been found in Pakistan (Z. Ahmad 1975). As a result, the nation must import all of its fissionable fuel. The instability of this supply places severe limitations upon the development of nuclear energy, and there appear to be no plans to construct atomic power plants in addition to those at Chasma.

Thermal Power. As early as 1959 Pakistan had begun to exploit its considerable resources in thermal energy. That year 193 MW were produced from thermal sources; by 1975-76 the capacity had grown to nearly 1500 MW, exceeding the sizeable hydroelectric output. Major stations are at: Faisalabad, Lahore, Multan, and Gudu in the Punjab; Hyderabad, Kotri, and Karachi in Sind; and Quetta in Baluchistan (Fig. 15). By 1983 thermal power is expected to approach 2000 MW.

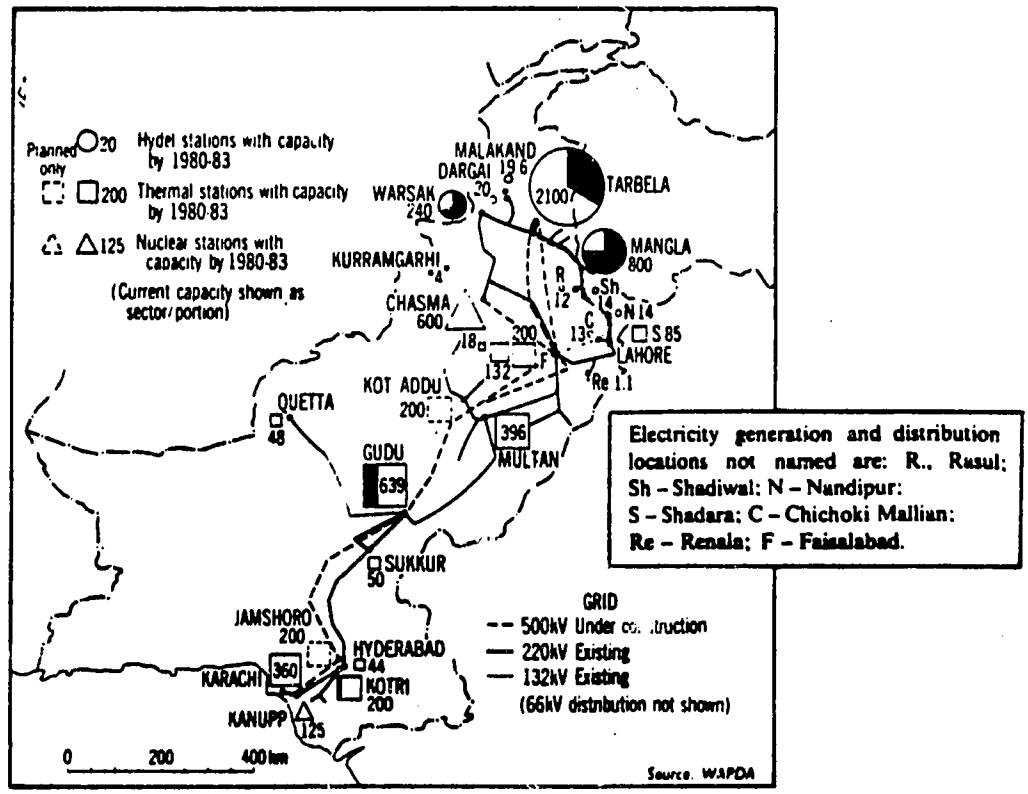


Figure 15. Distribution of Electric Power Sources.

Source: Johnson. 1979.

3.1.4. Soils

All of Pakistan's soils are pedocals, soils exhibiting calcium carbonate horizons. In terms of soil order, these soils are either entisols or aridisols, the dominant orders in Asia's arid regions (Dregne 1976). The entisols cover the entire Indus plain, whereas the aridisols are found only within the deltaic region along the coastline. In broader geographic terms, the country's soils can be divided into three major groupings: mountain soils, Indus plain soils, and desert soils (Fig. 16).

Mountain Soils. Found along the slopes of the northern and western ranges, these soils are either residual, alluvial, or eolian. Most of them are low in organic content, though soils are somewhat richer in the sub-humid north. Within the valleys, the soils are predominantly alluvial and are comprised of calcareous silt loam and sandy loam, both of low organic content. South of the Himalayas, in the Potwar plateau, there are residual soils and silty loess, also of low organic content. Unlike the other mountainous soils, these can be made productive through sufficient irrigation. Further south and west, at the edge of the arid and

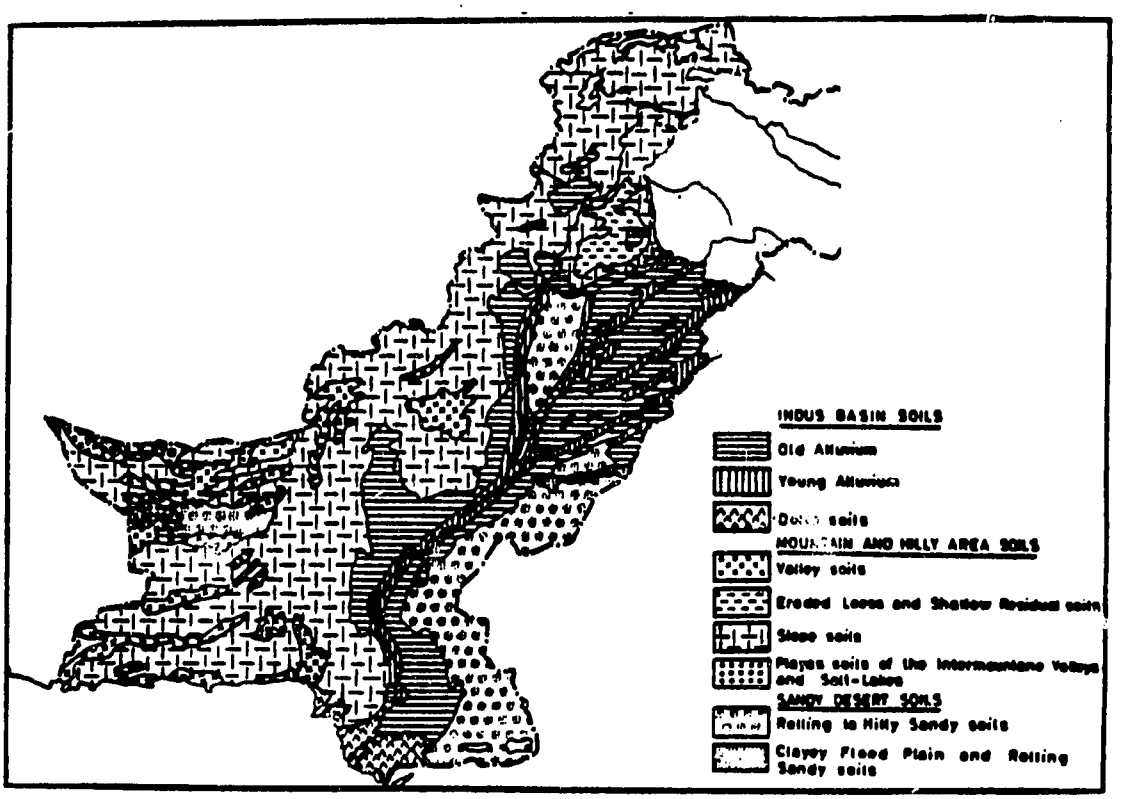


Figure 16. Soils

Source: Kureshy. 1977.

semi-arid flat lands, the soil is saline and unproductive.

Indus Basin Soils. This region is an expansive alluvial basin whose soils are deposited by the Indus river system. The soils covering most of the basin are old alluvium *(bhangar)*. Chalky, medium to fine, and of low organic content, these soils extend across most of the Punjab and most ofthe Indus flood plain in Sind. Irrigation and fertilization render these soils very productive.

Within the immediate flood plains of the principal rivers, newer alluvium *(khadar)* predominates. These soils are sandy and silty, but unlike much of the bhangar, they tend to be salt-free.

The soils within the deltaic region are composed of sub-recent alluvium and estuarine deposits. Most of these soils are loamy and saline, but about a third are clayey. The deltaic soils support irrigated rice cultivation, though the coastal areas are marshy and non-productive.

Desert Soils. The non-mountainous portion of the southwest consists predominantly of arid sandy tracts. Western Baluchistan and eastern Sind are the nation's driest regions. In the former, the soils are principally eolian and calcareous. The eastern deserts are covered mostly with hilly sandy soils, occasionally interrupted by clayey soils. The desert soils have been unable to support cultivation of any sort. Only marginal grazing facilities exist (Fig. 10).

3.1.5 Administration, Policy, and Planning

Responsibility for planning and implementing the development of Pakistan's mineral and energy resources is apportioned among three central ministries: Petroleum and Natural Resources, Atomic Energy, and Water and Power. Assignment of sectoral priorities and allocations of funding are the responsibility of the Planning Commission, the branch of the Ministry of Finance, Planning, and Coordination which authors the nation's five-year plans. Specific aspects of governmental implementation are assigned to various agencies and public corporations. Pertinent legislation appears in Appendix IV.

Minerals. The Geological Survey of Pakistan, an outgrowth of the pre-partition Geological Survey of India, is charged with surveying, mapping, prospecting, and evaluating the nation's mineral resources. Exploration and exploitation of established mineral wealth has been assigned to the Pakistan Mineral Development Corporation and the Resource Development Corporation, both set up in 1974. In addition, each province except Sind has established a regional agency to oversee mineral development.

Throughout Pakistan's existence the mineral sector has been a low priority element of the nation's economy. The current Fifth Five-Year Plan is attempting to reverse this trend by encouraging mining operations. Public investment in this sector has been increased to approximately $200 million for the 1978-83 period. The present Plan assigns to it 1.3 percent of total allocations, nearly a three-fold increase over the 0.5 percent figure in 1976-77. Chief priority is given to the development and exploitation of alluminous clays, bauxite, coal, copper, gemstone, gypsum, iron ore, rock phosphate, and salt (GOP 1978).

Energy. Fossil fuel development is divided among the agencies which deal with minerals and those concerned exclusively with oil and natural gas. Coal exploration and mining are thus included within the mineral sector. The federal Oil and Gas Development Corporation (OGDC), established in 1961, is charged with identifying new sources and developing them. Transmission of natural gas is handled primarily by the Sui Gas Transmission Company. Refining of crude petroleum is presently carried out by a consortium, the Pak-Arab Refinery Company (PARCO). Pakistan's hydroelectric resources are managed by the Water and Power Development Authority (WAPDA), a semiautonomous body established in 1958. WAPDA has managed the construction and operation of Pakistan's ambitious hydroelectric power plants. Additionally, a number of licensed private corporations supply electric power to major urban areas. The Karachi Electric Supply Corporation (KESC) is the largest of these. The nation's small, but growing nuclear energy resources are controlled and administered by the Pakistan Atomic Energy Commission (PAEC). Atomic energy is supplied to Karachi by the Karachi Nuclear Power Project (KANUPP).

Priorities. The Fifth Five Year Plan proposes to intensify exploration for indigenous fossil fuels and to hasten the development of these resources. Indeed, the gross allocation for the fuel sector shows a sizeable growth of approximately $45 million per year over the amount for 1976-77. But as a percentage of total allocation, this sector currently receives a lower proportion than it did under the previous plan (3.8 percent vs. 4.2 percent).

Electric and nuclear power, by contrast, have benefited from a clear boost in priority. Total outlay is slated to be nearly $2.8 billion for 1978-83, an average annual increase of $330 million over the 1976-77 allocation. This represents a 138 percent increase in gross expenditure. It is matched by a rise to an unprecedented 18.8 percent of total allocation, making this sector the largest in the economy. It reflects the intentions of Pakistan's planners to assign maximum priority to hydroelectric generation (GOP 1978).

3.2 Water Resources

3.2.1 Surface Water [8/]

Pakistan is among the world's largest predominantly arid nations (Eckholm & Brown 1977). As in all such countries, rainfall is insufficient for cultivation. But unlike most other arid lands, much of Pakistan lies within the drainage basin of a major system of rivers (Section 2.1.2). The Indus and its four chief tributaries discharge more than 200 billion meters of water annually (Table 9).

Because rainfall is heavily concentrated during the monsoon months, there is notable fluctuation between maximum and minimum discharge rates for each river. The Indus, which is primarily supplied by glaciers, is subject to the least seasonal variation, though its maximum flow is more than fifty times its minimum.

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[8] Sources: Johnson. 1979.
Kureshy. 1977.
U.N. ECAFE. 1966.
U.N. ECAFE. 1968.

Table 9. Discharge and Characteristics of Indus System

River	Total Drainage Area[a] (sq km)	Length[a] (km)	Location[b]	Discharge Rate (1000 m^3 per second) Maximum	Minimum	Total (billion m^3)
Indus[c]	1,047,850	3,380	Attock	26	0.48	115
Chenab	61,000	1,200	Marala	20	0.11	32
Jhelum	63,500	725	Mangla	22	0.11	28
Sutlej	86,000	1,450	Near Suleimanke	14	0.08	17
Beas	25,900	470	?	10	0.06	16
Ravi	11,600	725	Near Baloki	7	0.03	9

[a] The Indus, Chenab, Ravi, and Sutlej are partly in India; the Jhelum originates in disputed territory.
[b] Within Pakistan except for Beas.
[c] Includes the Kabul River.

Sources: Johnson. 1979; Kureshy. 1977; U.N. ECAFE. 1966.

Volume increases markedly by April in the Indus, Chenab, and Jhelum, but only by June for the remaining rivers. Maximum flow is achieved during the June to September period, during which more than two-thirds of the annual discharge is carried (Fig. 17). Throughout the year the evaporation accounts for significant water losses, particularly in the plains (Fig. 6).

The Indus basin covers about two-thirds of Pakistan's area. A second, much smaller, river basin comprises the slopes and plateau west of the central ranges. This basin in Baluchistan drains the coastal rivers and desert streams. Of these, only the Zhob and five other minor rivers are perennial, and only at their lower ends. The remaining streams flow exclusively during the rainy season. In general, the western drainage basin is too small and irregular to sustain cultivation.

Within the Indus basin, flooding is virtually an annual occurrence. In all, nearly 15 million hectares of terrain are subjected to inundation.

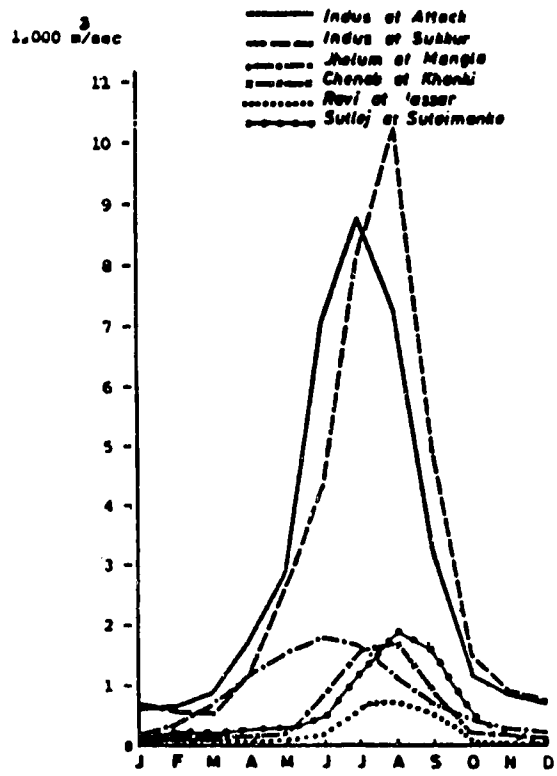

Figure 17. Mean Monthly Discharge of the Indus System

Source: Dureshy. 1977.

When rainfall is exceptionally heavy the rivers overflow their banks and cover the adjacent flood plain. In spite of modern control measures, severe floods such as those of 1955, 1973, 1977, and 1978 have caused immeasurable loss to crops, property, and human and animal life. The plains of Punjab and Sind are particularly susceptible to such disasters. Poor drainage in the lower Indus basin prolongs flood conditions and increases damage.

At the other extreme, Pakistan lies in a geographical area which has been historically subjected to repeated droughts. Low annual rainfall, resulting low riverine discharge, and high levels of evaporation have made most of Pakistan water deficient. Without irrigation, agriculture in most of the Indus basin would be impossible.

3.2.3 Groundwater[9]

The Indus basin and western Pakistan are situated above extensive channels of groundwater. Baluchistan, in fact, was one of the first regions in the world to tap subsurface aquifers. For millenia, farmers have dug underground canals known as karez. Emanating from sources near mountain foothills, the waters are directed toward the plains where they are used to irrigate gardens and fields.

Recognizing these early developments, British administrators considered tapping groundwater in the Indus basin, an area whose water table was accessible. By the 1920s both artesian wells and tubewells had been introduced throughout the Punjab and Sind, while the use of karez continued in Baluchistan. The proliferation of unlined canal irrigation in the Punjab, however, led to dramatic rises in the level of the water table. Water logging and salinity due to seepage began threatening agricultural land. By the 1950s increasing attention was drawn to these problems and to potential remedies. During the same period advances in exploration technology permitted geologists to improve techniques for determining the location, depth, and quality of groundwater supplies. In 1970 Pakistan's usable groundwater supply was estimated at 55.5 billion cubic meters, approximately a third as much as the volume of surface water available from the Indus system (NESA 1970). The depth of the water table varies enormously, from just beneath the surface in parts of Punjab to hundreds of feet below the surface in the deserts of eastern Sind.

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[9] Sources: Johnson. 1979.
Kureshy. 1977.
Tamburi. 1973.

3.2.3 Irrigation[10/]

The irrigation system presently employed in Pakistan is one of the most diverse in the world. It includes not only three types of canals (inundation, perennial, and karez), but dams, barrages, tubewells, artesian wells, tanks, ponds, and natural floodwaters (Fig. 18a). Together these techniques irrigate 14 million hectares, or approximately 72 percent of the country's cultivated land (Johnson 1979; Fig. 18b).

Aside from the previously discussed technique of karez irrigation, the oldest method employed in the area appears to have been the use of natural floodwater. There is evidence that as early as the third century B.C., floodwaters were diverted by means of man-made channels. Throughout the medieval period Islamic administrations pursued a public works policy which included canal construction. Inundation canals, intended for seasonal use during the monsoon, were dug along the active and meander flood plains of the Indus basin.

British engineers continued this mode of irrigation during the nineteenth century. By 1861 the government felt the need to extend the limits of irrigation beyond the brief flood season. Through the construction of barrages, canals were made to flow year-round. The Upper Bari Doan Canal, the region's first perennial network, was followed by other canals, all in the Punjab (Fig. 19a). At present the entire Indus basin is covered by a web of canals which bring river water to interfluvial areas and link the rivers themselves (Fig. 19b). By 1978 the network included ten interriver link canals, about twenty barrages and dams, and more than 16,000 km of canals.

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[10] Sources: Johnson. 1979.
Kureshy. 1977.
Lowdermilk et al. 1978.
NESA. 1970.
Nyrop et al. 1975.
Trout et al. 1979.
U.S. AID. 1976.
U. N. ECAFE. 1966.
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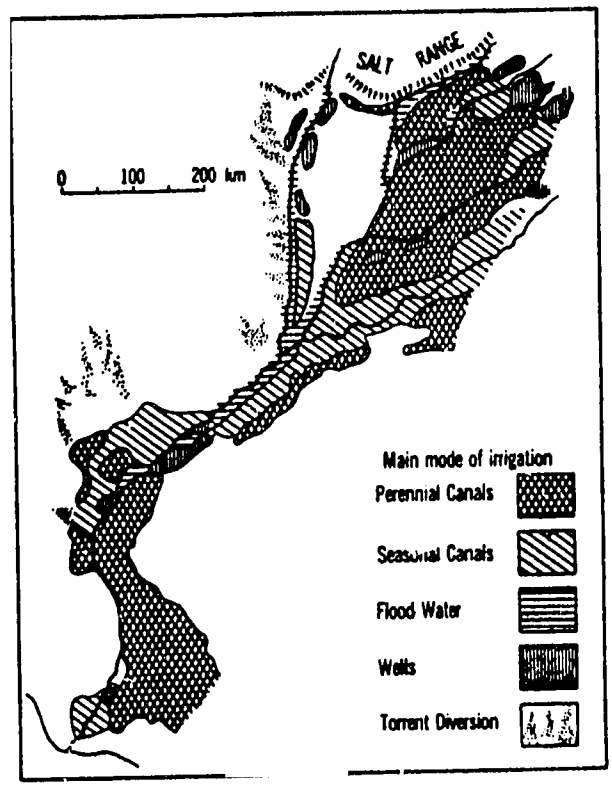
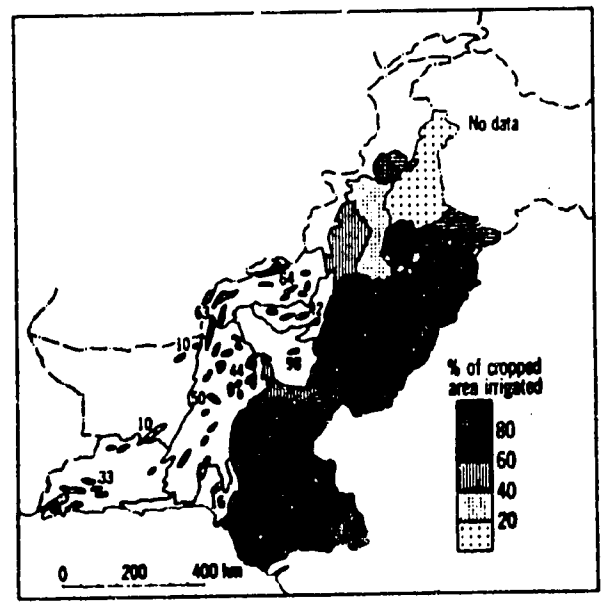


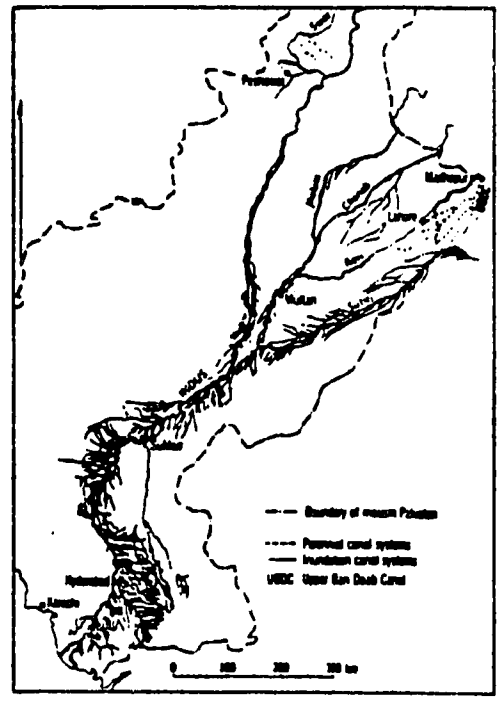
18a. Modes of Irrigation



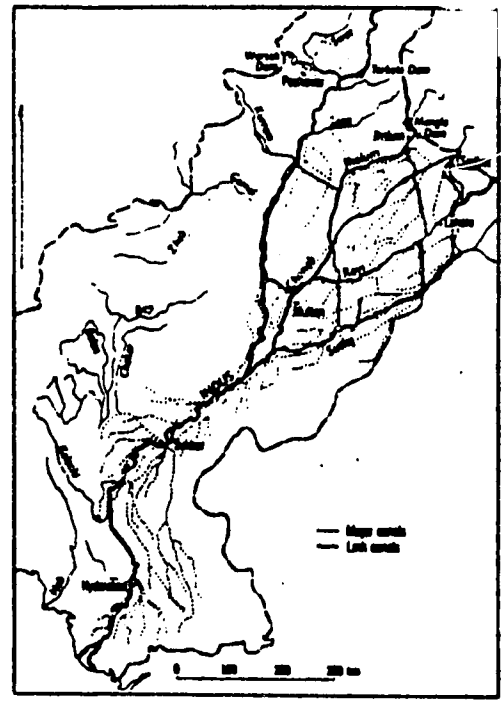
18b. Areas Served

Figure 18. Irrigation: Prevalent Modes and Areas Served

Source: Johnson. 1979.



19a. Late Nineteenth Century



19b. Present

Figure 19. Extent of Canal System

Source: Adapted from Johnson. 1979.

This system is comprised of three components: the region watered by the Indus tributaries, the Indus basin south of its confluence with its tributaries, and the areas west of the Indus. The first subsystem, which serves the tributaries in the Punjab, includes the Upper and Lower Jhelum, Upper and Lower Chenab, Haveli, Upper Bari Doab, Lower Bari Doab, and Sidhanai Canals, and the Sutley Valley Project. On the Indus itself, the Tarbela Dam, Jinnah, Taunsa, Gudu, Sukkur, and Ghulam Mohammed Barrages make up another subsystem. Finally, to the west, the region is served principally by the Swat Canals, the Warsak Multi-Purpose Project, and the Kurran Garhi Project.

In each case, canal water is delivered to the fields by an intricate network of local channels. The Indus basin contains approximately 78,000 such watercourse systems. Each is made up of two components: a government controlled outlet tapping water from an irrigation canal *(mogha)*, and a farmer-controlled inlet passing water from the mogha to the field *(nakka)*. The amount of water supplied by each mogha is determined by the government strictly on the basis of plot size. This rate is currently fixed at 1 liter per second per 5 ha. The land served by these watercourses is usually divided into small level diked basins which distribute the water evenly over the plot (Lowdermilk et al 1978; Trout et al 1979).

In addition to canal irrigation, Pakistan employs well irrigation extensively. Conventional animal-powered wells and motor-operated tubewells serve the entire Indus basin (Figures 20a and 20b). The latter, which serve the dual purposes of reclaiming waterlogged soil as well as distributing groundwater, have been installed at a rapid pace since the early 1960s. By 1973 there were more than 100,000 such wells pumping approximately 10 billion cubic meters annually (Johnson 1979; Nyrop et al 1975). The number is scheduled to grow by about 1000 wells per year (GOP 1978).

3.2.4 Water Quality[11/]

The proliferation of unlined canals and the construction of massive dams have combined to deteriorate the chemical quality of much of Pakistan's water. Seepage, sometimes

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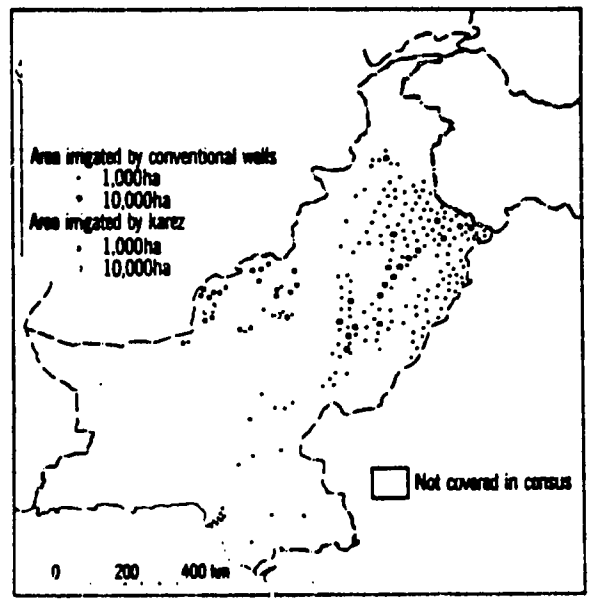
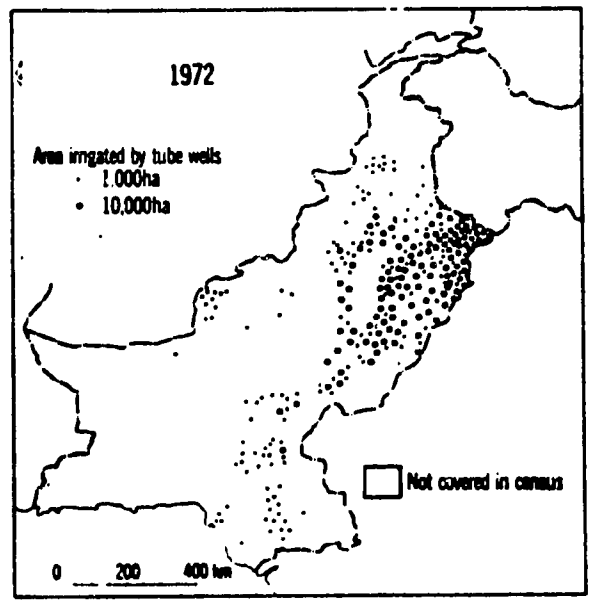
[11] Sources: Johnson. 1979.
Nyrop et al. 1975.
U.S. AID. 1980.



20a. Wells and Karez



20b. Tubewells

Figure 20. Distribution of Wells, 1972

Source: Johnson. 1979.

as high as 50 percent, has induced steady rises in the water table of the Indus basin. The river water which saturates the soil is high in mineral content. As a result, the growing reservoir of groundwater is becoming increasingly saline and therefore unusable (Fig. 21).

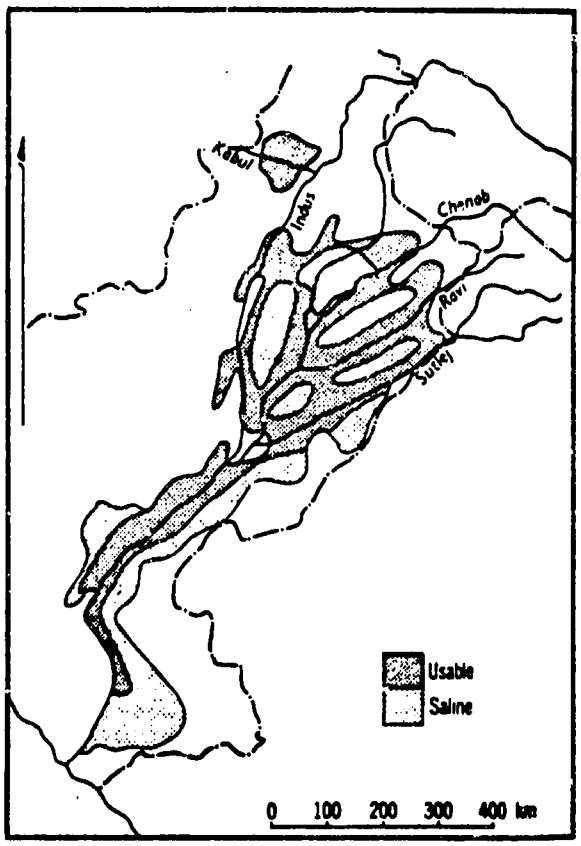


Figure 21. Quality of Groundwater

Source: Johnson. 1979.

Such alkaline water threatens underground roots and thus prevents the extension of agriculture. In addition, saline groundwater cannot be pumped and utilized for irrigation. The government is therefore undertaking drastic measures to remove damaging salts from groundwater supplies (Section 3.2.5).

Much of the nation's drinking water is drawn from subsurface sources such as boreholes, wells, and springs. In the densely populated Indus basin, the water is becoming impotable due to excessive salinity.

This chemical imbalance aggravates an already chronic problem with the nation's drinking water supply. In rural areas, only a fraction of the population has access to safe water. U.S. AID has estimated this figure at 5 percent; the Pakistan government has estimated a considerably higher proportion, 14 percent (U.S. AID 1980a; GOP 1978). Wells are frequently left uncovered, exposing the water to contamination. Drinking water is also obtained from stagnant ponds and irrigation ditches. The nearly universal lack of rural waste disposal facilities (less than 1 percent of villagers have access to proper sewage treatment; U.S. AID 1980a) permits the reintroduction of pollutants, parasites, and microbes into the groundwater. Urban areas have been introducing water treatment systems, but problems remain. Because of low pressure which permits seepage and improper piping, pollutants enter the system after processing. Sewage is improperly disposed of in the cities; there too, only one in five inhabitants has access to adequate facilities (one in three according to the government; GOP 1978; U.S. AID 1980a).

3.2.5 Legislation, Policy, and Planning[12/]

Administration. Pakistan's Water and Power Development Authority (WAPDA), created by the West Pakistan Act of 1958, has been charged not only with the management of the nation's hydroelectric resources, but with the overall operation of irrigation schemes. Although WAPDA receives two-thirds of the total allocations for water development, there are other agencies and organizations sharing in the implementation of this sector's plans. The provincial Irrigation Departments of the Punjab, Sind, NWFP, and Baluchistan,

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[12] Sources: S. M. Akhtar. 1978.
GOP. 1978.
Johnson. 1979.
Johnson and Johnson. 1977.
Lowdermilk et al. 1978.
Mirza and Merrey. 1979.
U.N. ECAFE. 1966.
U.S. AID. 1979b.
U.S. AID. 1979c.

and the administrations of Azad Kashmir, the Centrally Administered Tribal Areas, and the Northern Areas each contribute manpower, resources, and funding to their region's water management schemes. Additional assistance is provided by the central Ministry of Food and Agriculture, the Meteorological Department, the Geological Survey of Pakistan, the Federal Flood Commission, and the Irrigation, Drainage and Flood Control Research Council (IDFCRC, part of the Ministry of Science and Technology).

Legislation and Policy. Legislation affecting water use closely followed the construction of canals during the 1860s. The Canal and Drainage Act of 1873, and the Punjab Minor Canals Act of 1905 are the earliest statutes governing the implementation of irrigation in the Indus basin (Appendix IV lists other pertinent legislation). These acts governed canal use throughout the remainder of the British period, and with amendments have continued in force since independence. With partition, however, allocation of canal water became the subject of intense controversy. Not until the Indus Waters Treaty of 1960 was the issue successfully resolved.

Even before this treaty had been concluded, Pakistan had embarked upon two major development schemes: the Warsak project, begun in 1949 and completed in 1961; and the Kurram Garhi project (1950-58). Other irrigation schemes followed and development intensified after the adoption of the Indus Waters Treaty. During the 1960 to 1970 decade there was a dramatic seven-fold rise in the amount of new or improved irrigated area. With the completion of the giant Tarbela project on the Indus River, Pakistan has met most of its goals for increasing irrigation capacity.

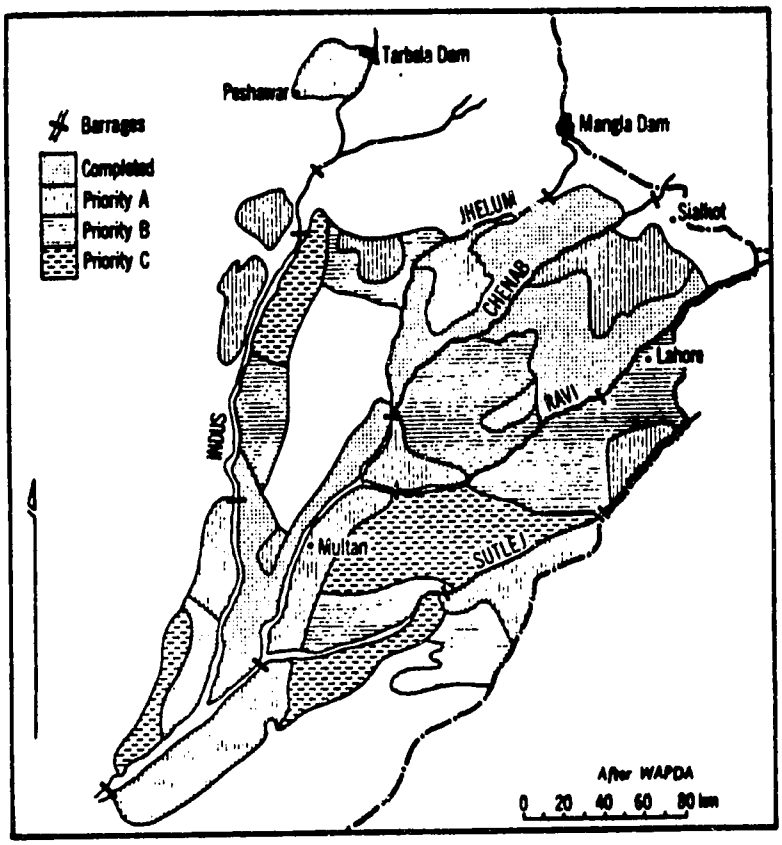
But as more and more land came under irrigation, waterlogging and salinity drew increasing attention from observers, engineers, and planners. By the late 1960s, 40,000 ha were being lost annually on account of these twin problems (U.N. ECAFE 1966). After undertaking extensive groundwater and salinity investigations, the government embarked upon a series of reclamation projects. The first of these, in the Central Rechna Doab between the Ravi and the Chenab, was launched by the newly-established WAPDA in 1959. These Salinity Control and Reclamation Projects (SCARPs) pursued a strategy of installing an intensive set of tubewells to pump excess water from the soil. Other SCARPs were implemented in 1962, 1965, and 1974 in the Chaj (Chenab and Jhelum), lower Thal (Indus and Jhelum-Chenab), and Upper Rechna Doab

regions (Fig. 22). With these four completed projects, a total of 7728 fresh and saline groundwater tubewells have been installed and 2.25 million ha have been reclaimed (Johnson 1979). Under the Master Plan currently in operation, five other SCARPs have been planned. Administration of the SCARPs is handled by the Board for Waterlogging and Salinity Control.

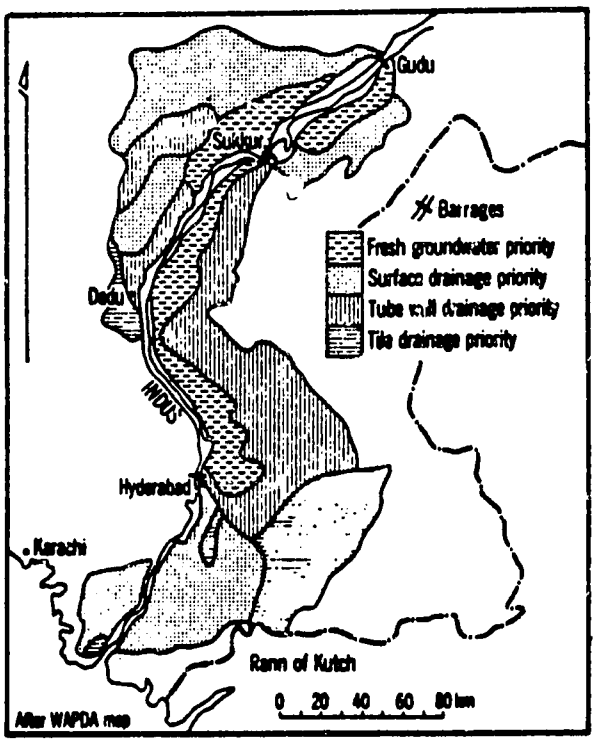
In addition to the above problems of waterlogging and salinity, recent observers have noted that the nation's irrigation system operates at a relatively low level of efficiency (Merrey 1979; Lowdermilk et al 1978). Both by comparison to irrigation practices elsewhere and in terms of potential productivity, the system functions well below capacity. Improper training of management personnel, inadequate enforcement of existing regulatory measures, incomplete dissemination of information, insufficient knowledge of technology by farmers, and substandard maintenance of existing facilities have been identified as the most prominent reasons for the inefficiency of the nation's irrigation system (Lowdermilk et al 1978). The recently implemented Mangla Watershed Project and Mona Reclamation Experimental Project have attempted to develop better techniques of watershed and watercourse management (Mirza and Merrey 1979; U.S. AID 1979b).

Planning. The Fifth Five Year Plan has raised the priority of the nation's water development programs. This sector of the economy is scheduled to receive 11.6 percent of allocations in comparison to its previous average share of 9.0 percent. It is worthy of note, however, that prior to its completion, the Tarbela project alone commanded an additional allocation once (in 1971-72) comprising a staggering 34.1 percent of total sectoral outlays. As an entity, Pakistan's water resources development sector has remained the fourth largest recipient of central expenditures (Johnson 1979; Appendix II).

In particular, the Plan has identified drainage and reclamation, canal remodelling, canal construction for additional distribution of Tarbela water, development of groundwater resources, and better on-farm water management as targets for emphasis in the current Plan. In this way, the government expects to raise the amount of irrigated cropped acreage by 2.5 percent annually while simultaneously increasing yields and improving water quality. Within this sector, drainage and reclamation projects (SCARPs) and the Accelerated Waterlogging and Salinity Programme (AWSP) clearly receive



22a. Northern Zone



22b. Southern Zone

Figure 22. Salinity Control and Reclamation Projects

Source: Johnson. 1979.

maximum attention (39 percent of allocations). Irrigation (26 percent), the remaining implementation of Tarbela and the complimentary Indus Basin Project (13 percent), and flood control (11 percent) command the next highest priorities. Research, water management, survey, investigation, and miscellaneous activities round out the budget for water development (Table 10).

Table 10. Allocation to Water Development under the Fifth Five Year Plan

Activity	Amount (million Rs.)	Percentage of Allocations
Drainage and Reclamation	6,702	39.1
Irrigation	4,376	25.5
Tarbela and Indus Basin Project (IBP)	2,289	13.4
Flood Control	1,795	10.5
Research and Water Management	1,066	6.2
Survey and Investigation	561	3.3
Miscellaneous	331	1.9
Total	17,120	100.0

Source: GOP. 1978.

In keeping with the stated emphasis of improving water quality, the Fifth Five Year Plan has targeted sanitation and water supply as areas needing substantial improvement. The government hopes to provide sanitation to 17.5 percent of its residents and safe water to 49.3 percent of the population by 1983, respectively doubling the former and increasing the latter by 70 percent (GOP 1978).

In interviews with U.S. AID personnel (U.S. AID 1979c), Pakistani officials indicated that the government was planning to establish an agency whose functions will include regulation of pollution. The legislation intended to create this agency is expected to set standards for quality and to arm the

agency with powers of monitoring and enforcement. Further plans envision the installation of laboratories staffed with trained personnel who will test water affected by industrial pollution. Whether any of these measures will be implemented is unknown.

3.3 Vegetation

3.3.1 Natural Forests[13/]

According to available figures, forests cover approximately 5.2 percent of Pakistan's reported land and 3.5 percent of the nation's total area (Table 4). Table 11 shows the areas of major forest types and Figure 23 illustrates their geographical distribution. Appendix V provides a listing of major floral species found in each of the principal environments. The following discussion of vegetative regions and types is based principally upon the description by Zehngraff (1967).

The mountainous extreme northern part of the country and several pockets of elevated lands in the west are characterized by Himalayan dry and moist temperate forests (Fig. 23). These areas support coniferous forests. Estimates of the total acreage covered by coniferous forests vary considerably from 891,200 ha (Zehngraff 1967) to 1,382,800 ha (Aleem 1979); Table 11 shows 923,000 ha, an amount based upon Champion et al (1968?) and Zehngraff (1967).

In the Himalayas and Hindu Kush mountains, these forests are of two types--first at the upper temperate zone elevations (2300-3400m) where rainfall is higher, and pine at the lower temperate zone elevations (1200-2300m) whether wet or dry (Fig. 23). Within the fir forests, two species predominate--fir

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[13] Sources: CENTO. 1971.
Champion et al. 1968?
GOP. 1974.
Kureshy. 1977.
Pakistan Forest Institute. 1974.
Sheikh and Aleem. 1975.
Zehngraff. 1967.

Table 11. Forest Land Types

Forest Type	Area (1000 ha)	Percent of total
Coniferous	922.8	32.3
Scrub	1088.4	38.2
Hill scrub	834.1[a]	29.2[a]
Inland scrub	230.0[a]	8.1[a]
Mazri	23.3[a]	0.9[a]
Riverain	277.4	9.7
Plantations	222.3	7.7
Irrigated	155.5[a]	5.4[a]
Linear	66.8[a]	2.3[a]
Mangroves	345.4	12.1
Total	2856.3	100.0
Total		100.0

[a]Figures not included in total.

Source: Champion et al: 1968? Originally from *Forest Statistics of West Pakistan*, 1968; Zehngraff, 1967.

(Abies webbiana) and spruce *(Picca smithiana)*. These trees grow to the tree line (3400 m), thriving on the relatively high rainfall of up to 2000 m per annum (Fig. 4). Beyond the tree line, the mountains are covered by alpine meadows which support stunted shrubs *(Salix* spp.) and grasslands used for grazing. The fir forests tend to be well stocked, but they are populated by mature and overmature trees subject to high mortality.

At their lower reaches (c. 2300 m), the moist temperate forests merge with pines, deodars *(Cedrus deodara)*, and occasional hardwoods. The dominant trees of this lower subtropical moist forest (Fig. 23) are chir pine *(Pinus roxburghii)* and blue pine *(P. wallpiciana)*. Himalayan pine forests tend to include broad-leaved trees such as oak *(Quercus semecarpitalia)*, maple *(Acer caesium)*, horse chestnut *(Aesculus indica)*, and walnut *(Juglans regia)*. The deodars and blue pines are of

especially high value as timber and pulp, but their exploitation has been limited by their remoteness.

The coniferous forests of the high (1800-3000 m) dry temperate regions of western Baluchistan and southern NWFP (Fig. 23) consist primarily of juniper *(Juniperus macropoda)*. The western mountains receive scant and concentrated rainfall (300 mm), and the junipers and other trees of this area are short and limby. Perhaps more than other Pakistani mountain forests, these lands are being deforested by overgrazing. The lower elevations of juniper forests produce a valuable medicinal plant, ephedra *(Ephedra gerardiana)*, employed in the manufacture of ephedrine.

Scrub forests cover nearly two-fifths of Pakistan's forest lands. (Table 11 and Fig. 23). These are of two types -- 80 percent of them are subtropical hill scrub forests, located at elevations of 300 to 1200 m; the remaining scrublands are in the tropical lowlands. The southwestern corner of the country not shown in Figure 23 consists entirely of both types of scrub forest.

The subtropical hill scrub forests predominate in the northern and western foothills. Most of the land there is covered with brush and low-grade hardwoods. Of these, the most important species are acacia *(Acacia modesta* and *A. senegal)* and olive *(Olea cuspicata)*. At their upper limits these species coexist with pines.

As the hills slope toward the southern Indus plains, tropical inland scrub forests begin to dominate (Fig. 23). Comprising 230,000 ha of mostly unmanaged lands, this terrain is covered principally by salvadora *(Salvadora oleoides)*, tamarix *(Tamarix articulata* and *T. gallica)*, and mesquite *(Prosopis spicigera)*. Much of Pakistan's inland scrub forest is situated on heavily saline and waterlogged land. Another type of tropical scrub forest known as *mazri* covers some 24,000 ha in the NWFP. These are mostly barren lands occasionally containing a short-stemmed palm *(Nannorrhops ritchiana)* whose fibers are used for making baskets and twine.

The remaining quarter of Pakistan's natural forest land consists of riverain forest (not shown on Fig. 23) and tidal mangrove forest (Fig. 23). Riverain forests are scattered along the major flood plains, while the tidal forests are found in two

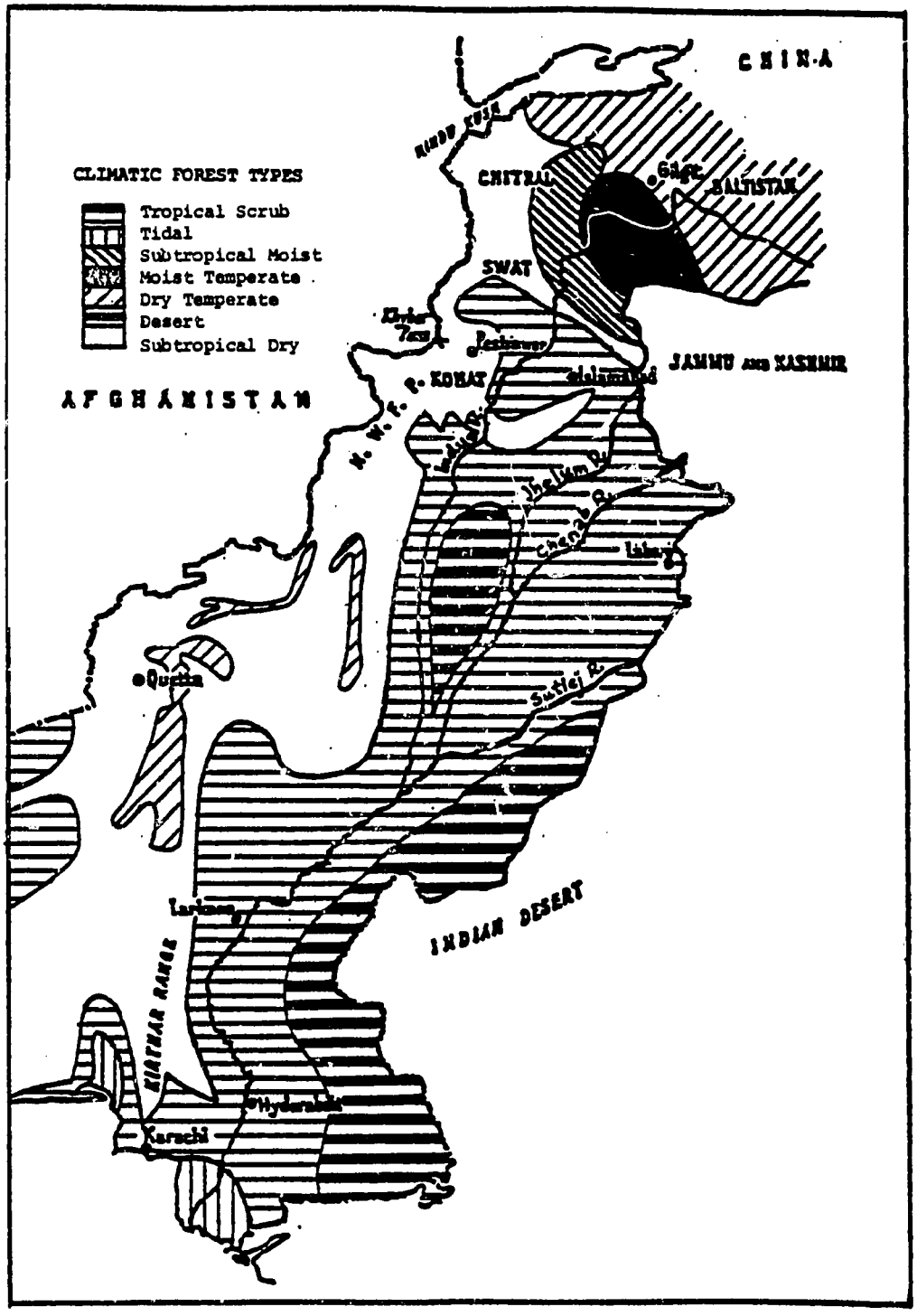

Figure 23. Climatic Forest Types

Source: Adapted from Mountfort (1969) and Champion et al (196[illegible]).

regions along the coast. Riverain forests, in their natural state, include poplars *(Populus euphratica)*, acacia *(A. arabica)*, and mesquite. Tamarix and cane *(Saccharum* spp.) are also found. The acacia trees which thrive in this region produce tannin, a raw material employed in tanning leather.

Mangrove forests, consisting primarily of avicennia *(Avicennia officinalis)* and ceriops *(Ceriops candolleana)* are situated in the southern deltaic and coastal regions. They are poorly stocked and of generally low quality. Previously overgrazed, these lands are now used to produce cattle fodder.

3.3.2 Plantations [14/]

Plantations, or artificial forests, account for 8 percent of Pakistan's forested area (Table 11). They are of three types: irrigated plantations which produce commercially valuable products, canalside plantations (c.15,000 km), and roadside plantations (c. 18,000 km; GOP 1975). The latter two types have traditionally served to landscape and provide shade to the roadways and watercourses. The trees break the winds, prevent erosion, and reduce evaporation. They also furnish timber and repair materials for local works.

In the plains, irrigated plantations were originally established to supply fuel for steam-driven locomotives. Eventually, with the spread of the canal system, trees were planted to supplement the region's insufficient timber supply. The most common species are shisham *(Salbergia sissoo)* and mulberry *(Morus alba)*. Shisham, a hardwood, is used extensively in furniture manufacturing. At higher elevations, up to 2700 m, fruit trees are commonly grown. They cover extensive portions of the northern valleys of Gupis, Hunza, Punyal, and Yasin. The main trees are apricot and peach *(Prunus armianica* and *P. persica)*, almond *(P. amygdalis)*, mulberry *(Morus* spp.),and pomegranate *(Punica granatum)*.Grape vines *(Vitis vinifera)* are also commonly grown. In addition, pine trees grown in these regions yield a variety of useful substances such as turpentine, resins, camphor, scents, and medicines (Nazir 1974).

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[14] Source: Zehngraff. 1967.

3.3.3 Rangelands[15]

Nearly three-quarters of Pakistan is considered rangeland (see Section 2.3.2). An ecological system of rangeland classification developed by C.M.A. Khan (1974) distinguishes Himalayan, trans-Himalayan, tropical submontane, tropical plains, mediterranean, and tropical maritime regions (Fig. 24). Much of the material below relies upon Khan's work. Figure 24 shows Pakistan's range ecological regions. Appendix V lists some of the important species of rangeland flora.

The tropical maritime zone of the coastal flatlands receives the most rainfall (200-380 mm) and has a climax vegetation of steppe-savannah with localized woodlands (mangroves). Further north, in the non-sandy tropical plains of the Punjab and Sind, most of the land is under cultivation. The natural vegetation includes *Dicanthium annulatum, Dismostachya bipinnata, Cenchrus ciliaris, C. setig, Elyonurus histurus, Cymbopogon jwarancusa, Panicum turgidum, Eleucine flagellifera, Dactyloctenium scindicum,* and most of the trees found in inland scrub forests (Section 3.3.2). A large portion of the land is under cultivation and much of its original vegetation has been eliminated. In the most arid areas of the non-sandy tropical plains, the climax vegetation is desert forest. Little grows here and the land offers only limited grazing potential.

The sandy tropical plains of Sind and western Punjab (Fig. 24) are less irrigated than the non-sandy plains and thus far less cropped. Characteristic species are: *Calligonum polygonoides, Haloxylon salicornicum, Aerua tomentosa, Pennisetum dichotomum, Elyonurus hirsutus, Panicum turgidum, and Aristida depressa*. There are extensive rangelands on deserts, semi-arid deserts, and steppes. Vegetation here has generally deteriorated due to overgrazing and extended periods of dryness.

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[15] Sources: Pakistan Forest Institute. 1974.
Sheikh and Aleem. 1975.
Snead and Tasnif. 1966.
Zehngraff. 1967.

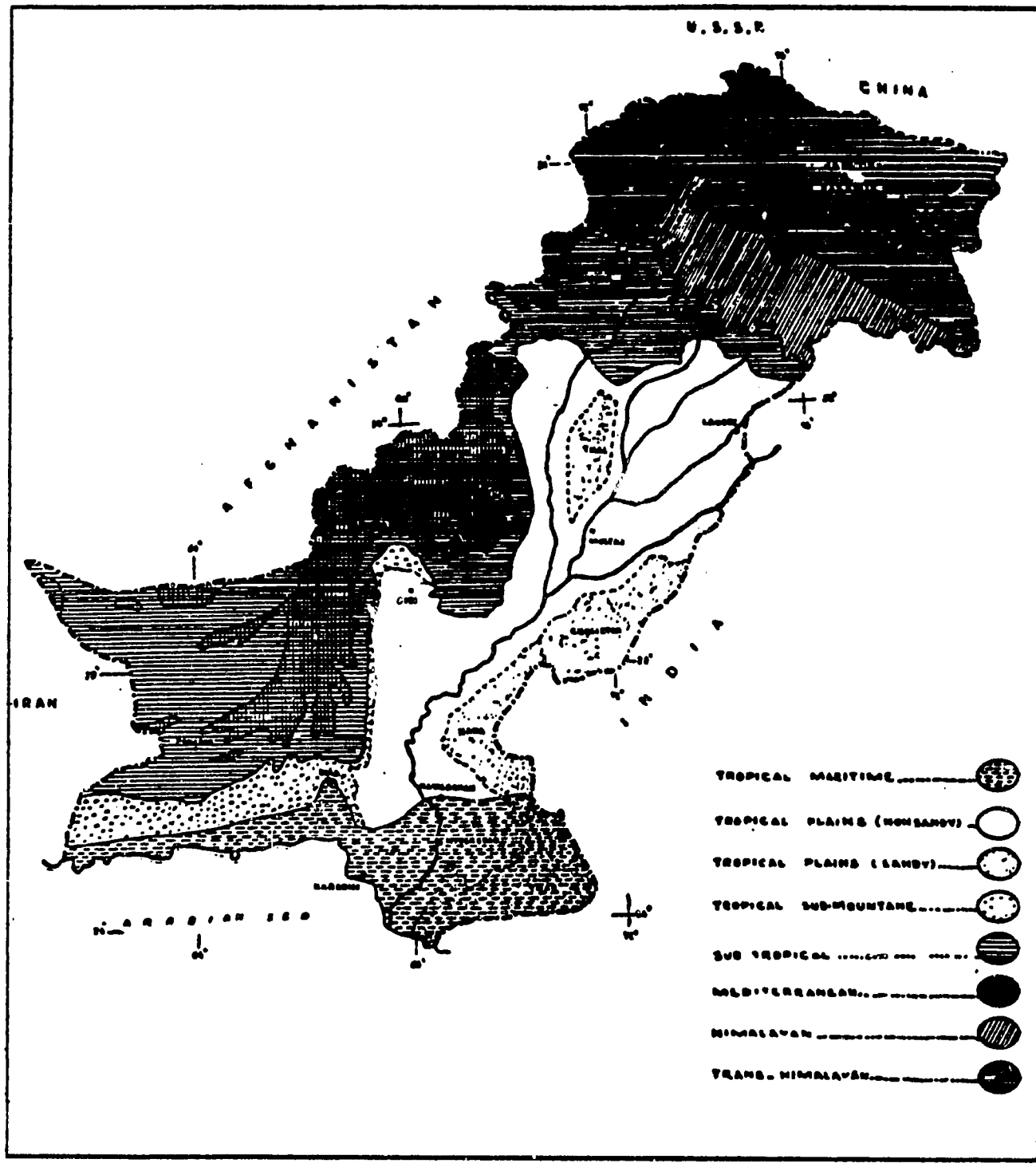

Figure 24. Range Ecological Regions

Source: C.M.A. Khan., 1974.

To the west a pocket of continental mediterranean climate prevails in the hills of Baluchistan. Vegetation, except in the forest areas, consists mainly of shrubs and herbs related to mugworts (*Artemisia* spp.). The area is sparsely populated, but its easy access to nomadic herders has resulted in serious devegetation by goats and sheep. A tropical submontane belt surrounds the plains. Its chief vegetation is steppe savannah, but here too, overgrazing has created pockets of desert and semi-desert.

The finest rangelands lie at the higher elevations in the Himalayas and the regions beyond. Plentiful precipitation in the former area has resulted in rich grasslands, meadows, and shrub meadows. The alpine and sub-alpine grazing grounds above 3000 m remain snow-covered until late April and grasses begin to appear soon after. Cattle are then brought from the foothills and plains to graze in the highlands. The area also produces grasses which are converted to hay and used as fodder during the winter months. This region is considered to possess great potential for development of range-related industry.

3.3.4 Administration, Legislation, Policy and Planning[16/]

Administration. Pakistan's nearly three million hectares of forest lands are under the control of the central Forest Department headed by an Inspector General of Forests. The

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[16] Sources: R. Akhtar. 1975.
CENTO. 1970.
C. H. Ahmad. 1975.
GOP. 1974.
GOP. 1978.
Hecox and Imtiazi. 1977.
Johnson and Johnson. 1977.
Pakistan Forest Institute. 1974.
U.S. AID. 1979c.
White. 1968.

Department is a branch of the Ministry of Food, Agriculture, and Cooperatives. Responsibility for regulation and exploitation of forest resources is assigned to the provincial Forest Departments and to the Conservators of Forests in the federally administrated areas. Actual development of these resources, however, is administered by the Pakistan Industrial Development Corporation (PIDC), a division of the Ministry of Production and Industries.

Administration of forests is by regions known as forest circles, which correspond to administrative divisions (Fig. 1). These circles are subdivided into Forest Divisions, each supervised by a Divisional Forest Officer (DFO). Beneath each DFO there is a staff of professionals consisting of Technical Forest Officers, Forest Range Officers, Foresters, and Forest Guards, in descending order of training and responsibility.

Forest and range management research is undertaken principally by the Pakistan Forest Institute (PFI) in Peshawar, where it is an affiliate of the University of Peshawar. The Institute has four administrative divisions: Forestry Research, Biological Sciences Research, Forest Products Research, and Forestry Education. Additional contributions to forestry research and development are made by such public institutions as universities, agencies, and ministries. For example, the University of Agriculture in Faisalabad, the University of Karachi, the University of Peshawar, and the Division of Range Management and Forestry of the Agricultural Research Council in Islamabad engage in research relating to management techniques and to the production of forest-derived substances. The central Ministries of Petroleum and Natural Resources, and Science and Technology, and WAPDA generate occasional projects in the field of forestry. Pakistan's National Committee on Man and the Biosphere (MAB) has also undertaken a number of studies which relate to forests (Appendix VII lists MAB projects in Pakistan). At the international level, the nation has been participating in the U.N. FAO-sponsored Ecological Management of Arid and Semi-Arid Rangelands in Africa and the Near and Middle East (EMASAR) program established in 1974.

Legislation. During the 19th century British administration engaged in numerous projects relating to arboriculture and forest management. By 1894 the Government of India had formulated an explicit policy concerning the use and control of the subcontinent's then shrinking forest lands. In 1927 India was provided with its first comprehensive legislation, the Forest Act of that same year. The statute sought to "consolidate the law relating to forests, the transit of forest produce and the duty leviable on timber and other forest produce." With two subsequent amendments, the West Pakistan Goats (Restriction) Ordinance of 1959, and the West Pakistan Goats Restrictions Rules of 1961, the Forest Act remains Pakistan's principal legislative instrument controlling forestry.

The Act of 1927 empowers the government to set aside forest reserves, appoint officers charged with the management of these territories, enforce rules governing the use of forests, determine the degree to which timber and other products may be exploited, and regulate the movement of cattle upon these lands. Moreover, the Act authorizes the government to punish violators of the stipulations contained therein. The 1959 and 1961 goat restriction ordinances recognize the damage incurred by rangelands due to limitless grazing of goats. Accordingly, the government has been empowered to limit the number of goats in the country and to regulate their movement (C.H. Ahmad 1975). More recently, passage of the Firewood and Charcoal (Restriction) Act of 1964 limits the burning of firewood and charcoal. Similar legislation regulating forest use exists at the provincial level (Appendix IV).

The Forest Act provides for the imposition of penalties when its provisions are violated. Two years imprisonment and a Rs.600 (c. $60) fine may be imposed. Enforcement of this and other laws, however, remains uneven. The government concedes that a growing population and adverse socio-economic conditions are exerting severe pressures on forest lands. These factors are acknowledged to hamper the strict enforcement of forest laws (U.S. AID 1979c).

Policy and Planning. Partition left the bulk of the subcontinent's forest lands in India. Less than 2 percent of Pakistan's territory was covered by forest (Table 4). In 1962 the nation's policy focused upon the following objectives:

1) maximization of wood production through afforestation.
2) control of grazing and shifting cultivation resulting in deforestation.
3) minimization of soil erosion through better conservation and management techniques.

By the end of the decade officials admitted that these goals were not being achieved at a sufficiently fast pace. Increased emphasis in food production and other sectoral priorities and inadequate institutional apparatus were cited as chiefly responsible for the lack of progress.

During the 1970s forestry programs were assigned higher priority in the nation's development scheme. More lands were set aside for afforestation and the Forest Department claimed a substantially larger area under its administrative purview (2.8 million ha in 1972-73 vs. 1.38 million ha in 1947; Table 4). By 1978 the Fifth Five Year Plan recognized that the previous afforestation rate of 12,000 ha per year was too slow (GOP 1978). Acceleration of this pace to a target of nearly 30,000 ha annually was consequently assigned the highest priority. In keeping with this emphasis, during 1973-75 a total of 46.1 million trees (two-thirds of these in the Punjab) were planted in the four provinces (R. Akhtar 1975). Figures for 1978 suggest that the pace had been at least sustained; the Punjab Government expected to plant 12.5 million trees that sping alone (Pakistan Times 1978).

The current Five Year Plan additionally hopes to implement the following measures:

1) encouragement of farm forestry
2) development of forestry in regions of adequate rainfall, particularly in places where competition with agriculture is minimal
3) shift from traditional timber species to faster growing ones
4) strengthening of forest extension in privately owned woodlands.

In conjunction with these objectives, the government has attempted to improve the management of existing forests so as to increase timber and fuelwood production and extract more and better by-products. Furthermore, the Forest Department is attempting, through legislation, to limit the frequently detrimental role of private contractors in forest exploitation (Punjab Barani Commission 1976). Simultaneously, the government, through its growing research facilities is hoping to improve the protection of forest resources by controlling biological pests (Pakistan Forest Institute 1974).

Finally, in recognition of the diminishing potential of rangelands, in 1973 the government established a Committee on Range Management. The committee has been charged with formulating a policy which will improve the grazing capacity of the nation's expansive rangelands which currently produce only 10 to 15 percent of their potential. The strategy of the Committee has been to restore the vegetative cover by reseeding and planting and to bring more land under improved livestock management techniques (GOP 1978).

3.4 Fauna and Conservation Measures

3.4.1 Native Terrestrial Fauna and Its Uses [17/]

The wide diversity of Pakistan's climatic and topographical features is mirrored by an unusually varied faunal population with affinities to three major biogeographic regions. The northern trans-Himalayan and western trans-Indus regions have a Palearctic fauna, while Azad Kashmir and the Indus basin comprise a portion of the Oriental region and their wildlife shows affinities to that of the

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17 Sources: Baqai. 1979.
Ferguson. 1978.
GOP. 1971.
Grimwood. 1972.
Mountfort. 1969.
National Council for Conservation of Wildlife, Pakistan (NCCW). 1978.
Qadri. 1974.

Ethiopian region. Altogether, Pakistan's fauna includes approximately 160 species of mammals, 900 birds, and several dozen reptiles and amphibians (Ferguson 1978).

Early Hindu and Muslim administrations recognized the inadvisability of uncontrolled hunting. Game reserves were set aside and hunting was prohibited during breeding seasons. Nevertheless, as towns, villages, and fields spread through the plains, the numbers of reptiles, amphibians, birds, and mammals declined steadily. This process has been accelerating under the pressures of modernization and industrialization. Already, among large mammals, the lion *(Panthera leo persica)*, tiger *(Panthera tigris)*, great one-horned rhinoceros *(Rhinoceros unicornis)*, and swamp deer *(Cervus duvauceli)* have reportedly become extinct. The cheetah *(Acinonyx jubatus)*, Indian wild ass *(Equus hemionus)*, and Kashmir stag *(Cervus elaphus hanglu)* are also supposed to be extinct (Ferguson 1978).

The continuation of practices which have threatened wildlife for centuries has led to a visible decline in total numbers as well as in surviving species. Various surveys undertaken during the past decade have attempted to identify those animals which are most severely in danger of disappearance. The results of these surveys, which are not in complete agreement, appear in Table 12. The government's attempts to protect endangered species are discussed in Sections 3.4.3 and 3.4.4.

To some degree, the threat to selected species has resulted from their economic value. Worldwide demand for skins, furs, horns, feathers, shells, and animal-derived substances such as musk and oils has been increasing steadily in spite of attempts by several nations to limit distributions of such products. Whenever possible, Pakistani dealers have eagerly sought to profit from the international market for wildlife products.

Similarly, live animals are in demand to stock zoos, serve as subjects for medical and biological experimentation, aid in hunting, or to serve as pets. Pakistan, in particular, has in the past exported many animals for such purposes. Rhesus monkeys are a prime example of a declining species whose economic value is high on account of their suitability as clinical subjects. In recognition of this fact, the government, through the Zoological Survey Department, has restricted export of rhesus monkeys to 200 per year. Falcons

Table 12. Extinct and Endangered Species. Extinct = X; endangered = E.

Mammals	IUCN	FWS	NCCW	Baqai	GOP
Horses					
Asian wild ass *(Equus hemionus)*	E	E	X		E
Bears					
Baluchistan black bear *(Selenarctos thibetanus gedrosianus)*	E		E		E
Brown bear *(Ursus arctos)*					E
Cats					
Asiatic cheetah *(Acinonyx jubatus)*	E	E	X		X
Caracal *(Felis caracal)*					E
Fishing cat *(Felis viverrina)*			E		E
Golden cat *(Felis temmincki)*			E		
Himalayan palm civet *(Paguma larvata)*					E
Leopard *(Panthera pardus)*	E	E			E
Leopard cat *(Felis bengalensis)*			E		E
Lion *(Panthera leo persica)*			X		
Lynx *(Felis lynx)*			E		E
Marbled polecat *(Vormela peregusna)*					E
Pallas's cat *(Felis manul)*					E
Sand cat *(Felis margarita)*					E
Snow leopard *(Panthera uncia)*	E	E	E		E
Tiger *(Panthera tigris)*		X	X		
Deer					
Barking deer or muntjac *(Muntiacus muntjak)*					E
Black buck *(Antilope cervicapra)*			X		E
Chinkara *(Gazella gazella)*					E
Chowsingha *(Tetracerus quadricornis)*					X
Goitered gazelle *(Gazella subgutturosa)*					E
Himalayan musk deer *(Moschus moschiferus)*	E				E
Hog deer *(Axis porcinus)*					E
Kashmir stag *(Cervus elaphus hanglu)*		E	X		E
Nilgai *(Bosephalus tragocamelus)*			E		E
Swamp deer *(Cervus duvauceli)*			X		
Dogs					
Asiatic wild dog *(Cuon alpinus)*	E				X
Wolf *(Canis lupus)*	E				
Dolphins					
Indus dolphin *(Platanista indi)*	E		E		
Dugong *(Dugong dugong)*		E			
Goats					
Chiltan markhor *(Capra falconeri chiltanensis)*		E			
Straight-horned or suleman markhor *(Capra falconeri jerdoni)*		E	E		E
Tahr *(Hemitragus jemlahicus)*					E
Martens					
Yellow-throated marten *(Martes flavigula)*					E

Table 12. - continued	IUCN	FWS	NCCW	Baqai	GOP
Monkeys					
Entellus langur *(Presbytis entellus)*		E			E
Rhesus monkey *(Macaca mulatta)*					E
Oxen					
Gaur *(Bos gaurus)*		E			
Others					
Common otter *(Lutra lutra)*					E
Smooth Indian otter *(Lutra perspicillata)*					E
Pangolin *(Manis crassicaudata)*					E
Rhinoceros					
Great one-horned rhinoceros *(Rhinoceros unicornis)*		X	X		
Sheep					
Marco Polo sheep *(Ovis ammon polii)*			E		E
Punjab urial *(Ovis orientalis punjabiensis)*					E
Shapu *(Ovis vignei)*		E	E		
<u>Birds</u>					
Bustards					
Great Indian bustard *(Choriotis nigriceps)*		E	E		E
Houbara bustard *(Chlamydotis undulata)*			E		E
Lesser florican *(Sypheotides indica)*					E
Cranes					
Common crane *(Grus grus)*					E
Demoiselle crane *(Anthropoides virgo)*					E
Siberian crane *(Grus leucogeralus)*					E
Sarus crane *(Grus antigone)*					E
Ducks and Swans					
Spotbill duck *(Anas poecilorhyncha)*					E
White-headed ducks *(oxyura leucocephala)*					E
Whistling swan *(Cygnus columbianus)*			X		
Cotton teal *(Nettapus coromandelicus)*					E
Marbled teal *(Anas angustirostris)*					E
Junglefowl					
Red junglefowl *(Gallus gallus)*					E
Peafowl *(Pavo cristatus)*			E		E
Pheasants					
Cheer pheasant *(Catreus wallichii)*			E		E
Himalayan monal pheasant *(Lophophorus impejanus)*					E
Kaleej pheasant *(Lophura leucomelana)*					E
Koklas pheasant *(Pucrasia macrolopha)*					E
Western tragopan *(Tragopan melanocephalus)*		E	E		E
Sandgrouse					
Large pintailed sandgrouse *(Pterocles alchata)*					E
Woodcock *(Scolopax rusticola)*					E

Table 12. - continued	IUCN	FWS	NCCW	Baqai	GOP
Reptiles					
Crocodilians					
Gavial or gharial *(Gavialis gangeticus)*	E	E	E	E	E
Marsh or mugger crocodile *(Crocodylus palustris palustris)*	E	E	E	E	E
Lizards					
Banded dwarf gecko *(Tropicalotes helenae)*				E	
Broad-tailed gecko *(Teratolepis fasciata)*				E	
Desert or Central Asian gray monitor *(Varanus (griseus)*	E	E		E	E
Fat-tailed gecko *(Eublepharus maculiaris)*				E	
Monitor *(Varanus salvator)*				E	E
Yellow monitor *(Varanus flavescens)*		E		E	E
Snakes					
Afro-Asian sand snake *(Psammophis schokari)*				E	
Indian python *(Python molurus)*	E			E	E
Malabar sea snake *(Lapemis curtus)*				E	
Striped river snake *(Enhydris pakistanica)*				E	
Tortoises					
Afghan tortoise *(Testudo horsefieldi)*				E	
Indian flap-shell tortoise *(Lissemys punctata punctata)*		E			
Turtles					
Brown river turtle *(Kachuga smithi)*				E	
Hawksbill sea turtle *(Eretmochelys imbricata)*		E		E	E
Indian soft-shell turtle *(Trionyx gangeticus)*		E			
Leatherback sea turtle *(Dermochelys coriacera)*		E			E
Narrow headed soft-shell turtle *(Chitra indica)*				E	
Sea turtle *(Caretta* spp.*)*					E
Sea turtle *(Chelone* spp.*)*					E
Spotted pond turtle *(Geoclemmys hamiltonii)*		E			

Sources: Baqai. 1979.
Ferguson (U.S. Fish and Wildlife Service). 1976.
GOP. 1971.
IUCN. 1975.
IUCN. 1978.
NCCW. 1978.

also have been valuable commodities, particularly among wealthy hunters in the Near East. Their export, too, has been limited to 300 per annum. Other species, however, have not benefited from the protective shelter of export quotas. Porcupines *(Hystrix indica)*, jackals *(Canis aureus)*, field rats *(Tatera* spp. and *Meriones* spp.), various snakes *(Hydrophis* spp.), and other fauna may be exported freely or with only moderate restrictions (Siddiqui 1974; Appendix VI). In 1973 a single Pakistani dealer obtained and filled an order for 36,000 live turtles. Throughout the early 1970s indications were that exports of live animals were increasing. In 1970-71 total exports of faunal species amounted to Rs. 380,000 (C.$38,000). Three years later the figure had more than doubled, reaching Rs. 835,000 (c.$84,000).

Illegal exports have further depleted certain animal populations. Monkeys, finches, buntings and parakeets have been smuggled out of Pakistan at alarming rates. In many instances, enforcement of export quotas has remained incomplete, uneven, and arbitrary (M. Ahmed 1980)

Hunting, both legal and extra-legal, has also played a leading role in reducing Pakistan's wildlife population and limiting its diversity. Hunting for sport (*shikar)* has remained an important pastime among wealthy landed classes. Such hunting has always been subject to restrictions but centuries of activity have nevertheless reduced or eliminated some game species. The value of game meat, furthermore, guaranteed a continuation of poaching within preserves and private lands. Here, too, strict regulations have remained ineffectual as hunters have depopulated entire forests and jungles of selected species (GOP 1971).

3.4.2 Fisheries[18/]

Marine. Commercial fishing in Pakistan occurs both along the 1000 km Arabian Sea coastline and in inland waters. In terms of total catch, marine fishing is by far the more significant activity. In 1974 nearly 89 percent of the total

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[18] Sources: R. Akhtar. 1975.
GOP. 1966.
GOP. 1977.
Government of the Punjab. 1976.
Johnson. 1979.
Kureshy. 1977.
Naveed. 1974.
Nyrop et al. 1975.
Quershi. 1974.

production of 133,000 metric tons arose from marine fishing (Quershi 1974). Most of this fishing is carried on just off the shallow 250 km long coastline of Sind, centered in Karachi. Approximately 72,000 persons operate approximately 1100 trawlers, 700 gill net boats, and 4000 sail boats. To the west, along the Makran coast of Baluchistan, another 25,000 persons are employed as fishermen. Based in the small ports of Gwadar, Jiwani, Ormara, and Pasni, they ply 2200 sail boats and 60 gill net boats.

The coastal waters are richly endowed with edible fish and crustaceans. More than half the catch by weight is comprised of catfish, croakers, drums, rays, sharks, and skates. Another 15 to 25 percent of the catch is made up of twenty species of shrimps and three species of rock lobsters. The remainder consists of bonita, sea bass, and tuna which appear in winter. Most of the fish are caught during the post monsoon and winter seasons (mid-August to mid-February). As much as 80 percent of the total marine catch is dried and exported to the Near East, Sri Lanka, and Japan.

In order to protect offshore fish resources, in 1973 Pakistan extended its fishery zone from twelve to fifty miles. By eliminating foreign fleets from this area, Pakistan has attempted to limit depletion and to induce normal patterns of fish movement from the deep seas to the coastal zone (Nyrop et al 1975).

Inland. Fishing from inland waters is widespread, occurring in all of Pakistan's provinces. The lakes, ponds, and barrages along the Indus and its tributaries within the Punjab and Sind, and the dams and reserviors of NWFP and the Punjab are the chief breeding areas and principal producers. Over the past two decades total inland production has increased substantially (from 16,000 metric tons in 1959-60 to 25,000 metric tons in 1974). This rise, however, has not kept pace with the growth of the marine fishing industry. Consequently, during the same period the inland fisheries' share of total production has gradually fallen from 24 percent in 1959-60, to 14 percent in 1964, to barely 11 percent in 1974.

Nevertheless, inland fisheries employ more persons than their marine counterparts. Of 201,300 persons engaged in fishing, more than half, or 104,000, worked at non-marine hatcheries and fisheries. The main sites for these activities are: Manchar, Kalri, and Haleji Lakes in Sind; the barrages at Gudu, Kotri, Sukkur, and Thatta on the Indus River; the Barani tract in the Punjab; the artificial lakes created by dams at Warsak, Mangla, and Tarbela in NWFP; and the Chitral, Kaghan, and Swat valleys in NWFP. Endemic species of carp such as *mahseer (Barbus mosal)*, *rohu (Labeo rohita)*, *mori*, and *thaila* have been supplemented with imported breeds such as the common carp *(Cyprinus carpio)* and rainbow trout *(Salmo gairdnerii)*. These species breed better than the native types when in confined waters. In addition to providing a source of protein and a means of livelihood for thousands, fish hatcheries are expected to stock several picturesque northern mountain streams and thereby boost tourism and sporting in these areas.

3.4.3 Policy: Reserves and Protected Areas [19]

Prior to 1966 Pakistan had taken no significant steps toward establishing national parks, sanctuaries, or reserves. That year the government requested the World Wildlife Fund (WWF) to undertake an extensive survey of the country (then including East Bengal). The investigation was to recommend a cohesive policy which would enable Pakistan to protect its endangered fauna and to maintain equilibrium within its ecosystem. Accordingly, two expeditions were undertaken in 1966 and 1967 under the leadership of Guy Mountfort and including other noted naturalists such as Duncan Poore, Eric Hosking, George Shannon and Jimmy Hancock. The reports of the team provided valuable and previously unavailable information on existing species and recommended several steps

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[19] Sources: Ferguson. 1978.
GOP. 1971.
Holloway and Khan. 197[illegible].
Mountfort. 1969.
NCCW. 1978.
Nizami. 1974.
Qadri. 1974.

which would lead to a national conservation program.

Among the suggestions, the Mountfort team advised the government to establish two large national parks and eight wildlife reserves. In 1971, after the appointment of a Pakistan Wildlife Enquiry Committee a number of the WWF suggestions were implemented. In its report, the Committee agreed to set up five national parks comprising 3415 sq km, eighteen wildlife sanctuaries, and fifty-three game reserves (GOP 1971).

The three categories of protected land are defined as follows (U.S. AID 1979c):

(1) National Parks. These are areas set aside for the protection and preservation of scenery, flora, and fauna in their natural states. National parks are accessible to the public for recreation, education, and research. Hunting is strictly prohibited.

(2) Wildlife Sanctuaries. These lands are reserved as undisturbed breeding grounds intended to protect wildlife. Public access is limited and exploitation of forest and animal products are prohibited.

(3) Game Reserves. Within these territories, the government limits hunting and shooting of animals by issuing permits. These permits specify the maximum number of animals which may be killed or captured.

In 1972, within a year of the issuance of the committee's report, the nation's first national park was declared. The Lal Suhanra National Park in Bahawalpur District in southern Punjab set aside 344 sq km of land for the propagation of wildlife and preservation of the natural environment. A year later a much larger (1883 sq km) park was established at Kirthar in Sind primarily for the protection of the Sind ibex *(Capra hircus blythi)*. In 1975 a third park (684 sq km) was declared in Hunza. Its main intention has been to sustain the population of Marco Polo sheep, blue sheep or shapu, Asian wild ass, and snow leopard. By 1978 another park was created in Swat (389 sq km) to preserve the ibex, markhor, snow leopard, and the Himalayan monal pheasant. Azad Kashmir, Baluchistan, and the federally administered area surrounding Islamabad are also slated to receive national parks (NCCW 1978).

In keeping with the Wildlife Enquiry Committee's recommendations, the government embarked upon a program of establishing wildlife sanctuaries and game reserves. The suggestions have, in fact, been substantially exceeded. By 1978, 44 wildlife sanctuaries and 65 game reserves had been set aside (Table 13). More than half the sanctuary acreage lies in Baluchistan while the largest amount of game reserve land is in the Northern Areas. In no instance does sanctuary or reserve land amount to more than 2 to 3 percent of a province. A number of the sanctuaries are designed to protect endangered deer, goats, sheep, and birds. The large sanctuaries in the Northern Areas are specially intended to preserve rare mammals such as the black bear and brown bear, lynx, snow leopard, and the wolf.

Table 13. Wildlife Sanctuaries and Game Reserves

A. Wildlife Sanctuaries

Province	Sanctuary	Area (sq km)	District (Fig. 1)
Baluchistan	Buz Makola	1,451.0	Makran
	Chiltan	103.6	Kalat
	Chorani	194.3	Khuzdar
	Dhrun	305.7	Khuzdar
	Dureji	1,782.6	Las Bela
	Hazar Ganji	22.0	Quetta-Pishin
	Kachau	216.6	Khuzdar
	Kolwa Kap	332.0	Makran
	Khurkhore	183.5	Las Bela
	Maslakh	465.6	Quetta-Pishin
	Raghai Rakshan	1,254.3	Kharan
	Sashamaba	66.1	Sibi
	Shaslan	295.5	Khuzdar
	Surkhab	37.4	Quetta-Pishin
	Ziarat Juniper	372.5	Sibi
	?	243.6	Kalat
Subtotal (Baluchistan)		7.326.3	
NWFP	Bilyamin	16.4	Kohat
	Borraka	20.2	Kohat
	Chitral Gol	77.4	Chitral
	Giddar Baik	18.0	Swat
	Manglot	7.2	Peshawar
	Manshi	9.4	Hazara
	Sheikh Buddin	46.7	Dera Ismail Khan
Subtotal (NWFP)		195.3	

13, cont.

Province	Sanctuary	Area (sq km)	District (Fig. 1)
Punjab	Chashma Lake	331.0	Mianwali
	Diljabba	20.2	Jhelum
	Jajja Kalan and Guruke	12.2	Kasur
	Khabbake Lake	2.8	Sargodha
	Kharrar Jheel	2.4	Sahiwal
	Nemal Lake	4.9	Mianwali
	Phalra	214.2	Bahawalnagar
	Rasul Barrage	1.2	Gujrat/Jhelum
	Taunsa Barrage	65.7	Muzzafargarh
Subtotal (Punjab)		654.6	
Sind	Drigh Lake	1,051.3	Larkana
	Haleji Lake	17.0	Thatta
	Hudero Lake	132.1	Thatta
	Kalri Lake	134.7	Thatta
	Lung Lake	122.7	Larkana
	Mahal Kohistan	706.9	Dadu
	Takkar Area	435.1	Khairpur
	?	?	?
		2,599.8+	
Northern Areas	Astore	414.4	Diamer
	Baltistan	414.4	Baltistan
	Kargah	442.9	Gilgit
	Nalter	272.0	Gilgit
Subtotal (Northern Areas)		1,543.7	
Total (Pakistan)		12,319.7	

B. Game Reserves

Province	Reserve	Area (sq km)	District (Fig. 1)
Baluchistan	Gogi	77.7	Sibi
	Raskoh	116.6	Kharan
	Wam	103.6	Sibi
	Zawarkan	38.9	Quetta-Pishin
Subtotal (Baluchistan)		336.8	
NWFP	Agram Basti	10.4	Chitral
	Daggar	0.4	Swat
	Darosh Gol	6.8	Chitral
	Gariat Gol	15.0	Chitral
	Makhniai	16.8	Hazara
	Nasampur	3.2	Peshawar

13, cont.

Province	Sanctuary	Area (sq km)	District (Fig. 1)
NWFP (cont.)	Purit-Chinar Gol	22.1	Chitral
	Resi	20.4	Kohat
	Shinawari	1.6	Kohat
	Surrahe	4.4	Hazara
	Swaglai	6.6	Chitral
	Thanedarwaia	16.4	Bannu
	Totlai	65.6	Swat
	Yakhdarra	4.2	Swat
Subtotal (NWFP)		193.9	
Punjab	Abasia	100.8	Rahimyar Khan
	Attari	17.4	Shekhupura
	Bajwat	39.3	Sialkot
	Bakh Gharibwal	1,342.2	Attock
	Bhiot	55.3	Sargodha
	Chak Dauluana	24.3	Jhang
	Chak Kator	5.4	Bahawalpur
	Chak No. 178/J.B.	8.3	Jhang
	Chaupalia	98.6	Bahawalnagar
	Cholistan	42.1	Bahawalpur-Bahawalnagar
	Gulf Manda	?	Rawalpindi
	Islamabad	1.2	Rawalpindi
	Kamalia	45.0	Faisalabad
	Kheri Murat	56.2	Attock
	Rakh Mirjal	6.3	Attock
	Sodhi	58.2	Sargodha
Subtotal (Punjab)		1,900.6+	
Sind	Deh Jangisar	3.1	Thatta
	Deh Khalifa	4.3	Thatta
	Dosu Forest	23.1	Larkana
	Hala	9.5	Hyderabad
	Khipro Forest	38.9	Sanghar
	Mandodero	12.3	Sukkur
	Mirpur Sakro	7.8	Thatta
	Nara	1,100.1	Khairpur
	Pai Forest	19.7	Nawabshah
	Rainkot-Sumbak	406.5	Dadu/Thatta
	Sahib Samo	3.5	Hyderabad
	Tando Mitha Khan	53.4	Sanghar
Subtotal (Sind)		1,682.2	
Azad Kashmir	Ghomote	272.9	Muzafarabad
	Hillan	4.2	Poonch
	Machayara	102.9	Muzafarabad
	Mohri Said Ali	2.4	Poonch
	Moji	30.6	Muzafarabad

13, cont.

Province	Sanctuary	Area (sq Km)	District (Fig. 1)
Azad Kashmir (cont.)	Phallah	3.2	Poonch
	Qazinag	48.3	Muzafarabad
	Solkhala	8.1	Muzafarabad
	Vatallah	4.5	Mirpur
Subtotal (Azad Kashmir)		485.1	
Northern Areas	Chassi-Bowasdar	370.4	Ghizar
	Danyor Nallah	442.9	Gilgit
	Kilik-Minteka	650.1	Gilgit
	Nor Nallah	72.5	Baltistan
	Nazbar Nallah	334.1	Ghizar
	Pakora	75.1	Ghizar
	Satpara	310.9	Baltistan
	Sherkillah	168.4	Ghizar
	Tanger	142.5	Diamer
Subtotal (Northern Areas)		2,566.9	
Total (Pakistan)		7,165.5+	

3.4.4 Administration, Legislation, and Planning[20]

Administration and Legislation. Systematic efforts by indigenous administrations to restrict the destruction of wildlife traditionally have been linked to preservation of game. Because hunting provided amusement for the ruling classes, governments and wealthy landowners strove to guarantee a perpetual supply of wild animals. Favored species such as deer, antelope, ibex, leopards, lions, tigers, and ducks, partridge, pheasants, and grouse were permitted to breed on restricted preserves. These areas were stocked and hunting was limited to allow for breeding. Already by the late sixteenth century, the Mughals' *Ā'in-i Akbari* had codified regulations pertaining to hunting. The Sikh and British rulers who succeeded the Mughals, also fond of hunting, continued these policies. In 1860 the Criminal Code outlawed the killing or maiming of any animal whose value exceeded

[20] Sources: Ferguson. 1978.
GOP. 1971.
GOP. 1978.
Grimwood. 1972.
Hecox and Imtiazi. 1977.
Johnson and Johnson. 1977.
NCCW. 1978.
Pakistan Criminal Procedure Code. 1898.
Pakistan Forest Institute. 1980.
Pakistan Penal Code. 1860.
U.S. AID. 1979c.

ten rupees. The statute, moreover, extended protection to domesticated animals such as elephants, camels, horses, mules, buffaloes, bulls, cows, or oxen (Pakistan Penal Code 1860). These laws were incorporated into the Criminal Procedure Code in 1898 and have been maintained ever since. By the twentieth century, with faunal populations coming under increasing threat of elimination, the British government enacted the Wild Birds and Animals Protection Act of 1912. This law has remained in force and has served as a model for provincial and local legislation adopted after independence (Appendix IV lists legislation regarding wildlife).

Establishment of provincial Game Departments charged with issuing hunting permits and preventing illegal hunting, trapping, and poaching dates back to the 1930 s. Each district was provided with a Game Warden who was assisted by several Game Inspectors. Today, following the recommendations of the WWF, provincial game departments are independent branches of the provincial departments of forestry and wildlife. Forestry and Wildlife Departments are, in turn, divisions of the provincial ministries of agriculture.

At the federal level, in fulfillment of the Wildlife Enquiry Committee's guidelines, Pakistan in 1974 created the National Council for Conservation of Wildlife (NCCW) within the Ministry of Food, Agriculture, and Cooperatives. Within the same ministry, the Zoological Survey Department provides additional technical support. The NCCW helps formulate policies, coordinates activities with provincial governments and international agencies, and promotes conservation (Khattak 1980). Additionally, Wildlife Management Boards have been set up to advise local administrations. Existing wildlife legislation limits hunting to certain areas, to non-breeding seasons, to licensed individuals, and of non-endangered species (Appendix VI). As has been noted, the central government sets export quotas for live animals and animal trophies and products (U.S. AID 1979c).

Administration of fisheries is by a National Fisheries Development Board (NFDB), also part of the Ministry of Food, Agriculture, and Cooperatives. The NFDB coordinates policies at the federal and provincial levels. The provinces carry out fisheries programs through regional Fisheries Departments, development committees, associations, and cooperatives.

Planning. According to the NCCW (1978), the central aims of Pakistan's wildlife conservation strategy are threefold. The

stated priorities include:

1) wildlife education and training,
2) conducting surveys of threatened wildlife and habitats,
3) restoration and management of species and their habitats.

To date, wildlife management has been taught at the Pakista Forest Institute in Peshawar. Since the early 1970s attempts have been made to improve the facilities at PFI while simultaneously introducing Pakistani wildlife personnel to modern management techniques. Foreign exchange programs are now permitting these objectives to be fulfilled. Two large projects (valued at more than $400,000) begun in 1978 have created fellowships abroad and have begun to establish better facilities in Pakistan. Both international organizations such as IUCN, UNDP, and FAO, and foreign nations such as Australia, New Zealand, and the U.S. have been assisting Pakistan in improving its management training programs (Appendix VI).

Field studies in progress are attempting to ascertain the status of threatened species and their habitats. These surveys are being conducted by the NCCW, regional wildlife management boards, provincial wildlife departments and other agencies, and individual Pakistan researchers. In conjunction with these surveys, there are efforts to reintroduce and protect endangered animals. In 1978 the NCCW listed eleven projects whose aims included reintroduction of species, restoration of their habitats, anti-poaching campaigns, and management of wildlife (NCCW 1978; Ferguson 1978; Appendix VI).

Fisheries have received increasing attention over the past decade due to the mounting protein shortage. Recent surveys of marine fishery resources have revealed that the Arabian Sea is a generally underused source of fish. Present plans call for specific expansion of fishing activities along the Makran Coast. Facilities at the Karachi Fish Harbour are being improved by adding to the number of fishing vessels and by increasing the engine sizes on powered boats.

Inland fish production is also slated for improvement and development. The government is extending the area allotted to these fisheries. Estimated available area is more than 3 million ha. By better utilizing this area, Pakistan hopes to raise inland fish production to more than 200,000 metric tons per year from the 1978 figure of only 34,000 metric tons. These efforts will be carried out in conjunction with programs intended to introduce new species and designed to make better use of available scientific hatchery techniques. The Fifth Five Year Plan allocates Rs. 411 million ($ 41.1 million) to the development of fisheries (GOP 1978).

4.0 Environmental Problems

4.1 Water Related Problems [21]

4.1.1 Waterlogging, Salinity, and Sedimentation

Drainage and reclamation projects currently are assigned top priority in Pakistan's water development budget, receiving 40 percent of the sectoral allocation (GOP 1978; Section 3.2.5). This is a clear indication of the magnitude of the nation's irrigation-induced water problems. Recent studies have estimated that as much as half of Sind and a third of the Punjab provinces experience moderate to severe waterlogging. In 1977 approximately 3 percent of canal-irrigated soil was considered "heavily waterlogged" (Johnson and Johnson 1977). Similarly, more than 98 percent of Sind's agricultural land is affected by salinity (Table 14). As early as the late 1950s planners had begun to note the seriousness of these phenomena. At that time 4.85 million ha, or nearly half the nation's irrigated area had become waterlogged or oversalted, or both. The amount of land subjected to these dangers, furthermore, was increasing at the rate of 40,000 ha per year (Akhtar 1978; U.N. ECAFE 1966).

Table 14 Waterlogging and Salinity

Province	Waterlogging Level[a] (% of land[b])			Salinity Level (% of land[b])			
	Moderate (1.5-3m)	Severe (0-1.5m)	Total	Slight	Moderate	Severe	Total
Baluchistan	-		.1	-	-	-	6.9
NWFP	2.5	10.0	12.5	-	-	-	9.0
Punjab	32.9	7.3	40.2	14.8	4.3	6.5	25.6
Sind	35.3	23.5	58.8	20.6	27.1	50.5	98.2
Pakistan	32.3	13.2	46.0	15.8	11.7	20.9	48.4

[a]Measured in April when at a minimum.

[b]Percentage of irrigated land affected.

Sources: Akhtar. 1978.
Johnson. 1979.

[21]Sources: Akhtar. 1978.
Chotani. 1974.
Daifuku. 1973.
Johnson and Johnson. 1977.
U.S. AID. 1979b.

In Pakistan, as in many developing nations, irrigated land is inadequately drained and canals are unlined. Water thus seeps into the ground and causes a rise in the water table level. Throughout the irrigated regions of the nation, the level has risen to the surface or just below it. This inhibits the growth of the deep-rooted crops and causes an accumulation of alkaline salts and other minerals near the surface. The saline build-up further impairs agricultural yield by reducing soil fertility.

An additional problem is caused by the combined effects of erosion and the proliferation of large dams built along the Himalayan foothills. Mangla, Warsak, and most recently, Tarbela, have significantly raised the amount of sediment carried by rivers below the dam sites. The additional weight of this sediment load poses a threat to water reservoirs, barrages, and other structures downstream. (Johnson and Johnson 1977).

The problems above affect yet another important resource--a number of the nation's archaeological sites. The construction of the Sukkur Barrage in Sind, for example, has effected notable rises in the local water table and in the saline content of the groundwater. Mohenjo-Daro, perhaps the best-known and most thoroughly excavated of the ancient Indus Valley civilization sites, lies about 70 km downstream from the barrage. The water table at Mohenjo-Daro varies seasonally from 1.5 to 3.9 m below the surface. Through capillary action, water rises about 2.4 m above the aqueous layer and deposits salts into the baked mud bricks used in the ancient buildings. High temperatures and low humidity evaporate the water, leaving residual magnesium and potassium sulfates and carbonates. These destructive chemical agents progressively fragment and weaken the bricks and endanger the survival of the site. Countermeasures have been implemented, but they remain extremely expensive and of unproven effectiveness. UNESCO has been active in supporting the reclamation of Mohenjo-Daro and other imperiled sites (Daifuku 1973).

These and other attempts to salvage land damaged by waterlogging and salinity are costly and are being undertaken at the expense of other development projects. Tens of thousands of tubewells are being sunk to remove water from the ground even while the irrigation network is being expanded. Most of the new canals remain unlined and their addition will no doubt contribute to the problems being combatted with SCARPs. The deployment of additional dams

and barrages and enlargement of existing ones are certain to increase the environmental damage caused by silting and sediment loading.

4.1.2 Flooding and Drought

Flooding. As Figure 16 shows, there is a very large difference between maximum and minimum discharges of Pakistan's rivers. This variance is most notable for the Indus, whose peak discharge is more than fifty times its winter minimum. This phenomenon, in conjunction with the region's unpredictable rainfall,can result either in flooding or in drought.

While periodic occurrences of each have recurred throughout history, it is noteworthy that severe flooding of the Indus plains has been more frequent during the past twenty-five years than over the previous sixty-five years (Akhtar 1978; U.S. AID 1979b). Some have attributed this change to long-term meteorological conditions. Most observers, however, agree that the probable factors have been the gradual denuding of hilly catchments and the introduction of artificial barriers. Deforestation and overgrazing cause rainwater to run off into the rivers instead of soaking into the ground. The destruction of vegetation also erodes the soil, thereby depositing silt into the river beds, raising their levels, and permitting them to flow over low-lying flood plains during times of maximal discharge. Construction of barriers such as dams, barrages, and embankments has added to the problem by raising riverine water levels in adjoining areas. These structures cause additional silting, raising the levels further. When accumulated pressure occasionally washes away these obstructions, water flows with increased force and causes more damage (Akhtar 1978).

In the past, floods have wreaked enormous destruction to life and property. Between 1973 and 1978 five serious floods have victimized 12.7 million persons (1516 persons killed) and cost perhaps $15 million (U.S. AID 1979a). Floods in 1973 innundated approximately two million ha of crops and ten thousand villages. Flood control expenditures have been increased but they account for only 10 percent of the water development budget. Plans include engineering river flood control and improved warning systems employing radar and satellite stations. In order to be effective, long-term flood control measures will need to focus upon preventing the causes of flooding. Afforestation and improved planning of artificial barriers are the most likely targets of such a strategy.

Drought. Most of Pakistan receives inadequate rainfall to sustain cultivation. Because of the monsoon climate, the precipitation is unevenly distributed through the year. Furthermore, both the amount of rainfall and the onset of the rainy season are subject to wide variation (Section 2.1.3). These are precisely the climatic conditions generally associated with drought. Indeed, Pakistan has been persistently subjected to drought. Only by the large-scale introduction of canal irrigation have sizeable tracts of land been protected from water shortages. Even so, large portions of the country lie beyond the reach of the irrigation system. These areas are vulnerable to chronic water deficit and remain unsuitable for cultivation.

As the above section on flooding has shown, the various attempts to counteract drought conditions have frequently resulted in the creation of unexpected environmental problems. Given the present state of technology and management, it would appear that further progress in drought ravaged regions of Pakistan may only be achieved at the expense of problems induced by irrigation.

4.1.3 Pollution and Contamination of Water Supply

Irrigation-caused groundwater salinity is but one of the problems affecting the nation's water supply. Groundwater, the major source of drinking water, is also subjected to chemical pollution from agricultural and industrial sources and to bacterial contamination. To increase agricultural production, Pakistan has been relying increasingly upon chemical pesticides, many of them dangerous chlorinated biphenyls such as PCB (Yates et al 1974). Between 1972 and 1978 the amount of cropland sprayed nearly tripled to 5 million ha, approximately a third of the total sown agricultural area (Akhtar 1978). The most productive farmlands lie within the Indus basin. Thus, many of the chemicals employed as pesticides ultimately seep into the soil and contaminate the groundwater. Chemical fertilizer use has also dramatically increased, doubling between 1968 and 1977. The components of these fertilizers filter through to the groundwater to become unhealthy ingredients of the water supply (Jackson 1973).

Industrial discharges into rivers constitute yet another source of water pollution. The magnitude of this problem has yet to be fully assessed. A recent empirical study in

Pakistan has revealed that the effects of industrial pollutants are more harmful than those of organic pollutants (R. Ali 1977, cited in MAB 1979). It is clear, moreover, that industrial practices causing pollution are widespread. Numerous manufacturing facilities in the Punjab have been disposing of harmful by-products by dumping them into nearby streams. A number of textile mills and dying plants in Faisalbad produce such toxic liquids as intensely alkaline liquors with high biological oxygen demand (BOD). These are routinely left untreated and discharged. Similarly, Lahore, on the Ravi, is an industrial center. Preliminary surveys there have revealed that local tanneries and chemical industries release dangerous effluents which adversely affect the quality of subsoil water, damaging crops and polluting the water supply. Other Punjab industrial complexes in Gujranwala, Gujrat, and Daudkhel lie on the banks of major rivers and are suspected of causing similar environmental damage (Chotani 1974).

Finally, living organisms pose perhaps the greatest impediment to a safe water supply. As has been described above (Section 3.2.4), drinking water is often drawn from open, untreated sources. Rural supplies are particularly exposed to infestation by rodents, insects, flatworms, roundworms, and microorganisms. Gastrointestinal disorders as well as other serious infectious diseases such as polio, salmonella, hepatitis, cholera, typhoid, and tuberculosis are contracted from stagnant, unclean water and spread rapidly through population centers. There is also evidence that contamination of water has begun to threaten fresh water organisms. This not only endangers wildlife and fish, but affects the food supply (MAB 1979).

In the cities, a greater proportion of residents are said to have access to safe drinking water--75 percent according to U.S. AID; 61 percent according to the government (GOP 1978; U.S. AID 1980). Nevertheless, inadequate pumping facilities cannot maintain sufficient water pressure to prevent seepage. Old, decaying pipes permit additional seepage and reintroduction of both chemical and infectious pollutants. Treatment plants operate inefficiently due to shortage of materials and manpower, and often contradictory regulations and standards. This factor compounds the problems of supplying safe water.

Water disposal facilities remain even more inaccessible than pure water. Overall, fewer than 10 percent of Pakistanis are served by sanitation or sewage treatment facilities--9.7 percent according to the government; 6 percent according to U.S. AID. (GOP 1978; U.S. AID. 1980). Accordingly, water which was originally unclean and unsafe is reintroduced into the ground and further contaminates the water supply.

4.1.4 Marine Pollution

To date, very little information has been compiled on problems of marine pollution. Karachi is the only major coastal urban center. The Master Plan Department of the Karachi Development Authority has launched a study and investigation of environmental pollution in the vicinity of the city. The tentative conclusions indicate that factories and other industrial facilities have been disposing of waste products by releasing them into deltaic streams and directly into the sea. Pollution in these streams appears to be of alarming proportions (Chotani 1974).

With rising levels of oil importation, furthermore, there is a growing danger of tanker oil spills. There is not yet any legislation prohibiting discharges of pollutants into the coastal zone or the high seas. Proposed legislation imposes strict liability upon responsible shipowners and oil companies. Pakistan, however, has not yet developed an oil spill contingency plan (U.S. AID 1979c).

4.2 Environmental Problems in Rural Areas

4.2.1 Natural Disasters [22]

Floods and droughts are only two of the adverse natural phenomena in Pakistan. Earthquakes, tidal waves, and cyclones have periodically caused serious damage to the nation's environmental resources. Baluchistan, NWFP, and the northern Punjab, in particular, are situated atop seismologically active zones. In 1931 the vicinity of Quetta was struck by

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[22] Sources: Akhtar. 1978.
Johnson and Johnson. 1977.
Sheikh and Aleem. 1975.
U.S. AID. 1979a.
U.S. AID. 1979d.

major tremors and four years later the city was destroyed, killing between 20 and 60 thousand inhabitants (Stamp 1970; Nyrop et al 1975). More recent quakes killed nearly 5000 persons in the northern Indus valley in 1974, and struck NWFP in 1975, and again in 1981. The amount of cropland lost to these disasters was not estimated, but most of them occurred in remote, non-agricultural areas. Major tidal waves and cyclones are less frequent, but nevertheless cause extensive damage periodically along the coast.

In contrast to these unpreventable natural catastrophes are other disasters which are caused by human interference or mismanagement of the environment. Landslides are a prime example of such phenomena. In the mountainous regions of the north, land clearing, roadbuilding, irrigation channel construction and livestock grazing have made the soil less cohesive. Slides of these unstable soils have diminished the availability of topsoil, reduced the amount of cropland, threatened settlements below, and increased the destructive capacity of rivers which carry the resulting debris and soil (Sheikh and Aleem 1975).

Epidemics and vermin plagues are two other natural disasters whose frequency and intensity have been amplified by interference and improper application of control measures. The spread of disease has been shown to be highly correlated to inadequate sanitation facilities and unhygienic drinking water supply (Section 4.1.3). While numerous factors enhance conditions for the proliferation of parasitic and other infectious organisms, Pakistani society's inability to eliminate the sources of infection is the principal reason for the nation's chronic epidemics.

The problem of infestation by rodents, insects, and other vermin is also age-old. Locust plagues and invasions by rats have recurred periodically and few measures have provided effective control. To some degree the appearance of these destructive and frequently disease-carrying animals is inevitable and unpredictable. But many observers believe that the problem has been aggravated through centuries of interference with the ecosystem. Predators have been eliminated for reasons of sport, economic value, or nuisance. This disruptive tendency has permitted certain species to thrive and multiply. The result is that worms, insects, crows, and rodents have reproduced alarmingly. In

the process, they have caused unprecedented damage to an already insufficient food supply, endangered forest and range vegetation, and imperiled the health of humans and livestock. Inadequately protected storage facilites, faulty sewage systems, and poor hygiene have encouraged the spread of destructive species. Unfortunately, available methods of pest control have introduced new hazards whose effects are incompletely understood (Section 4.2.3).

4.2.2 Underuse and Misuse of land [23/]

Efforts to increase agricultural production have brought more land under cultivation. Over the past thirty years, Pakistani farmers have increased the net area sown by about 40 percent (Table 4, Section 2.3.1). It is generally believed that additional land which is presently classified as waste can be converted to cropland.

Often, however, the conversion of terrain to farmland is accompanied by erosion, flooding, and pest outbreaks. As plains land reserves become exhausted, sloping land is brought under the plow, and natural vegetation is removed, exposing and loosening the soil. Even when properly terraced, such land is easily eroded to gullies by rain and wind. The Potwar plateau has been particularly subjected to such erosive processes (Brown 1978; Johnson 1979). Converting land to agriculture also causes pests to increase as their natural predators and competitors are eliminated either directly or by habitat destruction. Finally, removal of vegetation also increases runoff, causing floods that damage crops in the floodplain. Ironically, these losses may nullify the attempt to raise production by expanding cropland.

Production may also be increased by raising yields. Since independence, crop production has increased at a faster rate than the growth of cropland, indicating higher yields. But in spite of this rise, yields remain low, averaging

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[23] Sources: Akhtar. 1978.
Brown. 1978.
Mian. 1976.

just 1.24 tons per ha of wheat and 1.48 tons per ha of rice. These yields compare unfavorably with those of developed countries and even those of the neighboring province of Indian Punjab, where they can be twice as great. Agronomists agree that current yields could be increased by more intensive use of cropland and improved land tenure distribution.

Cropping intensity presently averages less than 120 percent. It may be possible to raise it to perhaps 180 percent. Fertilizer usage, currently about 56 kg per ha, could be doubled (Akhtar 1978). Ideally, then, these two improvements alone could raise yields threefold (Akhtar 1978).

Past and present distribution of land tenure has inhibited maximum production. Land tenure problems are of three kinds: absentee landlordism, exploitation of tenant farmers, and uneconomical farm size. Since partition a number of federal and provincial tenancy laws have attempted to alleviate these obstructions to full land utilization (Appendix IV). There have been difficulties in enforcing this legislation and it is impossible to evaluate its success in improving production and land utilization.

4.2.3 Pesticide Use [24/]

Section 4.1.3 describes the effects of pesticide use on groundwater and the drinking supply. But the hazards associated with pesticides are not limited to water pollution. Persistent and increasing applications of insecticides, herbicides, fungicides, and rodenticides have begun to damage the native flora and fauna. "Green revolution" techniques of farming introduced in the 1960s use more intensive pest management measures. To maximize production from high yield hybrid varieties of grain, it was more important than ever to protect these and other crops from losses to insects, weeds, and pathogens. Accordingly, new and more potent chemicals were applied in order to reduce losses, estimated as high as 15 percent of total output (Akhtar 1978). By 1978, 5 million ha of rice, maize, sugarcane, fruits, vegetables,

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[24] Sources: Akhtar. 1978.
Hayes. 1979.
Jackson. 1973.
Kazmi. 1976.
U.S. AID. 1979c.
Yates et al. 1974.

cotton, and tobacco were being sprayed for boll weevils, army worms, jassids, stem borers, flies, and caterpillars. The current plan calls for a 232 percent increase in the area sprayed by 1983 (GOP 1978). In addition, the government hopes to double the level of pesticide application to 0.64 kg per ha.

Little research has been done to discover specific deleterious effects of pesticide use in Pakistan. There is good reason to believe, however, that there, as elsewhere, the toxicity of these substances is not limited to their targets. Non-target organisms such as beneficial insects, predators, and harmless fish, birds, and mammals are often victimized by pesticides. Chemical toxins are passed from one organism to another in the food chain. Chlorinated hydrocarbons are not readily broken down by biological agents, but accumulate in the ecosystem, further poisoning food supplies and organisms. Some of the PCBs such as DDT have been proven to lower reproductive potential in animals.Malaria eradication programs, the largest users of DDT, are discussed separately in Section 4.3.4. Herbicides, whose use is not especially widespread in Pakistan, are regarded as safer than insecticides. Nevertheless, indiscriminate or improper application can eliminate harmless plants and trees. (Jackson 1973).

While the benefits of plant protection measures are considered more important than the environmental damage they cause, the government has taken steps to register and control toxic substances. An Agricultural Pesticides Technical Advisory Committee (APTAC) was created in 1971 under the provisions of the Agricultural Pesticides Ordinance. Composed of representatives of the central and provincial governments, agricultural universities, the Council of Scientific and Industrial Research (CSIR), and other concerned organizations, APTAC is responsible for the registration of pesticides upon determination of their effectivenes and safety. In addition, Customs S.R.O. 410 of 1959 regulates the import of pesticides.

An analysis of pesticide use in Pakistan by a team of U.S. specialists (Yates et al 1974) recommended to the government that:

(1) Non-agricultural sale and use of pesticides be regulated.
(2) Registration be based upon performance of vigorous field tests.
(3) Toxicity categories be explicitly defined.

(4) Only those pesticides which are most useful and "safe" be approved for use. Specifically, the team advised the elimination of Azodrin[R], Bidrin[R], dieldrin, methyl parathion, phosphamidon, and dichlorvos (DDVP), substances in use in 1974.

(5) Pesticides be microencapsulated for safer application.
(6) Containers should meet minimum strength specification.
(7) The government regulate transportation of pesticides to minimize leakage.
(8) Standards controlling storage be promulgated.

As of 1979 it did not appear that any of these recommendations had been implemented. There are, however, indications that researchers are developing non-chemical techniques of pest control for use in Pakistan. Biological control employing parasites has shown some encouraging results, as has utilization of insect pathogens such as viruses, bacteria, and fungi (Mohyuddin 1974; Zethner 1974).

4.2.4 Deforestation, Overgrazing, and Desertification [25/]

Although land classified as forest appears to have grown since independence (Table 4, Section 2.3.1), it is likely that actual forest area has been decreasing (Section 2.3). In Pakistan, as in most of Asia, woodlands and scrublands are subjected to encroachment from human and domesticated animal population growth. As Pakistanis seek new croplands, additional living space, and timber for construction, they apply relentless pressure upon remaining forests, scrublands, and ranges. Additional damage is caused by large herds of livestock, often introduced simultaneously. Along the fringes of the densely settled Indus basin, these two forces combine to destroy natural vegetation and wildlife. Elsewhere, Baluchistan's sparsely populated grazing lands are being rapidly depleted by migrant herds of goats and sheep. The

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[25] Sources: Brown. 1977.
Brown. 1978.
Eckholm. 1979.
GOP. 1974.
Johnson. 1979.
PFI. 1974.
U.S. AID. 1979b.

rangeland's already low carrying capacity of 10 to 15 percent (GOP 1978) is being still further reduced by overexploitation (U.S. AID 1979b).

Deliberate deforestation is most pronounced in some of the northern Himalayan valleys. Migratory herdsmen and residents of Hazara, Kagan, and Swat have felled entire deodar and pine forests in order to resettle or to extend their fields. Terracing is extensive, but few precautions are taken to prevent erosion. Landslides are common and cause widespread damage to structures and fields (Masrur 1974; Johnson 1979; Section 4.2.1). Monsoon winds and rainstorms intensify the erosive forces and cause serious losses of topsoil.

The long-term consequences of this soil loss are multifold. Farming becomes less productive and land must be abandoned. The tracts are then converted to grazing lands and in time are allowed to become overgrazed. Finally, the loose soil, subjected to additional erosion, becomes incapable of sustaining growth of any sort. This is a permanent condition unless topsoil is replaced and afforestation measures are undertaken to prevent further erosion. While afforestation has been encouraged and applied on a large scale, efforts to date have not made up for the widespread losses of land.

The process of desertification has been occurring for decades in Pakistan. Even while available grazing land diminishes, the number of animals has been steadily increasing. The number of goats has tripled to 21 million between 1960 and 1977; the number of sheep has doubled to 18 million during that same period (Nyrop et al 1971; Johnson 1979). Techniques of range management have been incapable of reversing the trend. As one observer has noted, it would require enormous social change and altered expectations to impose effective management and "green" all of the terrain which has been destroyed (Hewitt 1974). Section 3.3.3 has described the government's numerous measures to rectify the problems of deforestation and overgrazing. These steps have only recently been implemented and it is too soon to evaluate their success.

4.3 Environmental Problems in Urban Areas [26/]

4.3.1 Industrial Pollution

The by-products of industrial activity affect not only the water supply (Section 4.1.3), but the quality of the land, air, and the food supply as well. Factories and energy plants discharge effluents, solid and gaseous waste, radioactive substances, and dispose of refuse and hazardous materials. These products--both organic and inorganic--are generally harmful to the environment. Because industrial facilities are usually located in or near cities, it is frequently the city, rather than the countryside, which suffers the consequences of industrial pollution.

The materials released by industry include: Highly toxic chemicals and elements such as PCBs, mercury, lead, and arsenic; carcinogens such as asbestos, heavy metals, and soot; radioactive substances arising from nuclear waste and other manufacturing processes; decaying organic refuse; and particulate matters and noxious fumes such as carbon dioxide, carbon monoxide, sulfur dioxide and hydrogen sulfide.

These discharges pose a number of problems to the population centers. Untreated landfills promote the spread of infectious disease by harboring insects and other vectors. Toxic and radioactive waste permeates the soil and vegetation. Dairy cattle and poultry are generally raised in the vicinity of cities. Most vegetable farms are also found near cities. Meat, eggs, dairy, and vegetable products are thus frequently contaminated (Jafri 1977, cited in MAB 1979). In addition, canneries, bottling plants, and meat packing facilities are situated near sources of pollution, intensifying the contamination.

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[26] Sources: Chotani. 1974.
Hayes. 1979.
Kazmi. 1976.
MAB. 1979.
U.S. AID. 1979b.
U.S. AID. 1979c.

Finally, smoke, harmful dusts, and other airborne particles are concentrated in the cities. Heavy dependence upon wood and coal for fuel and increased use of motor vehicles have aggravated the problem substantially. The airborne emissions irritate eyes, nasal passages, sinuses, and lungs and can lead to long-term illnesses such as emphysema and cancer.

Because Pakistan has been trying to raise its level of industrialization, the government has often been reluctant to enact and enforce measures which might discourage private investment. In addition, the rapid growth of public enterprises such as energy generating and processing facilities, chemical, cement, and fertilizer manufacturing plants, light and heavy industrial production factories, and mines has increased the sources of pollution. As in other developing nations, this direct public involvement in development has placed the government in an awkward situation. While, on the one hand, officials have become increasingly aware of the dangers of pollution to public health and the ecosystem, the industrial sector is under intense pressure to increase productivity. Environmental concerns are thus often perceived as nuisances which hamper progress.

Nevertheless, the government has acted on several points to limit, if not eliminate, the dangers of industrial pollution. Perhaps the earliest measures attempting to regulate such matters were the nation's pure food laws. As early as 1960, each province enacted such an ordinance. These laws provided for controls over the manufacture, storage, sale, and transportation of edible substances. In 1965 the West Pakistan Pure Food Rules were promulgated, which increased control and focused particularly upon the adulterations of foods with chemical preservatives, antioxidants, colorings, and artificial flavorings. The laws also provide for testing of foods and thus monitor the presence of some harmful substances introduced by industrial pollution (Kazmi 1976). To date, no specific legislation exists to categorize and regulate the use of toxic substances. In the case of pesticides, measures have been suggested (Section 4.2.3) but these have yet to be enacted. The government states that release of radioactive materials is controlled in

keeping with recommendations of the International Commission on Radiological Protection (ICRP) and of the International Atomic Energy Agency (IAEA). It is the responsibility of the Nuclear Safety and Licensing Division (NSLD) of the Pakistan Atomic Energy Commission (PAEC) to monitor and regulate radioactive pollution. The only other area in which the government apparently has a role is in prohibiting mining operations from discharging mine tailings and waste into inhabited areas. Air pollution standards and legislation have not been adopted, but several Pakistani and international agencies have urged the government to do so (MAB 1979).

4.3.2 Noise Pollution [27]

Not until relatively recently has excess noise been treated as a form of environmental pollution. Pakistani cities, like their counterparts elsewhere in the developing world, are regularly subjected to a dangerously high level of noise from industry, transportation, and human voices (U.S. AID 1979b). In 1965 Pakistan enacted an ordinance regulating and controlling the use of loudspeakers and sound amplifiers (Ordinance II of 1965, C.A. Ahmad 1975). The law prohibits the use of such devices in the vicinity of hospitals, places of worship, educational institutions, courts, and other public places.

But the more serious noise caused by poorly maintained vehicles, excessive use of horns, street repair equipment, and factory machinery remain uncontrolled. Pakistani officials acknowledge the lack of noise control measures. They have indicated that legislation to limit noise pollution is under consideration (U.S. AID 1979c). But because of limited funds, and limited understanding of the potential hazards of noise pollution, the matter receives only low priority (U.S. AID 1979b).

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[27] Sources: C.A. Ahmad. 1975.
U.S. AID. 1979b.
U.S. AID. 1979c.

4.3.3 Malaria Control [28]

Malaria has been Pakistan's most persistent and widespread disease. The government first undertook an extensive eradication program in 1961, but malaria has made a dramatic reappearance after a period of relative control in the late 1960s. By 1972 the number of victims had increased thirty-fold and affected approximately 26 percent of the population (Nyrop et al 1975).

Although malaria strikes both rural and urban residents, most eradication projects have focused upon cities. Incidence there is generally more prevalent because of overcrowding, poor sanitation, and inadequate drainage. In addition, spraying in and around urban areas is considered more cost-effective due to the concentration of population. In Karachi alone, between 330,000 and one million of the 3.5 million inhabitants were estimated to have malaria (Mulhern 1975). In Lahore, Hyderabad, Multan, Faisalabad, Rawalpindi and the other major cities, malaria is as rampant. In all these places, vector mosquitoes breed indoors in homes and outdoors along the rivers, swamps, tanks, open sewers, storm water pools, and other polluted waters.

Efforts to control malarial infections have thus far relied upon chemical pesticides. Until recently DDT has been the primary insecticide. In addition to contaminating the food chain, groundwater, air, and household articles, DDT is highly toxic to non-target organisms. Moreover, there have been indications elsewhere in Asia that DDT-resistant strains have begun to emerge (U.S. AID 1979b). For these reasons, a number of observers have recommended decreased reliance upon DDT and corresponding increase in the application of other substances and techniques (Mulhern 1975, Hays et al 1978).

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[28] Sources: Hays et al. 1978.
Mulhern. 1975.
Yates et al. 1974.
Zaidi. 1975.

Malathion, an organophosphorus insecticide, has relatively low toxicity. It can be used both as a larvacide and adulticide. It was first employed on a wide scale in Pakistan in 1976; by the end of that year it accounted for over 70 percent of all pesticides used in malaria control. Malathion was found acceptable as an insecticide, but at least two varieties, Snia Viscosa and Rumianca, were determined to be dangerous to sprayers (Baker et al. 1976?, Davis 1977). It has been recommended that the use of these substances be discontinued.

Two other chemical agents, pyrethrum and pyrethroids, are fast acting and only moderately toxic and hazardous. They have proven effective as larvacides but their cost is high. "Dibrom," an adulticide, is highly corrosive and therefore hazardous to spraying personnel and to the environment. Hormonal growth inhibitors such as Altoside SR10 has yet to be approved by WHO.

In sum, none of the toxins used to eliminate mosquitoes are entirely safe. In all instances, the most immediate dangers are posed to sprayers and persons living in the immediate vicinity of the treated areas. Environmental damage is acknowledged by government officials and foreign advisors.

As an alternative to chemical pesticides, researchers have been developing biological control techniques. Usually, these measures involve the introduction of larva-eating fish such as guppies *(Poecilia* spp.), *Tilapia* spp., and *Gambusia* spp As of 1976, however, biological control of malarial vectors was still experimental and impractical.

Consequently, spraying with chemical toxins remains the only effective means to destroy the vector mosquito population. Government officials and foreign advisors tend to acknowledge the potential environmental damage caused by these substances. Some advisors such as the multi-disciplinary team headed by W.E. Yates in 1974, however, have downplayed the hazards of DDT and other chemicals, citing what they interpret as inconclusive tests and experiments. In a 1971 statement, the director of WHO minimized the risk of DDT use, supporting its continued application. The Pakistani population at large, furthermore, remains generally unaware of the dangers of insecticide use (Zaidi 1975).

Under these circumstances, and motivated by the pressing demands of reducing malarial infection, Pakistan is moving ahead with its eradication program. Between 1970 and 1978, 40 percent of the health sector allocation went to disease prevention. The main component of this expenditure was malaria eradication. The Fifth Five Year Plan optimistically, and most likely unrealistically, aims to reduce the level of malaria to a point where it will no longer pose a public health problem (GOP 1978). But while seeking this objective, the government has reduced the share of preventive programs to just 8.4 percent of health sectoral allocations, or Rs. 552,280 (c. $55,200).

4.4. Environmental Management Problems [29]

4.4.1 Training Facilities, Administration, Communication

In its environmental management report to Congress, U.S. AID (1979b) highlighted the constraints posed by inadequate numbers of trained personnel. Pakistan was considered one of the Asian countries facing such a shortage. At its very inception the new nation complained that disproportionately few of the experienced bureaucrats, educated scientists, skilled technicians, and research and training facilities of pre-partition India had reverted to Pakistan. Beginning in 1947, therefore, the government set out to expand the number of persons trained in administration, engineering, and the natural sciences. In order to effect this growth, the first national development plans provided for the establishment of more than twenty technical institutes and the improvement of existing facilities (GOP 1966).

Within the realm of environmental management, these problems were manifested in the scarcity of trained botanists, demographers, ecologists, foresters, geologists,

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[29] Sources: Hecox and Imtiazi. 1977.
MAB. 1979.
Pakistan MAB. 1976?
Punjab Barani Commission. 1976.
U.S. AID. 1979b.
U.S. AID. 1979c.

hydrologists, public administrators, soil engineers, toxicologists, and wildlife experts. Effective management of the biosphere also requires trained attorneys, economists, planners, and social scientists. These persons, too, have remained in short supply and have generally been drawn to more lucrative professional opportunities. With the establishment of the Pakistan Forest Institute, the Punjab Agricultural College and Research Institute, the Zoological Survey, the Geological Survey, and the upgrading of the nation's leading universities, Pakistan has been producing qualified environmentalists. Unfortunately, funds and salaries remain low. As a result, these institutions still do not train enough persons to manage Pakistan's serious ecological problems.

Another serious shortcoming was pointed out by several participants at a 1977 seminar sponsored by Pakistan's MAB Committee. The nation has failed to integrate its diverse measures and numerous governmental bodies charged with managing the environment (MAB 1979). As the preceding sections have demonstrated, Pakistan's management of environmental problems is distributed over a maze of ministries, departments, agencies, councils, and committees. More often than not, these administrative divisions communicate poorly with each other, foster rivalies, and duplicate efforts. Such piecemeal treatment of environmental issues makes it difficult for coherent policies to evolve. In addition, the ministries within which the pertinent agencies are situated have conflicting objectives. Frequently, as in the case of the Ministries of Atomic Energy or Petroleum and Natural Resources, the goals of these ministries are development-oriented and therefore incompatible with ecological concerns.

Pakistan has consequently been obliged to rely rather heavily upon foreign assistance. This aid has come in the form of funding, technical advice, employment of foreign experts, and education of Pakistani students abroad. Some of the help has been unilateral, as from U.S. AID (Appendix VIII) and the Ford Foundation. Much of it has been multilateral. The United Nations, through ESCAP, FAO, IBRD, UNDP, UNEP, UNESCO, WFP, and WHO has provided assistance and training in matters concerning the environment. Other multinational organizations such as the Indus-Tarbela Development Fund, the Consortium, and a group of Islamic nations have also contributed heavily

to the improvement of training facilities. Sometimes, as with the U.S. AID-sponsored Mangla Watershed Project, the programs include specific management training activities. Frequently, foreign nations provide selected Pakistani environmentalists with training courses abroad (for instance, the Joint Australia New Zealand International Training Course in Administration of National Parks and Reserves).

Pakistan's environmental management problems are amplified by the nation's difficulties in effectively disseminating information. Lack of a single national language is the first obstacle. Research, scientific instruction, and publication of technical materials are in English. Official transactions at the federal level are conducted in English and in Urdu. Provincial matters are frequently discussed, written, and communicated in Punjabi, Pashto, Balochi, and Sindhi. Except for English, technical vocabulary is limited. New words, derived from Arabic and Persian, are introduced into Urdu and the other languages, but few people are familiar with these terms. English remains inaccessible to all but perhaps two percent of the population while Urdu is spoken by about half the persons. If important decisions or policies relating to the environment are to be made public, the language barrier and the low literacy rate remain grave impediments to effective implementation. This problem is particularly troublesome with regard to health-related matters such as sanitation, water pollution, and malaria.

Administrative inefficiency, changing national and regional priorities, seemingly contradictory and inconsistent official pronouncements, ineffective use of media, and long-standing cultural barriers dividing various communities all add to the difficulties of communicating both within the government and to the public. General apathy regarding the immediacy of environmental hazards further hamper efforts to limit or eliminate such dangers (Zaidi 1975; U.S. AID 1979b).

4.4.2 Legislation, Policy, and Enforcement

As the foregoing sections have shown, Pakistan, and British India before it, have had a long tradition of environmental legislation. Land tenure and use, forestry, canal irrigation, wildlife protection, energy development, pesticide use, and noise pollution have all been regulated to some degree.

The quality of this legislation is not uniform, nor does it always cover all eventualities. Many aspects of environmental degradation remain uncontrolled or under-regulated. Mineral developers, for example, are not presently required to restore mined land. Toxic substances are neither categorized nor controlled. Offshore pollution and solid waste disposal are still uncontrolled. Nevertheless, the government of Pakistan has acknowledged the environmental consequences of development and modernization. The current Five Year Plan provides a number of instances of this recognition. Land reclamation, land tenure reform, disease eradication, improved sanitation and drinking water facilities and forest and range management are all provided for in the budget.

Pakistani officials are drafting legislative and budgetary provisions intended to improve the quality of the environment. New laws would limit water pollution through monitoring stations and implementation of standards. Proposed air quality control measures would restrict harmful chemical lands in fuels, and attempt to regulate vehicle emissions. Additional legislation is being prepared to regulate vehicular, industrial, and construction site noise (U.S. AID 1979c). It is not possible to fully evaluate the effectiveness of existing laws because no specific information exists on their enforcement. As with other laws in Pakistan it is reasonable to assume that those dealing with the environment are adhered to only in accordance with a number of cultural and political factors. These include: the nature of the political climate (enforcement and obedience are normally greater under military rule), the prevailing level of corruption, morale among enforcement personnel, the financial trade-offs of compliance and non-compliance, incentives for acquiescence, social dynamics between officials and potential violators, perceptions of the urgency of a given problem, and the social or religious merit accrued by obeying a particular injunction. In a society as diverse and as complex as that of Pakistan, it is clear that each of these factors poses numerous obstacles to effective enforcement of environmental legislation. Indeed, it is reasonable to state that in each of the above cases there are compelling inducements to disregard the laws.

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Appendix I

Demographic Characteristics

Appendix I. Table of Contents

Table 1. Estimates and Projections of Population and Growth Rates, 1950-1979

Table 2. Population by Age and Sex, 1972 and 1979

Table 3. Population by Urban and Rural Residence and Size of Urban Locality, 1961 and 1972

Table 4. Population by Province/Division and Density, 1972

Table 5. Vital Statistics

Table 1. Estimates and Projections of Population and Growth Rates, 1950-1979

(Numbers in thousands. Growth rates, in percent, are from midyear to midyear)

Year or period	Number or percent	Year or period	Number or percent	Year or period	Number or percent
POPULATION		POPULATION—Con.		POPULATION—Con.	
Estimates		Estimates—Con.		Projections—Con.	
1950	39,448	1965	57,495	1976	77,299
1951	40,382	1966	59,046	1977	79,477
1952	41,347	1967	60,642	1978	81,735
1953	42,342	1968	62,282	1979	84,075
1954	43,372	1969	63,970		
1955	44,434	1970	65,706	AVERAGE ANNUAL GROWTH RATE	
1956	45,536	1971	67,491		
1957	46,680	1972	69,326		
1958	47,869			1950-55	2.4
1959	49,104			1955-60	2.5
1960	50,387	Projections		1960-65	2.6
1961	51,719			1965-70	2.7
1962	53,101	1973	71,206	1970-75	2.7
1963	54,524	1974	73,164		
1964	55,988	1975	75,195	1975-79	2.8

Source: U.S. Dept. of Commerce. 1980.

Table 2. Population by Age and Sex, 1972 and 1979

(Numbers in thousands. Figures may not add to totals due to rounding)

Age	Adjusted census, September 1972			Projected population, midyear 1979		
	Both sexes	Male	Female	Both sexes	Male	Female
POPULATION						
All ages	69,717	36,936	32,781	84,075	44,390	39,685
0 to 4 years	11,909	6,184	5,725	14,548	7,535	7,013
5 to 9 years	9,667	5,078	4,588	11,655	6,120	5,535
10 to 14 years	8,295	4,363	3,932	9,972	5,248	4,723
15 to 19 years	7,022	3,707	3,314	8,586	4,528	4,058
20 to 24 years	5,507	2,903	2,604	7,334	3,881	3,453
25 to 29 years	4,759	2,488	2,271	5,863	3,106	2,756
30 to 34 years	4,270	2,249	2,021	4,802	2,527	2,275
35 to 39 years	3,721	1,974	1,746	4,275	2,253	2,021
40 to 44 years	3,109	1,675	1,434	3,766	2,001	1,765
45 to 49 years	2,722	1,485	1,237	3,156	1,692	1,464
50 to 54 years	2,498	1,388	1,110	2,654	1,436	1,219
55 to 59 years	2,089	1,165	924	2,361	1,292	1,070
60 to 64 years	1,629	905	724	1,976	1,085	892
65 years and over	2,520	1,372	1,148	3,127	1,686	1,442
PERCENT						
All ages	100.0	100.0	100.0	100.0	100.0	100.0
0 to 4 years	17.1	16.7	17.5	17.3	17.0	17.7
5 to 9 years	13.9	13.7	14.0	13.9	13.8	13.9
10 to 14 years	11.9	11.8	12.0	11.9	11.8	11.9
15 to 19 years	10.1	10.0	10.1	10.2	10.2	10.2
20 to 24 years	7.9	7.9	7.9	8.7	8.7	8.7
25 to 29 years	6.8	6.7	6.9	7.0	7.0	6.9
30 to 34 years	6.1	6.1	6.2	5.7	5.7	5.7
35 to 39 years	5.3	5.3	5.3	5.1	5.1	5.1
40 to 44 years	4.5	4.5	4.4	4.5	4.5	4.4
45 to 49 years	3.9	4.0	3.8	3.8	3.8	3.7
50 to 54 years	3.6	3.8	3.4	3.2	3.2	3.1
55 to 59 years	3.0	3.2	2.8	2.8	2.9	2.7
60 to 64 years	2.3	2.5	2.2	2.4	2.4	2.2
65 years and over	3.6	3.7	3.5	3.7	3.8	3.6

Source: U.S. Dept. of Commerce. 1980.

Table 3. Population by Urban and Rural Residence and Size of Urban Locality, 1961 and 1972

Area	1961[1]			1972		
	Number	Population	Percent of total country	Number	Population	Percent of total country
Total Country		42,880,377	100.0		65,309,340	100.0
Urban areas[2]	315	9,654,572	22.5	431	16,593,651	25.4
Localities with 500,000 or more inhabitants	2	3,209,075	7.5	6	6,846,474	10.5
Localities with 100,000-500,000 inhabitants	10	2,476,492	5.8	18	2,963,533	4.5
Localities with 50,000-100,000 inhabitants	10	702,269	1.6	22	1,514,518	2.3
Localities with 25,000-50,000 inhabitants	30	1,100,441	2.6	52	1,808,656	2.8
Localities with 10,000-25,000 inhabitants	78	1,149,870	2.7	159	2,433,294	3.7
Localities with less than 10,000 inhabitants	185	1,016,425	2.4	176	1,027,176	1.6
Rural areas		33,225,805	77.5		48,715,689	74.6

[1]Excludes 97,883 non-Pakistanis.

[2]Urban areas are defined as "those having a municipal corporation, municipal committee, cantonment board, or town committee. In general, an area was designated as urban if it had a concentration of population of at least 5,000 persons in a continuous collection of houses and if the community sense was well developed and the community maintained public utilities such as roads, street lighting, a water supply, and sanitary arrangements. In special cases, a few areas that had urban characteristics but had a population of fewer than 5,000 were also treated as urban." (Latif and Sheikh, 1976, p. 137).

Source: U.S. Dept. Commerce. 1980.

Table 4. Population by Province/Division and Density, 1972

Province/Division	Population	Density pop./sq km
Pakistan	64,979,732	81.4
Baluchistan	2,405,154	7.9
Quetta	1,306,001	9.3
Kalat	1,099,153	5.4
N.W.F.P.	8,337,385	112.0
Peshawar	5,498,137	197.7
Dera Ismail Khan	1,041,412	77.6
Malakand	1,797,836	54.1
Punjab	37,507,855	182.6
Rawalpindi	5,671,414	201.5
Sargodha	8,980,236	202.7
Lahore	9,795,042	424.7
Multan	9,508,008	147.9
Bahawalpur	3,553,155	78.0
Sind	14,007,722	99.2
Sukkur	5,045,373	101.2
Hyderabad	5,372,356	61.4
Karachi	3,589,993	1,017.8
Centrally Administered Tribal Areas	2,485,867	91.5
Federal Capital Territory (Islamabad)	235,749	260.2

Source: U.S. AID. 1979a

Table 5. Vital Statistics		Source
Population density per square kilometer (1978)	96.0	a
Population density per sq. km of arable land (1978)	305.0	a
Percentage of population in urban areas (1980)	28.0%	b
Urban population growth rate (1978)	4.4%	a
Crude birth rate per thousand (1978)	45	b
General fertility rate (1978)	6.7	b
Sex ratio at birth, males per 100 females (1974-75)	1.05	c
Crude death rate per thousand (1978)	15	b
Life expectancy at birth (1978)	52 years	b
Infant mortality rate per thousand live births (1971)	142	c
Males	140	
Females	144	
Average annual population growth rate (1970-78)	3.1%	b
Population per physician (1975)	3,730	a
Average daily caloric consumption (1977)	2,281	b
Percentage adult literacy (1975)	21%	b
Per capita share of GNP (1978)	US $230	b

[a] U.S. AID. 1980a.

[b] World Bank. 1980.

[c] U.S. Dept. Commerce. 1980.

Appendix II

Economic Characteristics

Appendix II. Table of Contents

Agricultural Sector

Table 1. Benchmarks (1977-78) and Crop Production Targets for 1982-83
Table 2. Subsectoral Allocations with Agricultural Sector, 1978-1983

Other Sectors

Table 3. Structure of GNP and GDP, 1971-1978
Table 4. Sectoral Allocations under the Fifth Five Year Plan (1978-1983)

Trade

Table 5. Balance of Trade, 1950-1978

Foreign Aid

Table 6. Foreign Debt Incurred, 1977
Table 7. Foreign Grants in Aid, to 1977

Appendix II. Economic Characteristics [1]

Insofar as per capita GNP per annum may be taken as an economic indicator, Pakistan ranks as the world's 24th poorest nation with an average figure of $230 (World Bank 1980). During the 1960s the country's GDP grew at a healthy rate of 6.7% per year. The following decade's growth rate was less impressive, but still respectable at 4.4% yearly--about 33% ahead of the population growth rate. Indicators of production, resources, services, trade, consumption, health, and education confirm that Pakistan remains one of the globe's least affluent countries despite visible efforts to improve economic conditions.

Agricultural Sector.

As in most low-income nations the economy is still heavily reliant upon agriculture. In 1978 a third of Pakistan's GDP was attributable to this sector, compared to 16% in middle income countries and just 4% in industrialized countries. Over the past two decades the government has been successful in reducing the emphasis on agriculture from 46% to 32% (World Bank 1980). The current Five Year Plan, although it increases spending for this sector, reflects government strategy by allocating just 21.7% of the total public sector outlay to agriculture and water. Nevertheless, planners would like to increase the annual growth rate of the agricultural sector (GOP 1978).

The Fifth Five Year Plan for the 1978-83 period spells out Pakistan's agricultural development objectives. The goals were to:

(a) achieve a growth rate of 6.0 per cent per annum for the agriculture sector;

(b) make a transition from self-sufficiency in wheat to export of agricultural products; to increase production of rice for domestic consumption and export; and to increase exports of other agricultural commodities;

(c) increase oilseeds production so as to limit imports of vegetable oil;

(d) accelerate production of protein rich foods such as pulses and of meat, milk, egg, and fish at a rate higher than the population growth in order to improve the average nutritional level;

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[1] Sources: GOP. 1978.
Johnson. 1979.
World Bank. 1980.

(e) accelerate production and productivity of cotton and sugarcane;

(f) accelerate fruit and vegetable production for local consumption and export;

(g) upgrade agricultural production in the ill-endowed areas (arid, hilly, *sailaba* and *barani*) through an integrated plan for exploitation of natural resources with a view to minimizing inter/intra-regional farm income disparities;

(h) improve productivity of small farmers in the irrigated areas;

(i) diversify agriculture, through a multiple cropping system and by promoting such minor crops as soya bean and sunflower; and

(j) increase and protect wooded area and develop rangelands for livestock production.

Table 1 compares agricultural production goals with past outputs. Table 2 presents the planned allocations within the agricultural sector under the current Five Year Plan.

Table 1. Benchmarks (1977-78) and Crop Production Targets for 1982-83

Crop	Area (000 acres)		Production (000 tons)		Area-yield (mds/acre)		Percentage Increase Over Benchmarks		
	1977-78	1982-83	1977-78	1982-83	1977-78	1982-83	Area	Production	Area-yield
Total Foodgrains	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Wheat	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rice	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Maize	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Jowar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Bajra	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Barley	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sugarcane	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	[illegible]
Cotton	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
			(3,302)*	(5,000)*					
Oilseeds	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rape and Mustard	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sesamum	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Groundnut	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cotton Seed	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Other Oilseeds	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pulses	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Gram	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Moong	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Other Pulses	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tobacco	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Potato	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Onion	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Vegetables	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Fodder	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Fruits	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

*Figures in thousand bales.

Source: GOP. 1978.

able 2. Subsectoral Allocations within Agricultural Sector, 1978-1983

Sub-sector Category		Allocation
I. Crop Production Sub-sectors		
1. Fertilizers	..	5,305.56
2. Improved Seed	..	888.60
3. Plant Protection	..	2,359.24
4. Soil Survey	..	39.00
5. Mechanization		595.00
6. Soil Conservation	..	110.00
II. Infrastructure and Institutional Arrangements		
7. Agricultural Marketing	..	31.80
8. Cooperatives	..	116.00
9. Government Foodgrains Storages	..	993.60
10. Research on Crop Production	..	425.00
11. Agricultural Education	..	173.00
12. Agricultural Extension	..	657.30
13. Agricultural Economics and Statistics	..	37.60
14. Consolidation of Agricultural Land Holdings	..	6.40
15. Share Contribution to ADBP	..	67.50
III. Other Sub-sectors.		
16. Animal Husbandry	..	1,201.80
17. Range Management	..	59.50
18. Forestry	..	953.10
19. Watershed Managrment	..	170.00
20. Fisheries	..	411.00
Sub-total	..	14,601.00
21. Kashmir Affairs Division	..	245.00
22. Interior Division	..	12.50
23. States & Frontier Regions Division	..	100.00
24. Planning Division	..	27.50
25. Commerce Division (Tobacco Board)	..	9.00
26. Science and Technology Division (Animal Husbandry)	..	5.00
Grand Total	..	15,000.00

Source: GOP. 1978.

Other Sectors.

The economy of Pakistan over the past decade was distributed as shown in Table 3.

Table 3. Structure of GNP and GDP, 1971-1978[a]

Sector	1971-72	1973-74	1976-77	1977-78[b]
		(percent of GNP)		
Agriculture	38.5	35.6	34.5	32.2
Mining & quarrying	0.5	0.5	0.5	0.5
Manufacturing	15.3	15.6	14.4	13.4
Large-scale	(11.6)	(12.2)	(10.9)	(10.2)
Small-scale	(3.7)	(3.4)	(3.5)	(3.2)
Construction	3.6	4.0	5.1	5.0
Electricity & gas	2.4	2.8	2.4	2.7
Transport, storage, communications	6.2	6.6	6.2	6.5
Wholesale & retail trade	13.5	14.3	13.6	13.1
Banking & insurance	2.0	2.3	2.	2.6
Ownership of dwellings	3.6	3.4	3.5	3.3
Public administration & defense	7.0	7.3	8.1	7.7
Services	7.3	7.1	7.1	7.4
Gross Domestic Product (GDP)	99.8	99.5	98.2	94.5
Net factor income from/to rest of the world	0.2	0.5	1.8	5.5
Gross National Product (GNP)	100.0	100.0	100.0	100.0

[a]At constant factor cost (1959-60).

[b]Provisional figures.

Source: Johnson. 1979. Originally from National Accounts, 1973-74 to 1976-77; Pakistan Statistical Yearbook, 1974; and Pakistan Economic Survey, 1977-78.

The industrial sector's share of the GDP rose from 16% in 1960 to 24% in 1978. Similarly, the manufacturing component of this sector also grew from 12% to 16% during this period (World Bank 1980). Over the past decade, however, this trend was not sustained. On the contrary, manufacturing declined by more than 12% (Table 3). During the 1970s only construction, defense, administration, and banking and insurance experienced meaningful growth. Between 1973 and 1978, moreover, energy, transport, and trade--other key components of developing economies-- all declined. These tendencies do not augur well for Pakistan's immediate economic prospects.

Table 4 shows the priorities of the Government of Pakistan under the current Five Year Plan.

Table 4. Sectoral Allocations under the Fifth Five Year Plan (1978-1983)

Sector	Percent of total outlay of Rs. 148,170 million
Power	18.8
Transport and Communications	18.5
Industry	14.2
Water	11.6
Agriculture	10.1
Education	6.9
Housing & Physical Planning	6.6
Health	4.5
Fuel	3.8
Minerals	1.3
Population Planning	1.2
Rural Development	1.0
Manpower	0.5
Mass Media	0.5
Tourism	0.4
Social Welfare	0.1
Total	100.0

Source: GOP. 1978.

Trade. Immediately following independence, Pakistan's export trade was minuscule and consisted primarily of agricultural produce. Raw cotton accounted for 84% of the nation's export earning. Principal imports were cotton cloth and yarn, heavy machinery, minerals, petroleum, and food supplies. In 1950-51, one of the few good years, exports exceeded imports by 15%. Throughout the 1960s and 1970s, however, imports generally rose at a far faster pace than exports. By 1978 Pakistan imported more than twice as much as it exported, pushing the balance of trade deficit to $1.8 billion for that year (World Bank 1980). Table 5 shows the nation's balance of trade since 1950.

Table 5. Balance of Trade, 1950-1978

Year	Imports	Exports	Balance
	(millions of Rs.)		
1950-51	1,167	1,342	+175
1955-56	964	742	-222
1960-61	2,173	540	-1,633
1965-66	2,880	1,203	-1,677
1970-71	1,998	3,602	-1,492
1971-72	3,495	3,371	-72
1972-73	8,393	8,551	+224
1973-74	13,479	10,161	-3,246
1974-75	20,925	10,286	-10,469
1975-76	20,465	11,253	-9,091
1976-77	23,012	11,294	-11,429
1977-78	27,178	12,730	-14,448

Sources: Pakistan Statistical Year Books; U.S. AID 1979.

Foreign Aid

Because the balance of trade usually has yielded a net deficit, Pakistan has had to borrow substantial capital abroad. By 1977 the cumulative total of this debt had reached $8.26 billion -- approximately a quarter of that amount resulting from U.S. loans. Table 6 presents Pakistan's outstanding foreign debts.

Table 6. Foreign Debt Incurred, 1977

(US $ Millions and per cent of total)[a]
Total: $8255 million of which disbursed $6341.5 million.

USA	2,187.3	26.5%	Canada	315.2	3.8%
IDA	791.2	9.6	China	263.3	3.2
Iran	778.6	9.4	France	261.8	3.2
Germany	617.2	7.5	UK	223.6	2.7
IBRD	542.9	6.6	Saudi Arabia	130.7	1.6
USSR	517.6	6.3	Italy	121.7	1.5
Japan	412.3	5.0	Abu Dhabi	113.0	1.4
ADB	392.8	4.8	Netherlands	111.8	1.4

[a]Only totals of more than 1% are included

Source: Johnson. 1979. Originally in Pakistan Economic Survey, 1977-78.

Table 7. Foreign Grants in Aid, to 1977 (millions of $)

Donor	Pre-1st Plan[a]	1st Plan 1955-60[a]	2nd Plan 1960-65[a]	3rd Plan 1965-70[a]	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77[b]
Consortium Countries[c]	207.9	566.9	573.2	330.5	82.5	27.6	32.4	55.5	82.2	53.3	106.4
Non-Consortium Countries[d]	7.7	11.2	66.1	50.4	0.2	-	-	-	-	-	-
Indus-Tarbela Devel. Fund[e]	-	-	465.9	321.9	12.6	33.9	16.4	13.3	11.6	14.7	24.0
Islamic Countries[f]	-	-	-	-	-	-	-	-	7.2	30.5	40.0
Total	215.6	578.2	1,105.2	702.9	95.3	61.5	48.8	68.8	101.0	98.5	170.4

[a]Pre-1971 figures refer to both wings of Pakistan, including present Bangladesh.

[b]Partial projection based upon figures to March 1977.

[c]Includes Canada, Germany (BRD), Japan, Netherlands, New Zealand, Norway, Sweden, Switzerland, U.K. and U.S.A. Also included are the following agencies: U.N., Ford Foundation, FAC, EEC.

[d]Australia and Taiwan.

[e]Australia, Canada, Germany (BRD), India, New Zealand, U.K., U.S.A.

[f]Iran and Saudi Arabia.

Source: GOP. 1977.

Appendix III

Acronyms Used in this Report

Appendix III. Acronyms Used in this Report

ADB: Asian Development Bank

AID: Agency for International Development

APTC: Agricultural Pesticides Technical Advisory Committee (Pakistan)

AWSP: Accelerated Waterlogging and Salinity Programme (Pakistan)

BRD: Bundesrepublik Deutschland (Federal Republic of Germany)

CSIR: Council of Scientific and Industrial Research (Pakistan)

DDVP: Dichlorvos

DFO: Divisional Forest Office

ECAFE: Economic Commission for Asia and the Far East (U.N.)

EEC: European Economic Community (Common Market)

EMASAR: Ecological Management of Arid and Semi-Arid Rangelands (U.N.)

ESCAP: Economic and Social Commission for Asia and the Pacific (U.N.)

FAC: Aid and Cooperation Fund (France)

FAO: Food and Agriculture Organization (U.N.)

FWS: Fish and Wildlife Service (U.S.)

GDP: Gross Domestic Product

GNP: Gross National Product

GOP: Government of Pakistan

IAEA: International Atomic Energy Agency (U.N.)

IBP: Indus Basin Project (Pakistan)

IBRD: International Bank for Reconstruction and Development, or World Bank

ICRP: International Commission on Radiological Protection (U.N.)

IDA: International Development Association (Branch of IBRD)

IDFCRC: Irrigation, Drainage and Flood Control Research Council (Pakistan)

Appendix III. Continued.

ITDF: Indus-Tarbela Development Fund

IUCN: International Union for Conservation of Nature and Natural Resources

KANUPP: Karachi Nuclear Power Project

KESC: Karachi Electric Supply Corporation

MAB: Man and the Biosphere (U.N., or Pakistan Committee for)

NCCW: National Council for Conservation of Wildlife (Pakistan)

NESA: Near East-South Asia Association

NFDB: National Fisheries Development Board (Pakistan)

NSLD: Nuclear Safety and Licensing Division (Pakistan)

NWFP: North West Frontier Province

OGDC: Oil and Gas Development Corporation (Pakistan)

PAEC: Pakistan Atomic Energy Commission

PARCO: Pak-Arab Refining Company

PCB: Polychlorinated Biphenyls

PFI: Pakistan Forest Institute

PIDC: Pakistan Industrial Development Corporation

SCARP: Salinity Control and Reclamation Project (Pakistan)

UNDP: United Nations Development Program

UNEP: United Nations Environment Program

UNESCO: United Nations Educational Scientific and Cultural Organization

WAPDA: Water and Power Development Authority (Pakistan)

WFP: World Food Program (U.N.)

WHO: World Health Organization (U.N.)

WWF: World Wildlife Fund

Appendix IV

Environmental Legislation

Appendix IV. Table of Contents

Table 1. Land Use Legislation
Table 2. Legislation regarding Energy and Soils
Table 3. Water Legislation
Table 4. Legislation regarding Vegetation
Table 5. Legislation regarding Wildlife
Table 6. Noise Legislation

Table 1. Land Use Legislation

1. The Easements Act (No. V), 1882. Law of Easements and Licenses.
2. Transfer of Property Act, 1882.
3. The Land Acquisition Act, 1894.
4. Government Grants Act (No. XV), 1895.
5. Punjab Tenancy Act (XVII), 1887.
6. Government Tenants (Punjab) Act, 1893.
7. The Punjab Land Preservation Act (No. II), 1900.
8. The Colonization of Government Lands (Punjab) Act, (No. V), 1912.
9. The N.W.F. Tenancy Act, (No. XXV), 1950.
10. The Punjab Betterment Charges and Acreage Rates Act, 1952.
11. West Pakistan Land Reform Rules, 1959.
12. West Pakistan Land Reforms Regulation, 1959, M.L.R. No. 64.
13. Consolidation of Holdings Ordinance (No. VI), 1960.
14. West Pakistan Land Reforms (Ejectment of Tenants to Provide for Buildings) Rules, 1961.
15. Grant of Land (Gudu Barrage Area) Rules, 1964.
16. Land Revenue Act, 1967; Rules, 1968; Assessment Rules, 1968.
17. Pat Feeder Canal (Control and prevention of alienation of land) Ordinance (No. IX), 1967.
18. West Pakistan Land Revenue (Conferment of Rights of Ownership) Rules, 1969.
19. Land Reforms Regulation, 1972 (Repeals 1959 Regulation).
20. Sind Land Reforms Rules, 1972.
21. Land Reforms Regulation Sind (Amendment) Act, 1972.
22. Land Reforms Regulation Sind (Second Amendment) Act, 1972.
23. The Punjab Land Reforms Rules, 1972.
24. Punjab Land Reforms Rules, 1972 (Amendments).
25. Land Reforms (Amendment) Act, 1973.
26. Land Reforms (Punjab Amendment) Act, 1973.
27. Land Reforms (Amendment) Act, 1974.
28. Procedure for Ejectment Suits Rules, 1974.
29. Land Reforms (Amendment) Act, 1975.
30. The Punjab Land Reforms Appointment of Managers of Impartible Joint Holdings Rules, 1975.
31. Board of Revenue Instructions about Colonization Operation. (Standing Order No. 67 date uncertain).

Sources: Johnson and Johnson. 1977.
M. Z. Khan. 1977.
Mian. 1976.

Table 2. Legislation regarding Energy and Soils

The Electricity Act (IX), 1910
Soil Reclamation Act, (No. XXI), 1952, (Amended by Ordinances, 1964, 1965, and amended and extended by Ordinance (No. V), 1964).

Sources: C. H. Ahmad. 1975.
Johnson and Johnson. 1977.

Table 3. Water Legislation

1. The Canal and Drainage Act (No. VIII) 1873. There are several similar and related acts; ordinances, amendments (1952, 1965, 1968, 1970).
2. The Sind Irrigation Act, 1879 (Amendment Ordinances, 1961, 1969).
3. Criminal Procedures Code (Act V), 1898. Sections 324 and 430.
4. The Punjab Minor Canals Act (No. VII) 1905.
5. The Inter-State Water Dispute Act, (No. 33) 1956.
6. The West Pakistan Water and Power Development Authority Act, 1958. (Similar Ordinance and Amendment Ordinances; 1958, 1964, 1967).
7. Determination of Land Revenue and Water Rate Ordinance, (No. IV), 1959, (Amended 1961).
8. The Indus Water Treaty, 1960.
9. The West Pakistan Land and Water Development Board (Authority for payment from Board Fund) Rules, 1966; Reclamation (Fee) Rules, 1965.
10. The Greater Lahore Water Supply Sewerage and Drainage. Ordinances, 1967.
11. Notification (No. 5174-68/155-CRI) National Calamities (Prevention and Relief) Rules, 1969. Extensive provisions especially in respect of flood control.
12. Ordinance (No. IV), 1969. The Kabul River Project (Control and Prevention of Speculation in Land) (Amendment) Ordinance, 1969. Further amends the Kabul River Project (Control and Prevention of Speculation in Land) Act, 1948.

Sources: Johnson and Johnson. 1977.
Major Acts. 1976.

Table 4. Legislation regarding Vegetation

1. Forest Act, (No. XVI) 1927. The Forest Act (Several Notifications fall under this heading). Protection, regulation of exploitation; includes protected forests.
2. The West Pakistan Goats (Restriction) Ordinance (XLII), 1959.
3. West Pakistan Goats Restriction Rules, 1961.

Sources: C. H. Ahmad. 1975.
Johnson and Johnson. 1977.

Table 5. Legislation regarding Wildlife

1. Wild Birds and Animals Protection Act, 1912.
2. Rules for the Prohibition and Regulation of Fishing Burboster, Labeo Rohita, Catlcatla, Cirrhina and Mirgala less than 10 inches in length. (No 2989/54-6541-D (f), 1954.
3. The Punjab Wild Birds and Wild Animals Protection Act (No. XIII), 1955. Punjab Wildlife (Protection, Preservation, Conservation and Management) Ordinance, (No. XXI), 1972; specifically related Rules, 1973.
4. Food and Agricultural Department (No. IV/(5) 17-SOA-VII-F and A/58). Rules for the Protection of Fish in the Waters of the Shikapur District. (Preceded by a Provisional Constitution Order , 1957).
5. The Goats (Restriction) Ordinance, (No. XLII), 1959. Restricts the number of goats.
6. West Pakistan Wildlife Protection Ordinance, 1959.
7. Wild Life Protection Rules, 1960. Regulates hunting. (Various licence forms attached.) Wild Life Protection Ordinance (No. LVI) 1959.
8. Fisheries Rules, (No. 4(107)S.O. (F and C)), 1964. Licences, etc.
9. The Sind Wildlife Protection Ordinance.
10. Baluchistan Wildlife Protection Act (No. XIX), 1974.
11. NWFP Wild-life (Protection, Preservation, Conservation and Management) Act (No. V), 1975.

Sources: Baluchistan Gazette. 1974.
Johnson and Johnson. 1977.
NWFP Gazette. 1975.

Table 6. Noise Legislation

The West Pakistan Regulation and Control of Loudspeakers and Sound Amplifiers Ordinance (II), 1965.

Source: C. H. Ahmad. 1975.

Appendix V

Vegetative Community Surveys

Appendix V. Table of Contents

Table 1. Vegetative Species in Forests

Table 2. Vegetative Species in Rangelands

Table 1. Vegetative Species in Forests

		Name of Species		
		Local	English	Botanical
1. Natural Conifer Forests				
a. Fir Type, 11,000 to 7,500 feet; moist, temperate				
Dominant	1.	Paludar	Fir	*Abies webbiana*
	2.	Kachal	Spruce	*Picca smithiana*
Associated	1.	Dayar	Deodar	*Cedrus deodara*
	2.	Kail	Blue Pine	*Pinus wallichiana*
	3.	Bhuj Patra	Birch	*Betula utilis*
	4.	Banjar	Oak	*Quercus semecarpitalia*
	5.	Tarkan	Maple	*Acer caesium*
	6.	Kain	Elm	*Ulmus wallichiana*
b. Pine Type, 7,500 to 4,000 feet; moist, temperate				
Dominant	1.	Kail	Blue Pine	*Pinus wallichiana*
	2.	Chil	Chir Pine	*Pinus roxburghii*
Associated	1.	Akhrot	Walnut	*Juglans regia*
	2.	Sufaida	Poplar	*Populus cilieta*
	3.	Rin	Oak	*Quercus incana*
	4.	Barungi	Oak	*Quercus delitata*
	5.	Tarkan	Maple	*Acer caesium*
	6.	Kalakot	Cherry	*Prunus padus*
	7.	Bankhor	Chestnut	*Aesculus indica*
	8.	Batangi	Wild pear	*Pyrus pashia*
c. Juniper Type, 10,000 to 6,000 feet; dry, temperate				
Dominant	1.	Juniper	Juniper	*Juniperus macropoda*
Associated	1.	Necza	Nut Pine	*Pinus gerardiana*
	2.	Pista	Pistacia	*Pistacia khinjak*
	3.	Hanus	Ash	*Fraxinus xanthoxyloides*
	4.	Ephedra	Ephedra	*Ephedra gerardiana*

Table 1 (continued)

		Name of Species		
		Local	English	Botanical
2. Natural Hardwood Forests				
a. Riverain Forests				
Dominant	1.	Babul	Acacia	*Acacia arabica*
	2.	Jand	Prosopis	*Prosopis spicigera*
	3.	Bhan	Poplar	*Populus euphratica*
Associated	1.	Pilchi	Tamarix	*Tamarix dioica*
	2.	Farash	Tamarix	*Tamarix articulata*
	3.	Kana	Cane	*Saccharum spp.*
b. Coastal Mangrove Type				
Dominant	1.	Tiwar	Avicennia	*Avicennia officinalis*
Associated	1.	Chauri	Ceriops	*Ceriops candolleana*
3. Artificial Hardwood Forests				
a. Irrigated Plantation, Plains areas				
Dominant	1.	Tali	Shisham	*Dalbergia sissoo*
	2.	Tut	Mulberry	*Morus alba*
Associated	1.	Bakain	Melia	*Melia azedarach*
	2.	Semal	Kapok	*Samalia malabarica*
	3.	Babul	Acacia	*Acacia arabica*
	4.	Sufeda	Eucalyptus	*Eucalyptus* spp.
	5.	Kala Shirin	Black siris	*Albizzia lebbeck*
	6.	Chitta Shirin	White siris	*Albizzia procera*
b. Canalside and Roadside Plantations				
Dominant	1.	Tali	Shisham	*Dalbergia sissoo*
	2.	Babul	Acacia	*Acacia arabica*
	3.	Semal	Kapok	*Salmalia malabarica*
	4.	Kala Shirin	Albizzia	*Albizzia lebbeck*
4. Shrub Forest				
a. Hill Schrub Forest				
Dominant	1.	Zaitun	Olive	*Olea cuspidata*
	2.	Phulai	Acacia	*Acacia modesta*

Table 1 (continued)

		Name of Species		
		Local	English	Botanical
	Associated	1. Ber	Jujube	*Zizyphus jujuba*
		2. Meskeet	Mesquite	*Prosopis juliflora*
		3. Sanatha	Dodonia	*Dodonia viscosa*
		4. Garna	Garanda	*Carissa spinarum*
b.	Inland Shrub Forest			
	Dominant	1. Pilu	Salvadora	*Salvadora oleoides*
		2. Farash	Tamarix	*Tamarix articulata*
		3. Jand	Prosopis	*Prosopis spicigera*
	Associated	1. Meskeet	Mesquite	*Prosopis juliflora*
		2. Karir	Capparis	*Capparis aphylla*

Source: Zehngraff. 1967.

Table 2. Vegetative Species in Rangelands (exclusive of species listed in Table 1)

a. Tropical maritime

Cenchrus setigerus
Cenchrus ciliaris
Commiphora mukul
Cymbopogon jwarancusa
Eleusine flagellifera
Elyonurus hirsutus
Euphorbia caudicifolia
Dactiloctenium scindicum
Panicum turgidum

b. Tropical plains (non-sandy)

Dicanthium annulatum
Dismostachya bipinnata

Most of the species of a. above except C. *mukul*, and *E. caudicifolia*.

c. Tropical plains (sandy)

Aerva persica
Aerva tomentosa
Aristida depressa
Calligonum polygonoides
Elyonurus hirsutus
Haloxylon salicornicum
Heliotropium tuberculosum
Ipomea pes-caprae
Panicum turgidum
Pennisetum dichotomum
Salsola foetida
Sericostoma pauciflorum
Suaeda fruticosa

d. Tropical submontane

Acacia modesta
Adhatoda vasica
Aristida spp.
Bothriochloa pertusa
Bothriochloa spp.
Capparis aphylla

Table 2 (continued)

d. Tropical submontane (continued)

Cenchrus ciliaris
Chrysopogon aucheri
Chrysopogan montanus
Cymbopogon jwarancusa
Cymbopogon shoenanthus
Cynodon dactylon
Desmostachya bipinnata
Dicanthium annualatum
Digitaria spp.
Dodonea viscosa
Eleusine flagellifera
Elyonurus hirsutus
Eulaliopsis binata
Gymnosporia royaleana
Haloxylon ammodendron
Haloxylon salicornicum
Heteropogon contortus
Olea cuspidata
Otostegia limbata
Panicum antidotale
Pennisetum orientale
Rhyza stricta
Sageretia theezan
Tetrapogon villosus
Themeda anathera
Zizphys spp.

e. Mediterranean

Acantholimon spp.
Artemisia maritima
Artemisia sacrorum
Caragana spp.
Causina spp.
Chrysopogon aucheri
Cymbopogon shoenanthus
Ebenus stellatus
Ephedra spp.
Fraxinus xanthoxylo ides
Haloxylon griffithii
Juniperus macropod
Lactuca spp.
Pinus gerardiana
Pinus wallichiana

Table 2 (continued)

e. <u>Mediterranean</u> (cont.)

Agropyron spp.
Bromus spp.
Erymopyron spp.
Koeleria crisata
Lolium spp.
Oryzopis aequiglumis
Pennisetum orientale
Poa bulbosa
Poa sinaica
Rotobellia spp.
Stipa pinnata

Source: C.M.A. Khan. 1974.

Appendix VI

Wildlife Information

Appendix VI. Table of Contents

Table 1. Animals which may be Hunted on an Ordinary Game Hunting License
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Table 1. Animals which may be Hunted on an Ordinary Game Hunting License

Taxon	Common Names	Season
ANATIDAE		Oct.1-Mar.1
Dendrocygna javancia	lesser whistling teal, silahli	
Dendrocygna bicolor	large whistling teal, bara silahli chuka	
Tadorna ferruginea	ruddy shelduck, brahminy duck, surkhab, chakwa lal surkhab	
Tadorna tadorna	common shelduck, safro chakwa safed surkhab	
Anas acuta	pintail, sanh, sikhpar, digosh	
Anas crecca	common teal, keraputari, suchuruka, huraro	
Anas formosa	baikal teal, keraputari, suchuruka, barkani	
Anas platyrhynchos	mallard, chaka, nilsir, nilrugi	
Anas strepera	gadwall, mila, bhur, beykur	
Anas falcata	falcated teal, chotiya, wano hurwa	
Anas penolope	wigeon, peasan, partarui, lal sir	
Anas querquedula	garganey, chai putari	
Anas clypeata	shoveler, tidari, punana, tarakwala, ghira	
Netta rufina	red-crested pochard, lalsir	
Aythya forina	common pochard, burarna, thurhandao	
Aythya nyroca	white-eyed pochard, karachiya, burar mada, lalbigri budha	
Aytha baeri	Baer's pochard	
Aytha fuligula	tufted duck, dubaru, ablak bohwara	
Aythya marila	scaup	
Clangula hyemalis	old squaw, longtail duck	
Bucephalus clangula	goldeneye duck, kumbaro	
Mergus albellus	smew, dayali, jhalli	
Mergus merganser	goosander	
Mergus serrator	red-breasted merganser	
PHASIANIDAE		
Lerwa lerwa	snow partridge, titlue dhedu parahut	Nov. 1-Mar. 1
Ammoperdix griseogularis	seesee partridge, kuckie chauklau, siai	Nov. 1-Mar. 1
Tetraogallus himalayensia	snow cock, golind, lip, lipya	Nov. 1-Mar. 1
Alectoris graeca	chukor, chukra, khonk, charu, zarkar	Wednesday, Sundays and gazetted holidays from Nov. 1-Mar. 1

Table 1. Continued

Taxon	Common Names	Season
Francolinus francolinus asiae	black partridge, kala titar, tetra, karo titra, kais titar	As above
Francolinus pondicerianus	gray partridge, titar, kyan khyr, kaijah, bhura titar	As above
Francolinus gularis	swamp partridge, gul titar, bheel titar	As above
Coturnix coturnix	common quail, bater, kurrak bhatri	Nov. 1-Mar. 1
Coturnix coromandelica	rain quail, baster	
Coturnix chinensis	blue-breasted quail, gurru	
Perdicula argoondah	rock bush quail, lowwa	
Perdicula asiatica	jungle bush quail, lowwa	
Turnix sylvatica	little bustard quail, badkhi, chota bater	
Turnix tanki	button quail, bater, lowwa	
Turnix suscitator	common bustard quail, gulu	
Arborophila rufogularis	rufousthreated hill partridge, dau bui	Wednesday, Sundays, and gazetted holidays from Nov. 1-Mar. 1
Arborophila atrogularis	white checked hill partridge, peura, san batai	as above
Gallus gallus	red jungle fowl, jungli murghi	as above
OTIDIDAE		
Chlamydotis undulata	houbara bustard, tiloor, khermor, kar wanak	as above
CHARADRIIDAE		
Vanellus leucurus	white-tailed lapwing	Nov. 1-Mar. 1
Vanellus vanellus	lapwing, rodhur, sabaz titti	
Vanellus cineneus	gray-headed lapwing	
Vanellus indicus	red-wattled lapwing, tita, titeri, tetechar	
Vanellus spinosus	superwinged lapwing	
Vanellus malabaricus	yellow-wattled lapwing, zirdi, jithiri	
Pluvialis apricaria	golden plover, chota battan	
Pluvialis dominica	eastern golden plover, sona batan	
Numenius phaeopus	whimbrel, chota, goungh, chota golinda	Nov. 1-Mar. 1
Numenius arquata	curlow, goar, goungh, choppa, sada	
Capella momoricola	wood snipe, chaha, sumkikri, julkikri	
Capella gallinago	fantail snipe, pakhi, jalakri	
Capella solitaria	solitary snipe, ban chaha	
Capella stenura	pintail snipe, pakhi, jalakri, kadakhocha	
Capella minima	jack snipe, chota chaha, asraf pak	
Capella media	great snipe, dum pakhi	
Rostratula benghalensis	painted snipe, rajchaha, baggargi	

Table 1. Continued

Taxon	Common Names	Season
BURHINIDAE		
Burhinus oedicnemus	stone curlew lambi, kerakwanak, basirl	Nov. 1-Mar. 1
Esacus magnirostris	great stone plover	
PTERICLIDIDAE		
Syrrhaptes tibetanus	Tibetan sandgrouse, nok kaling, kung	
Pterocles exustus	Indian sandgrouse, bhattitar	
Pterocles senegllus	spotted sandgrouse	
Pterocles orientalis	imperial sandgrouse, bhattitar gero bakht, bakh	
Pterocles coronatus	coronetted sandgrouse, bhatta, bal	
Pterocles indicus	close-barred or painted sandgrouse, harisia, sina, dukru.	
COLUMBIDAE		
All species of Pigeons, green pigeons and doves other than members of the genus *Ducula* (imperial pigeons) which are protected		
RALLIDAE		
Amauronis phoenicurus	white breasted moorhen dawk, pampaira, kuraki	Nov. 1-Mar. 1
Gallinula chloropus	moorhen, jal murghi	
Porphyrio porphyrio	purple moorhen, kaim, kulang, cajro	
Fulica atra	coot, khushkal, dasari, kanramdab	
MAMMALS		
Lepus capensis	cape hare, khargosh	all year round
Lepus nigricolis	Indian hare, khargosh	
Lepus arabicus	Arabian hare, khargosh	

Source: GOP. 1971

Table 2. Animals for the Hunting of which a Special Permit is Required

Taxon	Common Names	Season	Localities
Martes foina	beech or stone marten	Nov 1-Mar. 1	Wherever found except in national parks, wildlife sanctuaries or game reserves.
Selanarctos thibetanus	black bear (all races except *S. gedrosianus* which is protected) rich bhalu	July 1-Dec. 1	In areas to the north and east of the Kabul River that the Chief Wildlife Warden may from time to time specify.
Felis libyca	desert cat, jhang meno	Nov. 1-Mar. 1	Wherever found except in national parks, wildlife sanctuaries or game reserves.
Felis chaus	jungle cat, ban bilar, khatas	As above	As above.
Nemorhaedus goral	goral, pij, pijur, bai bom	As above	In such areas as the Chief Wildlife Warden may from time to time specify.
Capra ibex	ibex, sakin, danmo, tangrol	Nov. 1-1 Mar	As above.
Capra hircus	sind wild goat, sarah, phasin	As above	As above.
Capra falconeri	markhor (all races except the straight horned races *C.f. jerdoni and C. f. chialtanensis* which are protected) markhor	As above	As above.
Ovis orientalis	urial (all races except *O. o. punjabiensis*) which is protected, urial shpu, shah kohi, koch	As above	As above.

Source: GOP. 1971.

Table 3. Animals for which a Certificate of Lawful Possession is Required

1. Any live protected animal or game animal.

2. Any trophy or meat derived from a protected animal.

3. The horns of goral, ibex, Sind wild goat, markhor and urial.

4. The skins of beech or stone marten, jungle cat and desert cat.

Source: GOP. 1971.

Table 4. Animals which may not be Hunted, Killed or Captured

1. All game animals when immature or not fully grown.

2. All female game animals when:
   (a) pregnant;
   (b) in a condition that indicates they are suckling or feeding young;
   (c) accompanied by their immature offspring.

3. All females of the following species:

   Nemorhaedus goral (goral or piji, ban-bakri, gurrur, gudh, sar, pijur, rai, rom)
   Capra hircus (Sind wild goat or ter, sarah, pashin, pachin)
   Capra falconeri (all races--markhor or rawachi)
   Capra ibex (ibex or trangol, khail, dadmo, danmo)
   Ovis orientalis (all races--urial or shapu, hurian, shah kohi, koch, gad, garand)

4. All individuals of the following species, genera, families or groups of birds:

   All members of the family Ardeidae, i.e., all herons, night herons, paddy birds, egrets of bittorns
   All members of the family Pelecanidae, i.e., all pelicans
   All members of the family Ciconidae, i.e., all storks
   All members of the family Threskiornidae, i.e., all ibises, and spoonbills
   All members of the family Phoenicopteridae, i.e., all flamingos
   All members of the genera *Anser* and *Branta*, i.e., all geese, including the bar-headed goose

   The following species of ducks:

   Anas angustirostris (marbled teal or choi, lanjoh, dudjalri)
   Anas poecilorhyncha (spot-bill duck, or garmpai,gugral,hampur)
   Nettapus coromandelicus (cotton teal or giri, girria)
   Oxyura leucocephala (white-headed duck or stiff-tailed duck
   Cairina scutulata (white-winged, wood duck)
   Sarkidiornis melanotus (comb duck or nukhta)
   Rhodonossa caryphyllacea (pink headed duck)

   All members of the family Acciptridae, i.e., all hawks, vultures, kites, buzzards, hawk-eagles, eagles, harriers and ospreys

Table 4. Continued

All members of the family *Falconidae*, i.e. all falcons, kestrels, hobbies
All members of the family *Phasianidae*, i.e., all pheasants, partridges, quails, spurfowls, jungle fowls, and peafowls, other than these species specified in the First Schedule
All members of the family *Gruidae*, i.e., all cranes
All members of the genus *Heliopais*, i.e., all finfoots
All members of the family *Otididae*, i.e., all bustards other than the one species specified in the First Schedule
Scolopax rusticola (woodstock or simkukri, jalalkari,wilaiti chaha, bumpal, dhabba
Pterocles alchata (large pin-tailed sandgrouse)

All members of the genus *Ducula*, i.e., all imperial pigeons

5. All individuals of the following races, species, genera or groups of mammals:

Nycticebus coucang (slow loris or shamindi billi, lajja, lajjawoti, babar)
Macaca mulatta villosa (himalayan rhesus monkey, i.e., all rhesus monkeys found in Pakistan, bandar, punj, markat)
Macaca assemensis (assames macaque or bandar)
Macaca irus (crab-eating macaque)
Macaca speciosa (stump-tailed macaque)
Presbytis pileatus (capped langur)
Presbytis entellus (common langur or hanuman, dendoa)
Presbytis obscurus (dusky leaf monkey)
Hylobates hoolock (hoolock or white-browed gibbon, uluk)
Manis crassicaudata (pangolin or bajra kit, bajra, kapta, suraj mukhi, silu, kishaur, sibi, mirun, challa, kat pohu)
Vulpes cana (Blanford's fox)
Cuon alpinus (wild hog or dhole, rankun, ban kutta, bhoonsa)
Melursus ursinus (sloth bear, or bhalus, rinch)
Selenarctos thibetanus gedrosianus (baluchistan black bear (i.e. all black bears found south and West of the Kabul River kala rinch, bhalu, kaput, mam)
Ursus arctos (brown bear or red bear, barf ka rinch, safed bhal
Helarctos malayanus (sund bear or honey bear)
Martes flavigula (yellow-throated marten or tuturala, chitrala)
Vormela peregusna (marbled polecat)
Mellivora capensis (ratel or honey badger, beju, corpat, ghurna
Lutra lutra (common otter or ludher, ud-bilaw, pani kutta, sagi
Lutra perspicillata (smooth Indian otter or ludher,ludra,udni)
Aonyx cineria (oriental clawless otter or ludher)
Viverra zibetha (large Indian civet, kettas, mach bhondar, bagdos, pudu, gaula)
Viverricula indica (small Indian civet or naundero, gandogaula, kasturi)

Table 4. Continued

Paradoxurus hermaphroditus (common palm civet or toddy cat,kakati
Paguma larvata (civet of masked palm civet)
Arctictis binturong (binturong or bear cat)
Felis caracal (Caracal or Siya-gush, ech)
Felis manul (pallasis cat)
Felis Lynx (lynx or patsalan, phiauku)
Felis margarita (sand cat)
Felis bengalensis (leopard cat or chita billi, ban bilar)
Felis viverrina (fishing cat or mash billi, mach bagral)
Felis marmorata (marbled cat)
Felis temmincki (golden cat)
Neofelis nebulosa (clouded leopard or amchita, kung)
Panthera tigris (tiger or bagh, sher, char)
Panthera unica.(snow leopard or ounce, barhel he, lkar)
Panthera pardus.(leopard or panther, tendwa, chita, chita Bagh Suh)
Acinonyx jubatus (cheetah or laggar)
Caprolagus hispidus (hispid hare or Assam rabbit)
Calloscicurus pygerythrus (hoary-bellied Himalayan squirrel)
Elephas maximus (elephant or hathi, gaja)
Equus hemionus (wild ass or ghor khar, ghuran, kiang)

All members of the genera *Rhinoceros* or *Didemoseros* i.e. all rhinoceros, gainda, gagdan

Moschus moschiferus (musk deer or kastura, musch, bina,biiri)
Muntiacus muntjak (barking deer or muntjac, kakar, maya)
Axis axis (spotted deer or chitral, chitra, jhank, pagal, hiran, boro, khetiya)
Axis porcinus (hog deer or para)
Cervus unicolor (sambar)
Cervus duvauceli (swamp deer or barasingha, maha)
Cervus elaphus (kashmir stag or barasingha, hangal, honglu)
Bos gaurus (gaur or bison,solni (incl. the feral hybird B.g *frontalis* or Mithan, gayal)
Bos Banteng (banteng of tsaine)
Gazella subgutterosa (goitred or Persian gazella, pharal ghazal)
Boselaphus tragocamelus(bluebull or nilgai, gond,bain,ranjb,roz)
Tetracerus quadricornis (four-horned antelope or chowsingha)
Capricornis sumatraensis
Hemitragus jemlahicus (tahr or kras, jagla, tehr)
Capra faloneri jerdeni and *C.f. chialtanensis* (straight horned races of markhor(i.e. all markhor found to the south and west of the north Waziristan Agency) sarah,pachin,buzkuhi)
Pseudois nayaur(blue sheep or bharal, na, sna, maitu ghard warr)
Ovis ammon (both the race *O. a. Poli* (Marco Polo sheep or kuchan, roosh) and the race *O. o. hodgsoni* (great Tibetan sheep or nayan)
Gazella gazella (Indian gazelle or chinkara, kal-punch, gora hiran, chitka hiran, chiatica, abu, ast, phaskela, area gambat, gajar onashkai)

Table 4. Continued

Ovis orientalis punjabensis (Punjab urial, i.e. all urial found on the west bank of the river Indus below its junction with the River Kabul) Hurian, Shah Kohi, Koch, Kar Gad)
Sus salvanius (pygmy hog)
Platanista gangetica-(river dolphin or sus, susu, susuk, bhulan, sunsar)

6. The following reptiles:

Crocodilus palustris (marsh crocodile or mugger, magarmach)
Crocodilus porosus (estuarine crocodile or mugger)
Gavialis gangeticus (gharial, or soondy mugger, sansar)
All snakes of the genus *Python*, i.e. all pythons, azdha, or arar
All lizards of the genus varanus, i.e. all monitor lizards, goah bari chapkali ram gaddi, suna gaddi or kala gaddi
All marine turtles of the genera *Dermochelys, Chelone, Caretta and Eretomochelys, i.e.* all leatherback, green or edible, hawksbill, loggerhead and tortoise shell turtles.

Source: GOP. 1971.

Table 5. Annual Quota of Exportable Faunal Species

Taxon and Common Name	Season	Annual Export Quota
MAMMALS		
Rhesus macaque *(Macaca mulatta)*	April - Nov.	200 a.
Striped hyena *(Hyaena hyaena)*	May - Aug.	50
Common mongoose *(Herpestes edwardsi)*	Sept. - Dec.	100
Five striped palm squirrel *(Funambulus pennanti)*	April - July	2,000
Porcupine *(Hystrix indica)*	--	Any number
Jackal *(Canis aureus)*	--	Any number
Hedgehogs *(Hemiechinus* spp. *& Paraechinus* spp.*)*	Nov. - Feb.	300
Wildfield rats *(Tatera* spp. *Meriones* spp.*)*	--	Any number
BIRDS		
Black or king or eared vulture *(Torgos* spp.*)*	Dec. - April	50 b.
Indian griffon *(Gyps fulvus)*	Feb. - April	100 b.
Cinerous or hooded vulture *(Aegypius monachus)*	Feb. - May	200 b.
Saker or cherrug falcon *(Falco biamicus cherrug)*	April - July	200
Laggar falcon*(F. biarmicus jugger)*	Feb. - June	100 b.
Tawny eagle *(Aquila rapax vindhiana)*	Nov. - April	100 b.
Imperial eagle *(Aquila heliaca)*	Feb. - June	100 b.
Greater spotted eagle *(Aquila clanga)*	April - June	100 b.
Common quail *(Coturnix coturnix)*	April - June	5,000 b.
Pigeons (all sorts except blue rock *(Columba* spp.*)*	March - Oct.	1,000
Ring doves *(Streptopellia* sp.*)*	March - Oct.	1,000
Large Indian parakeet *(Psittacula eupatria)*	Dec. - April	5,000
Northern roseringed parakeet *(Psittacula krameria)*	Jan. - April	10,000
Indian myna *(Sturnus* sp.*)*	April - Aug.	400
Redvented bulbul *(Pycnonotus cafer)*	Feb. - June	1,000

Table 5. Continued

Taxon and Common Name	Season	Annual Export Quota
White eared bulbul *(Pycnonotus leucogenys)*	March - Sept.	1,000
Common weaver bird *(Ploceus philippinus)*	May - Sept.	2,000
White-throated munia *(Lonchura malabarica)*	Oct. - May	75,000
Red munia *(Estyilda amandava)*	Sept. - Jan.	260,000
Black-headed and red-headed bunting *(Emberiza melanocephala and Emberiza bruniceps)*	June - Aug.	6,000
Budgerigar *(Melopsittacus undulatus)*	Feb. - April	
(i) red-eyed (albino)		2,000
(ii) harlequin (telbino)		1,000
(iii) common (black-eyed)		8,000
Common turkey *(Meleagris gallopayo)*	--	5C
Domestic guinea fowl *(Numida meleagris)*	--	50
Gray pelican *(Pelecanus philippensis)*	Feb. - April	? b.
Egrets *(Egretta* spp.*)* and heron *(Ardea* spp.*)*	--	200 b.
REPTILES		
Freshwater turtles *(Kachuga smitti* & other spp.*)*	--	600
Python *(Python molurus)*	--	50 c.
Uromastix *Uromastix hardwicki)*	--	500
Sea snakes *(Hydrophis* & other spp.*)*	--	Any number

a. From NWFP & Azad Kashmir only
b. From NWFP & Baluchistan only
c. From Baluchistan only

Source: Siddiqui. 1974.

Table 6. Wildlife Species not Restricted for Export

Mammals

- Barking deer
- Gazelle (Indian gazelle and goitred gazelle)
- Goral
- Ibex (Siberian ibex and (Sind ibex)
- Urial (Balochi urial and Hazara urial)

Birds

- Buzzard and Vulture (except lame giere and golden eagle)
- Falcon
- Partridge
- Pelican
- Pheasant (except cheer pheasant)

Source: Qadri. 1974.

Table 7. Wildlife Development Programs

Note: More detailed information describing the programs below exists in NCCW (1977).

Title	Principal Investigator(s)	Budget
Foreign Training in Wildlife Managment and Conservation	NCCW	US$ 72,300
Education and Research in Wildlife Management	Pakistan Forest Institute	Rs. 3,400,000
Public Education in Environmental Conservation	NCCW	n.a.
Survey of Threatened Wildlife and their Habitats	A. Aleem, R. Masud, Z. Mirza, Z.B. Mirza	Rs. 590,000
Reintroduction of Blackbuck and Wild Ass in Kirthar and Lal Suhanra National Parks	Sind Wildlife Management Board and Punjab Wildlife Management Board	n.a.
Restoration of Gavial and March Crocodile in their Former Ranges of Occurrence in Pakistan	Government of Sind and Government of Punjab	Rs. 300,000
Restoration of Wetlands in Sind	Sind Wildlife Management Board	n.a.
Antipoaching in Punjab	Forestry and Wildlife Department, Government of Punjab	US$ 22,500
Antipoaching in NWFP	Chief Conservator of Forests, Govt. of NWFP	US$ 35,500
Antipoaching in Baluchistan	Div. Forest Officer for Wildlife, Baluchistan	Rs. 297,500
Antipoaching in Northern Areas	Conservator of Forests, Northern Areas; and Resident Commissioner, Northern Areas	US$ 15,100
Antipoaching, Propagation, Conservation, and Captive Breeding of Rare High-Altitude Pheasants in Azad Kashmir	Wildlife Warden, Forest Department, Azad Kashmir	Rs. 253,000
Restoration and Propagation of Wildlife in Pakistan Air Force Wildlife Reserve, Gilgit	Base Commander, Naltar, Gilgit	Rs. 312,500
Reintroduction and development of Wildlife in Marqalla Hills	Capital Development Authority, Islamabad	US$ 107,000

Source: NCCW. 1977

Appendix VII

MAB Projects in Pakistan

Table 1. Specific MAB Projects in Pakistan

Project	Specified Objectives
I. To 1977	
Modernization and improvement of agriculture in the Punjab basin area	1. Arrest rapid deterioration of resource base 2. Maximize high potential for growth
Increase and improve resource use and human welfare in the Northern Areas	1. Compile reference materials 2. Prepare maps of land hydrology 3. Identify opportunities for technology 4. Build infrastructure for science 5. Survey existing resources
Long-term stability and productivity of Indus basin	
Ecological studies of freshwater hypomycetes	1. Use as biological indicator of water pollution
Limnological survey of Rawal Lake, Islambad	1. Eventual introduction of commercial fishing
Impact of metropolitan expansion on the ecology of rural-urban fringe in Peshawar	1. Examine nature of ecological change 2. Guidance for future land reserve policies
Socio-demographic survey of Daudzai Integrated Rural Development Area	1. Creation of data bank for growth and development of area 2. Model for planning elsewhere in Pakistan
Problems of resource utilization in human settlement of Murree-Kahuta Region	
II. Post-1977	
Utilization and disposal of industrial wastes of Rawalpindi/Islamabad	1. Assess magnitude of industrial pollution 2. Find methods of recovering useful materials 3. Find ways of disposing of remaining waste
Utilization of sewage solid waste	
Atmospheric and water pollution studies for urban and industrial areas of Pakistan	1. Retrieval of solid sewage for industrial use
Pollution and aquatic organisms of Leh Stream in Rawalpindi	1. Study different kinds and degrees of pollution 2. Identify biological pollution indicators 3. Control water pollution by biological means

Appendix VII. cont.

III. Suggested projects

Preparation of a national resource atlas
Integrated resource survey of Baluchistan
Impact of heavy engineering works on ecosystems
Study of lake resources and ecosystems in Sind
Perception of environment in rural and urban Pakistan
Human migration from highlands to lowland cities of Pakistan
Monitoring and control of desertification in Pakistan

Source: Pakistan MAB. 1978.

Appendix VIII

Recent U.S. AID Programs of Environmental Significance

Appendix VIII. Table of Contents

Table 1. Project Descriptions (Source: U.S. AID 1980b)

a. Malaria Control
b. Water Management
c. Rural Development Programs

Table 2. Other Projects, by title (Source: U.S. AID 1980a)

Table 1 Project Descriptions

a. Malaria Control

PROJECT DESIGN INFORMATION

COUNTRY/BUREAU: PAKISTAN
PROJECT TITLE: MALARIA CONTROL

PROJECT: 3910139 SUB-PROJECT: 00
INITIAL FY: FINAL FY:

PROBLEM: EXISTING EFFORTS ARE UNSUCCESSFUL IN PREVENTIVE RESURGENCE OF MALARIA TO EPIDEMIC LEVELS. SOCIO-ECONOMIC DEVELOPMENT THREATENED BY ILLNESS AND SUBSEQUENT WORK ABSENTEEISM.

STRATEGY: LABOR INTENSIVE, LONG TERM, NEW AND EXISTING TECHNOLOGY, EXISTING INSTITUTIONS, DECENTRALIZED APPROACH.

SUMMARY: LOAN EXTENDED TO PAKISTAN TO SUPPORT 5 YR MALARIA CONTROL PROJECT REPLACING FORMER ERADICATION PROJECT WHICH FAILED THROUGH ORGANIZATIONAL & FUNDING DIFFICULTIES. NEW PROJECT SHIFTS ADMINISTRATION OF PROGRAM FROM NATL TO PROVINCIAL GOVTS & PROPOSES: 1.SPRAYING HOUSE INTERIORS & INFESTED AREAS 2.MASSSCREENING OF HOUSEHOLDS & BLOOD SLIDES FROM HOSP FEVER PATIENTS FOR MALARIAL SURVEILLANCE 3.TREATMENT OF KNOWN CASES 4.EPIDEMIOLOGICAL & ENTOMOLOGICAL RESEARCH 5.TRAINING MALARIA WORKERS ON PROGRAM MANAGEMENT & OBJECTIVES AND 6.EDUCATING PUBLIC TO CAUSES & PREVENTION OF MALARIA & ACTIVITIES OF CONTROL PROGRAM. OVERSEEN BY GOP DIRECTORATE OF MALARIA (DOM) & ADDITIONALLY FUNDED BY WHO & GOP. MALATH TOXIC MAJOR PROBLEM.

GOAL: IMPROVED PERSONAL WELL-BEING AND PRODUCTIVITY OF THE POPULACE. MALARIA PREVENTED FROM RESURGENCE WITH MINOR PUBLIC OUTLAY OF FUNDS.

PURPOSE: INCIDENCE OF MALARIA IS REDUCED TO A MINOR LEVEL IN RURAL AND URBAN AREAS.

OUTPUTS: 1.HOUSES SPRAYED 2.FOLLOW-UP VISITS MADE. 3.BLOOD TESTS TAKEN OF PATIENTS VISITING CLINICS, HOSPITALS, ETC. 4.MALARIA CASES TREATED.

PROJECT DESIGN INFORMATION

COUNTRY/BUREAU: PAKISTAN
PROJECT TITLE: MALARIA CONTROL

PROJECT: 3910163 SUB-PROJECT: 00
INITIAL FY: FINAL FY:

PROBLEM: IN THE FIVE YEARS FOLLOWING TERMINATION OF AN EFFECTIVE MALARIA ERADICATION PROGRAM,INCIDENCE OF THIS DISEASE IN PAKISTAN HAS ONCE AGAIN REACHED EPIDEMIC PROPORTIONS. A SHORTAGE OF INSECTICIDE,SPRAYING EQUIPMENT,AND WELL-TRAINED MALARIA EXTENSION PERSONNEL,HOWEVER,RESULTS IN THE GOP BEING UNABLE TO INITIATE CONTROL MEASURES TO ONCE AGAIN BRING DOWN MALARIA INCIDENCE TO AN ACCEPTABLE LEVEL.

STRATEGY: FIVE-YEAR PROJECT CONSISTS OF A LOAN AND GRANT PROVIDING TECHNICAL ADVISORY ASSISTANCE,INSECTICIDES,AND INSECTICIDE SPRAYING EQUIPMENT TO IMPLEMENT A MALARIA CONTROL PROGRAM. HOST COUNTRY PROVIDES OPERATIONAL PERSONNEL,OVERALL PROJECT ADMINISTRATION,TRAINING SERVICES,AND MEDICAL SUPPLIES. OTHER DONORS: WORLD HEALTH ORGANIZATION.

SUMMARY: LOAN & GRANT TO THE GOVT OF PAKISTAN WILL IMPLEMENT A MULTI-COMPONENT AND MULTI-DONOR(AID,GOP,WHO)MALARIA CONTROL PROGRAM. PROJ WILL CONSIST OF FOLLOWING ACTIVITIES: HOUSE SPRAYING,MALARIA SURVEILLANCE,TREATMENT OF DIAGNOSED CASES,PROGRAM EVALUATION,MALARIA RESEARCH,TRAINING,AND PUBLIC HEALTH EDUC. AID'S CONTRIBUTION WILL BE THE PROVISION OF PESTICIDES AND SPRAYERS AND AS-NEEDED TECHNICAL ASSISTANCE.
THE INTERIOR WALLS OF RURAL & VILLAGE HOMES WILL BE SPRAYED WITH A RESIDUAL TYPE INSECTICIDE ACCORDING TO SCHEDULES DEPENDENT UPON THE MALARIOGENIC POTENTIALS OF THE VARIOUS KNOWN MALARIA REGIONS. BOTH TOTAL("BLANKET")AND FOCAL SPRAYING TECHNIQUES WILL BE USED.
ACTIVE(ACD)AND PASSIVE CASE DETECTION(PCD)METHODS WILL BE EMPLOYED FOR MALARIA SURVEILLANCE. ACD OPERATION WILL COMPRISE HOUSE-TO-HOUSE VISITATION BY EXTENSIONISTS WHO WILL TAKE BLOOD SLIDES AND EXAMINE SUSPECTED MALARIA VICTIMS. POSITIVE CASES WILL BE REFERRED TO A MALARIA INSPECTOR FOR TREATMENT WITH CHLOROQUINIDE. MASS CHEMOPROPHYLAXIS MAY BE CONSIDERED FOR INFANTS & NURSING MOTHERS IN HIGH INCIDENCE AREAS; SUCH TREATMENT MAY ALSO BE EMPLOYED FOR ENTIRE POPULATIONS IN PARTICULARLY ENDEMIC AREAS. PCD ACTIVITY WILL SIMPLY CONSIST OF ENCOURAGING HOSPITALS & CLINICS TO REPORT WALK-IN MALARIA CASES TO PROJ PERSONNEL. THESE REPORTS ALONG WITH THE CASE REPORTS OF ACD PERSONNEL WILL BE USED NOT ONLY TO DIRECT SPRAYING EFFORTS BUT ALSO TO PROVIDE INPUT FOR A CONTINUOUS PROJ EVAL ACTIVITY. PROJ OFFICERS WILL MONITOR THE SUCCESS OF THE SPRAYING IN RELATION TO REDUCED DISEASE INCIDENCE. REGULAR EVALS OF PROJ LAB OPERATIONS WILL ALSO BE PERFORMED.
A SERIES OF STUDIES WILL BE CONDUCTED BY GOP'S DIRECTORATE OF MALARIA(DOM)ON INSECTICIDE SUSCEPTIBILITY,ALTERNATE METHODS FOR VECTOR CONTROL,EFFECTIVENESS OF ANTI-MALARIA DRUGS, ETC . CONTINUED WORK ON GENETIC METHODS OF VECTOR CONTROL WILL ALSO BE SUPPORTED.
TRNG ACTIVITIES PLANNED ARE AS FOLLOWS: 1)PRE-SRVC TRNG OF SUPERVISORY STAFF; 2)TRNG IN MALARIA ACTIVITIES & THEORY FOR PUB HLTH PERSNNL; 3)TRNG IN PREVENTIVE ASPECTS OF PUB HLTH FOR MALARIA WORKERS; 4)MALARIA EDUC PROGRAMS FOR PUBLIC. PP 9/77 IMPLEMENTS INCREASED SPRAYING SUPERVISION.

GOAL: THE HEALTH STATUS OF PAKISTAN'S POPULACE IS IMPROVED. I

PURPOSE: MALARIA DISEASE INCIDENCE RATE IN PAKISTAN REDUCED TO NO MORE THAN 500 PER ONE MILLION OF POPULATION. I

OUTPUTS: 1.HOUSES SPRAYED WITH RESIDUAL INSECTICIDE. 2.ACTIVE AND PASSIVE MALARIA CASE DETECTION PROGRAMS ESTABLISHED. 3.DIAGNOSED MALARIA CASES TREATED. 4.MALARIA PROGRAM CONTINUOUS EVALUATION SYSTEM ESTABLISHED. 5.MALARIA CONTROL METHODS RESEARCHED. 6.PUBLIC HEALTH PERSONNEL TRAINED IN MALARIA ACTIVITIES AND THEORY. 7.MALARIA WORKERS TRAINED IN PREVENTIVE ASPECTS OF PUBLIC HEALTH. 8.PUBLIC HEALTH EDUCATION PROGRAM INITIATED. I

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* PROJECT EVALUATION DOCUMENTATION *
* COUNTRY/BUREAU: PROJECT: *
* PROJECT TITLE: INITIAL FY: FINAL FY: *
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DOCUMENT TYPE: PROJECT APPRAISAL REPORT
DOCUMENT TITLE: MALARIA ERADICATION PROGRAM
AUTHOR(S):
CONTRACT:
PROJECT(S): 391013900

PUBLICATION DATE: 06/07/69
CALL NUMBER:
ORGANIZATION: USAID/PAKISTAN
OTHER ID: TCR-2/66
PUBLICATION NO:

ABSTRACT: EVALUATES PROJECT TO IMPLEMENT MALARIA ERADICATION PROGRAM IN PAKISTAN, AS OF 4/1/69. COOPERATIVE MALARIA ERADICATION PROGRAM (MEP) WAS UNDERTAKEN BY THE GOVERNMENT OF PAKISTAN, WORLD HEALTH ORGANIZATION, AND USAID. DATES SET FOR MALARIA ERADICATION IN WEST AND EAST PAKISTAN WERE 1974 AND 1975, RESPECTIVELY. US PUBLIC HEALTH SERVICE ADVISORS HAVE BEEN ASSIGNED SINCE 11/62. SIX FULL-TIME ADVISORS ARE PRESENTLY ON-BOARD. IN ADDITION, USAID HAS PROVIDED LOANS FOR US COMMODITIES AND LOCAL CURRENCY SUPPORT. THE MEP BEGAN IN SHEIKHUPURA AND DINAJPUR PROVINCES (3.2 MILLION COMBINED POPULATION) AND NOW COVERS THE ENTIRE NATION (112 MILLION). APPRAISALS OF THE MEP HAVE SHOWN THAT FOR EVERY RUPEE SPENT ON THE PROGRAM, TWO AND ONE-HALF ARE RETURNED THROUGH INCREASED FARM PRODUCTIVITY AND SAVINGS IN COSTS OF MEDICAL TREATMENT. PROVISION OF PL480 FUNDS LOCAL COSTS PREVENTED A FINANCIAL CRISIS WITHIN THE MEP. (LOCAL SURVEY SHORTAGES WERE BROUGHT ON BY THE INDO-PAKISTAN CONFLICT.) MALARIA TRANSMISSION IN URBAN AREAS OVER 20,000 WAS NOT ANTICIPATED. HOWEVER, EXCEPTIONALLY HIGH RAINFALL, A DEFECTIVE SEWER DRAINAGE SYSTEM, AND INADEQUATE SURVEILLANCE LED TO SERIOUS OUTBREAKS IN KARACHI. OTHER PROBLEMS INCLUDED INCREASED SALARY DEMANDS BY GOP EMPLOYEES, HIGH COST OF LOCALLY-PRODUCED DDT, AND THE GOP INSISTENCE THAT THE MEP PAY CUSTOMS DUTIES AND TAXES ON IMPORTED DDT. AID MADE PROGRAM ADMINISTRATION MORE DIFFICULT BY DIFFUSING RESPONSIBILITY AMONG THE HEALTH DIVISION, CAPITOL DEVELOPMENT OFFICES, AND THE US PUBLIC HEALTH SERVICES. DELAY IN PROVISION OF DDT, SPRAYERS, VEHICLES, AND PARTS RESULTED FROM AN UNWIELDY ADMINSTRATIVE PROCESS AND GOP UNWILLINGNESS TO STOCK SUPPLIES. THERE WAS NO CHIEF MALARIA ADVISOR FROM 1961-1963. IN ADDITION, MO'S ASSIGNED BY THE US NATIONAL CENTER FOR DISEASE CONTROL WERE NEITHER EXPERIENCED IN MALARIA CONTROL NOR ORIENTED TO LOCAL CONDITIONS. THEIR RECENT REPORT, "STUDY OF URBAN MALARIA IN KARACHI, WEST PAKISTAN" WAS UNSATISFACTORY AND CAUSED CONSIDERABLE ILL-FEELING IN THE GOP. MISSION HAS SCHEDULED A THOROUGH EVALUATION (EARLY 1970) TO DETERMINE THE POSSIBILITY OF ACHIEVING MALARIA ERADICATION BY 1975.

DOCUMENT TYPE: PROJECT APPRAISAL REPORT
DOCUMENT TITLE: STATISTICAL SERVICES
AUTHOR(S): LANDERS,FRANK M
CONTRACT:
PROJECT(S): 391003700

PUBLICATION DATE: 06/30/71
CALL NUMBER:
ORGANIZATION: USAID/PAKISTAN
OTHER ID:
PUBLICATION NO:

ABSTRACT: EVALUATES PROJECT TO DEVELOP RELIABLE AND TIMELY STATISTICS FOR IMPROVEMENT OF DECISION-MAKING IN PAKISTAN FROM 4/16/70 TO 6/30/71. US BUREAU OF THE CENSUS, WORKING ON PROJECT THROUGH PASA, IS JUDGED SATISFACTORY. PARTICIPANT TRAINING AND HOST COUNTRY COOPERATION ARE ALSO RATED SATISFACTORY. PROJECT ACCOMPLISHMENTS INCLUDE: 1)TRAINING OF 121 PARTICIPANTS IN US; 2)ESTABLISHMENT OF 5 MAJOR STATISTICAL UNITS; 3)INSTALLATION OF A COMPUTER IN 3 STATISTICAL UNITS; AND 4)ADDITION OF 26 TECHNICAL ADVISORS. ALSO,STATISTICAL SERIES HAVE BEEN ESTABLISHED CONCERNING PRICE, INDUSTRY, CONSTRUCTION, EXTERNAL TRADE, MANPOWER, GNP AND NNP. STATUS OF THE CENTRAL STATISTICAL OFFICE HAS BEEN RAISED, BUT NOT TO A DESIRABLE LEVEL; AND SUBSTANTIAL PROGRESS HAS BEEN MADE TOWARD INTRODUCTION OF PROBABILITY SAMPLING IN THE NATIONAL SAMPLE SURVEY, AGRICULTURAL CENSUS, AND OTHER AD-HOC SURVEYS.

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*                          PROJECT DESIGN INFORMATION                       *
*  COUNTRY/BUREAU: PAKISTAN                          PROJECT: 3910424  SUB-PROJECT: 00  *
*  PROJECT TITLE:  MALARIA CONTROL                   INITIAL FY: 78    FINAL FY:    81  *
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PROBLEM: MALARIA CONTROL WAS BEGUN IN PAKISTAN IN 1961 AND FUNCTIONED QUITE SUCCESSFULLY DURING ITS INITIAL YRS. HOWEVER,DUE TO A VARIETY OF TECHNICAL & MGMT DIFFICULTIES,THE DISEASE SHOWED A RESURGENCE BY 1969 AND BY 1974 REACHED 10 MILLION CASES. THE PRINCIPAL DIFFICULTIES HAVE INCLUDED PERSONNEL SHORTAGES,SUPPLY & MAINTENANCE PROBLEMS,VECTOR RESISTANCE TO DDT,AND THE LACK OF A PERMANENT HLTH INFRASTRUCTURE TO CONTINUE ERADICATION EFFORTS. THIS BREAKDOWN HAS RESULTED IN LOST PRODUCTION,HIGH HLTH CARE COSTS,AND OTHER MAJOR ECONOMIC LOSSES.

STRATEGY: FIVE-YR PROJECT CONSISTS OF A LOAN,TECHNICAL ASSISTANCE,AND EQUIPMENT TO IMPLEMENT A COUNTRY-WIDE MALARIA CONTROL PROGRAM IN PAKISTAN. IN ADDITION,A USAID GRANT WILL FINANCE 73% OF LOCAL CURRENCY COSTS. THE HOST COUNTRY WILL PROVIDE FINANCAL AND INSTITUTIONAL SUPPORT. THE WORLD HEALTH ORGANIZATION WILL ALSO PROVIDE TECHNICAL ASSISTANCE.

SUMMARY: LOAN,GRANT,TECH ASSISTANCE,AND EQUIPMENT ARE PROVIDED TO THE GOVT OF PAKISTAN TO IMPLEMENT A COUNTRY-WIDE MALARIA CONTROL PROG, WITH THE SPECIFIC OBJECTIVE OF REDUCING THE INCIDENCE OF ACTIVE PARASITES IN BLOOD SAMPLES TO 500 PER ONE MILLION OF POPULATION. THE PROG WILL INCLUDE FIVE BASIC COMPONENTS: 1)SPRAYING THE INTERIOR OF RURAL HOMES WITH RESIDUAL INSECTICIDES (DDT,MALATHION,BENEZENE HEXACHLORIDE-BHC), 2)CONTINUOUS SURVEILLANCE OF THE POPULATION AT RISK, 3)TREATMENT, 4)ASSISTANCE TO URBAN MALARIA CONTROL EFFORTS, AND 5)RESEARCH & PUBLIC HLTH EDUC.
THE FEDERAL DIRECTORATE OF MALARIA (DOM) WILL BE RESPONSIBLE FOR TECHNICAL AUDITING,INTER-PROVINCIAL COORDINATION WITH INTERNATNL AGENCIES,OVERALL EVALUATION,TRNG,AND RESEARCH. PROVINCIAL MALARIA ORGANIZATIONS WILL CARRY OUT THE ACTUAL SPRAYING & SURVEILLANCE ACTIVITIES. MALARIA SURVEILLANCE WILL INCLUDE ACTIVE CASE DETECTION IN WHICH RURAL HOUSE VISITORS MAKE MONTHLY INSPECTIONS,SEARCHING FOR FEVER CASES,TAKING BLOOD SLIDES,AND PROVIDING PRESUMPTIVE TREATMENT WITH ANTI-MALARIA TABLETS (CHLOROQUINE). A PASSIVE CASE DETECTION OPERATION WILL ALSO BE EMPLOYED CONSISTING OF BLOOD SLIDE COLLECTIONS AT HLTH CENTERS & HOSPITALS.
THE DOM WILL IMPLEMENT A RESEARCH PROG CONCENTRATING ON INSECTICIDE SUSCEPTIBILITY;VECTOR INVESTIGATION IN PROBLEM AREAS AND THE USE OF ALTERNATE METHODOLOGIES;THE SENSITIVITY OF P. FALCIPARUM (A PARASITE OF A VIRULENT TYPE OF MALARIA) TO ANTIMALARIA DRUGS;THE ROLE OF SECONDARY MALARIA VECTORS;AND THE IMPACT OF MALARIA ON ECONOMIC DEVELPMNT. MALARIA CONTROL THROUGH IMPROVED WATER MGMT,LARVICIDING,AND DRAINING & FILLING OF WATER SOURCES WILL ALSO BE INVESTIGATED. THE GOP WILL FINANCE IN-SERVICE REFRESHER TRNG & TRNG OF NEW MALARIA CONTROL PERSONNEL AT THE MALARIA ERADICATION TRNG CENTER IN LAHORE. ALSO,A HLTH EDUC PROG IS PLANNED WHICH WILL UTILIZE KEY OFFICIALS,UNIONS,AND COMMUNITY SOCIAL ORGANIZATIONS TO EDUCATE THE GENERAL PUBLIC CONCERNING THE CAUSES OF MALARIA & METHODS OF PREVENTION. IN ADDITION, THE WORLD HEALTH ORGANIZATION WILL GRANT-FUND FIVE MALARIA CONTROL SPECIALISTS.

GOAL: HEALTH AND ECONOMIC WELL-BEING OF THE PEOPLE PROMOTED IN PAKISTAN.

PURPOSE: THE INCIDENCE OF ACTIVE,MALARIA-BEARING PARASITES IN BLOOD SAMPLE REDUCE TO 500 CASES PER ONE MILLION OF POPULATION IN PAKISTAN.

OUTPUTS: I.COUNTRY-WIDE MALARIA CONTROL PROGRAM JOINTLY IMPLEMENTED BY THE FEDERAL DIRECTORATE OF MALARIA (DOM) & PROVINCIAL MALARIA CONTROL ORGANIZATIONS: A.THE INTERIOR OF RURAL HOMES SPRAYED WITH RESIDUAL INSECTICIDES (DDT,MALATHION,BENEZENE HEXACHLORIDE--BHC). B.POPULATION AT RISK PLACED UNDER CONTINUOUS SURVEILLANCE OF MALARIA CASES. C.MALARIA CASES TREATED. D. ASSISTANCE PROVIDED TO URBAN MALARIA CONTROL EFFORTS. E.MALARIA RESEARCH CONDUCTED AND THE GENERAL PUBLIC EDUCATED WITH REGARD TO THE CAUSES OF MALARIA AND METHODS OF CONTROL.

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*                       PROJECT EVALUATION DOCUMENTATION                    *
*  COUNTRY/BUREAU: PAKISTAN                          PROJECT: 3910424                  *
*  PROJECT TITLE:  MALARIA CONTROL                   INITIAL FY: 78    FINAL FY: 81    *
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DOCUMENT TYPE: PROJECT EVALUATION SUMMARY
DOCUMENT TITLE: PES OF MALARIA CONTROL PROGRAM (PAKISTAN)N
AUTHOR(S): STEFFEN,ALAN L
CONTRACT:
PROJECT(S): 391042400

PUBLICATION DATE: 04/07/78
CALL NUMBER:
ORGANIZATION: USAID/PAKISTAN
OTHER ID: USAID/PAKISTAN 391-78-2
PUBLICATION NO:

ABSTRACT: EVALUATES MALARIA CONTROL PROGRAM IN PAKISTAN FOR PERIOD 2/77 TO 2/78. PROGRAM IS AN INTENSIVE, NATION-WIDE ATTEMPT TO REDUCE MALARIA UNDERTAKEN BY GOVT OF PAKISTAN (GOP) WITH THE HELP OF AID AND THE WORLD HEALTH ORGANIZATION. PRESENT YEARLY EVALUATION WAS CARRIED OUT IN ACCORDANCE WITH THE PP WITH RESPECT TO TIMING, SCOPE, STUDY DESIGN AND METHODOLOGY. THE PRIMARY DATA FOR THE EVALUATION WAS COLLECTED AT THE FIELD AND NATIONAL LEVELS BY AN OUTSIDE TEAM OF EXPERTS FROM THE ABOVE ORGANIZATIONS AND THE FINDINGS WERE PRESENTED OFFICIALLY TO THE GOP FOR THE NECESSARY ACTION. THE TEAM MEMBERS REMAINED IN PAKISTAN TO REVIEW THEIR FINDINGS WITH GOP OFFICIALS RESPONSIBLE FOR IMPLEMENTING THE RECOMMENDATIONS.
IN SPITE OF A NUMBER OF SERIOUS PROBLEMS SUCH AS INSECTICIDE TOXICITY IN 1976 LEADING TO THE DEATH OF SEVERAL MALARIA WORKERS, THE LATE ARRIVAL OF COMMODITIES AND A LACK OF TRAINED PERSONNEL IN TECHNICAL AND ADMINISTRATIVE POSITIONS IN THE PROGRAM, THE MALARIA PROGRAM HAS MADE PROGRESS IN REDUCING THE INCIDENCE OF MALARIA. IT IS STILL NOT CERTAIN WHETHER OR NOT THE PROJECTED GOAL OF 500 CASES PER 1 MILLION POPULATION WILL BE REACHED BY THE END OF THE PROJECT. CASES ARE GOING DOWN, HOWEVER, AND THE EFFECTIVENESS OF THE PROVINCIAL MALARIA OFFICIALS TO DEAL WITH FUTURE OUTBREAKS OR OTHER PROBLEMS HAS GREATLY IMPROVED.
THE FOLLOWING ACTION DECISIONS WERE REACHED: 1. MALARIA TRAINING FOR HEALTH SECTOR EMPLOYEES PRESENTLY ASSIGNED TO MALARIA DUTIES AS A RESULT OF THE INTEGRATION AND RETRAINING OF MALARIA WORKERS NEEDS TO BE EXPANDED. 2. EPIDEMIOLOGICAL AND ENTOMOLOGICAL DATA COLLECTION AND EVALUATION NEED TO BE IMPROVED. 3. SAFETY MEASURES FOR USE OF INSECTICIDES MUST BE CONTINUED AND IMPROVED. 4. RESEARCH ON MALARIA-RELATED PROBLEMS SHOULD BE INCREASED AND STRENGTHENED. 5. CLOSE COORDINATION SHOULD BE DEVELOPED BETWEEN THE DIRECTORATE OF MALARIA, PROVINCIAL MALARIA, AND HEALTH OFFICIALS. COORDINATION IS ALSO REQUIRED WITH URBAN OFFICIALS WHERE URBAN MALARIA PROGRAMS ARE PLANNED. MUNDALE RUPEE GRANT PROPOSAL WILL BE PREPARED FOR RESEARCH.

DOCUMENT TYPE: PROJECT EVALUATION SUMMARY
DOCUMENT TITLE: MALARIA CONTROL
AUTHOR(S): MARTIN, J
STEFFEN, A L
CONTRACT:
PROJECT(S): 391042400

PUBLICATION DATE: 02/20/79
CALL NUMBER:
ORGANIZATION: USAID/PAKISTAN
OTHER ID: USAID/ISLAMABAD: 391-79-3
PUBLICATION NO:

ABSTRACT: EVALUATES IMPLEMENTATION OF A COUNTRY-WIDE MALARIA CONTROL PROG IN PAKISTAN FROM 2/78 TO 2/79. THE EXTERNAL REVIEW TEAM (ERT-79), WHICH UNDERTOOK THIS EVAL, CONSISTED OF USAID, GOP, AND WORLD HLTH ORGANIZATION REPRESENTATIVES.
DESPITE PREVIOUS ERT RECOMMENDATIONS TO STRENGTHEN SURVEILLANCE, PASSIVE CASE DETECTION (BLOODSLIDES TAKEN FROM FEVER CASES AT HLTH CLINICS & HOSPITALS) REMAINED AT A LOW LEVEL BOTH IN RURAL & URBAN AREAS. FOR EXAMPLE, THE AVG NUMBER OF SLIDES PROVIDED BY PCO UNITS PER YR IN PUNJAB PROVINCE FELL SUCCESSIVELY--227(1975), 163(76), 142(75), 110(78), 62(77), AND 40(78). ACTIVE CASE DETECTION (SURVEILLANCE BY HOME VISITORS) PRODUCED A MODERATE YIELD OF BLOODSLIDES. DISTRICT HLTH OFFICERS & THEIR MALARIA SUPERINTENDENTS OFTEN MISSED THE SIGNIFICANCE OF THE INCREASE OF P FALCIPARUM (A PARTICULARLY VIRULENT MALARIA) OVER THE LAST THREE YRS. THROUGHOUT PAKISTAN, THE SURVEILLANCE SYST WAS POOR, REVIEW & ANALYSIS OF DATA HAPHAZARD, AND CONTROL MEASURES UNSATISFACTORY.

THE ERT-79 SUPPORTS THE CONTENTION OF THE MAJORITY OF PAKISTANI MALARIA WORKERS THAT DDT & BHC ARE NO LONGER EFFECTIVE IN THIS COUNTRY. IN SIND PROVINCE, WHICH DEPENDED HEAVILY UPON BHC, THE INCIDENCE OF P FALCIPARUM WAS NINE TIMES THAT OF OTHER PROVINCES IN 1978. ALSO, A HEAVY RAINY SEASON & FLOODING IN 1978 PREVENTED A SECOND APPLICATION OF INSECTICIDES IN SIND & BALUCHISTAN. FLOODING LIMITED COVERAGE IN '76 & '77 AS WELL.
SPRAYMEN WERE GENERALLY CAREFUL TO PROTECT THEMSELVES FROM UNDUE EXPOSURE. HOWEVER, WITH REGARD TO HOME SAFETY, A USAID REPRESENTATIVE REPORTED THAT EATING & COOKING UTENSILS WERE OFTEN STILL ON THE SHELVES AND THAT OPEN TRAYS OF FOODSTUFFS WERE LEFT OUT DURING SPRAYINGS. THE ERT CONCLUDES THAT THE PAKISTAN PROGRAM IS SUCCEEDING ONLY BY VIRTUE OF THE STILL EFFECTIVE MALATHION. ERT EMPHASIZES THAT THERE SHOULD BE NO REDUCTION OF MALATHION SPRAYING WITHOUT A DETAILED EPIDEMIOLOGICAL EVALUATION.

DOCUMENT TYPE: AUDIT REPORT
DOCUMENT TITLE: MALARIA ERADICATION PROGRAMS
AUTHOR(S):
CONTRACT:
PROJECT(S): 391013900

PUBLICATION DATE: 05/07/76
CALL NUMBER:
ORGANIZATION: AID/W
OTHER ID: AUDIT REPORT NO: 76-348
PUBLICATION NO:

ABSTRACT: DETAILS HISTORY & PRESENT STATUS OF MALARIA ERADICATION PROGRAMS IN VARIOUS COUNTRIES-RELATING THEIR LEVEL OF AFFLICTION & REASONS FOR FAILURE OF ERADICATION PROGRAMS IN THOSE COUNTRIES WHICH HAVE HAD A RESURGENCE OF THE DISEASE. CITES DESTRUCTIVE EFFECTS OF MALARIA ON SOCIO-ECONOMIC GROWTH & SUGGESTS COUNTERMEASURES TO RESTORE EFFECTIVENESS OF PROGRAMS.

DOCUMENT TYPE: SPECIAL EVALUATION REPORT
DOCUMENT TITLE: CONSUMER DEMAND, MARKETING, AND COMMERCIAL DISTRIBUTION OF CONTRACEPTIVES IN PAKISTAN
AUTHOR(S): FORNOS,WERNER H
CONTRACT:
PROJECT(S): 391999999

PUBLICATION DATE: 08/03/76
CALL NUMBER: PK658.B09615766F727
ORGANIZATION: AMERICAN PUBLIC HEALTH ASSOCIATION
OTHER ID:
PUBLICATION NO:

ABSTRACT: THE MOST SIGNIFICANT SHORTCOMING OF THE PROGRAM AT THIS TIME IS THE LACK OF AN EFFECTIVE STRATEGY AND ACTION PLAN GEARED TO CREATING CONSUMER DEMAND. IF THE PROGRAM IS TO SUCCEED, A COMMERCIAL DEMAND CREATION, MARKETING, AND CONTRACEPTIVE DISTRIBUTION PROGRAM MUST BE DEVELOPED, TESTED, AND IMPLEMENTED WITH DELIBERATE SPEED. DEMAND FOR BIRTH CONTROL SERVICES HAS STABILIZED AT A VERY LOW LEVEL. CONTRACEPTIVE ACCEPTANCE RATES ARE THE SAME AS THEY WERE IN 1968. ALL AVAILABLE WAREHOUSE SPACE AND ALL DISTRIBUTION CHANNELS ARE FILLED TO CAPACITY. MORE OUTLETS AT THE RETAIL LEVEL ARE NEEDED TO ABSORB THIS SUPPLY. PRESENT MARKETING EFFORTS IN SUPPORT OF THE INUNDATION PROGRAM ARE DEVOID OF STRATEGY, IMPROPERLY UTILIZE THE MEDIA CHANNELS, LACK APPROPRIATE POINT OF SALES MATERIALS, AND DO NOT STIMULATE CONSUMER DEMAND. THERE IS PRESENTLY UNDERWAY A HIGHLY EFFECTIVE STUDY OF COMMERCIAL DISTRIBUTION OF CONTRACEPTIVES THROUGH THE COMMERCIAL SECTOR, EMPLOYING SUCH FAMILIAR TACTICS AS ATTITUDINAL ASSESSMENT, PACKAGING, AND MARKETING TECHNIQUES DESIGNED TO GET SHOPKEEPERS TO BECOME SALES AGENTS. THE EVALUATOR DISCUSSED CURRENT CONSUMER ATTITUDES, THE COMMERCIAL DELIVERY SYSTEM, AND NEW PROGRAM MANAGEMENT NEEDS. HE MADE ELEVEN RECOMMENDATIONS INCLUDING THAT: (1)A PUBLIC OPINION RESEARCH PROJECT BE UNDERTAKEN; (2)A COMMERCIALLY-RUN CONTRACEPTIVE DISTRIBUTION AND MARKETING SYSTEM BE TESTED, MODIFIED AND IMPLEMENTED; AND (3)THE FAMILY PLANNING EFFORT BE NATIONALIZED.

DOCUMENT TYPE: INCOMING CABLE (MISSION TO AID)
DOCUMENT TITLE: MALARIA CONTROL PROGRAM POLICY IMPLICATIONS
AUTHOR(S): LEVINTON,DAVID
CONTRACT:
PROJECT(S): 391013900

PUBLICATION DATE: 09/26/76
CALL NUMBER:
ORGANIZATION: AID/W
OTHER ID:
PUBLICATION NO:

ABSTRACT: DISCUSSES ILLNESS IN SPRAYERS AS A RESULT OF COMPOSITION AND UTILIZATION OF PESTICIDE. SUGGESTIONS MADE REGARDING CORRECTIVE SAFETY MEASURES AND AID'S POSSIBLE ROLE IN MONITORING SPRAYING. RELATES ACTION ALREADY UNDERTAKEN ON THIS MATTER.

b. Water Management

PROJECT EVALUATION DOCUMENTATION

COUNTRY/BUREAU: TECHNICAL ASSISTANCE — PROJECT: 9310489

PROJECT TITLE: ON-FARM WATER MGT/UTILIZATION — INITIAL FY: 68 FINAL FY: 80

DOCUMENT TYPE: SPECIAL EVALUATION REPORT — PUBLICATION DATE: 02/01/76

DOCUMENT TITLE: ASSESSMENT AND FIELD REVIEW OF WATER MANAGEMENT RESEARCH BY COLORADO STATE UNIVERSITY — CALL NUMBER: PN333.913H153

AUTHOR(S): HAISE,HOWARD; PEHLAN,JOHN; CATON,DOUGLAS — ORGANIZATION:

CONTRACT: AID/CSD-2162 — OTHER ID:

PROJECT(S): 391040100 931048900 — PUBLICATION NO: PNAAC004-A1

ABSTRACT: THE CSU WATER MANGEMENT RESEARCH PROJECT CONSISTS OF SEVERAL SUBPROJECTS. THE PROJECT HAS HELD COURSES AND EACH PIECE OFWORK HAS FOCUSED ON THE TARGET OF RESEARCH ON ON-FARM WATER SUPPLY AND USE. THE CSU APPROACH IS BASED ON THE FOLLOWING CONCEPT: ON ONE SIDE THERE IS TECHNICAL AND SOCIO-ECONOMIC RESEARCH ON INFORMATION NEEDS OF FARMERS AND POLICY-MAKERS. ON THE OTHER SIDE, THERE ARE THE EXTENDERS WHO CARRY THE MESSAGE TO FARMERS. IN THE MIDDLE IS A "PACKAGE" OF KNOWLEDGE AND ACTIVITY. FARMERS, RESEARCHERS AND EXTENDERS ALL CONTRIBUTE TO AND DRAW UPON THIS PACKAGE. THE TEAM FOUND THE MIDDLE GROUND BETWEEN RESEARCH AND THE FARMERS. ITS EXPERIMENTS WERE CONDUCTED IN AN ACCEPTABLE AND INNOVATIVE MANNER WHICH LOCATED AND POINTED OUT THE NATURE OF TECHNICAL, SOCIAL, AND ECONOMIC CONSTRAINTS. CSU EFFORTS HAVE BEEN OF HIGH ORDER AND OF GREAT DEMONSTRATIONAL VALUE. THE PROJECT HAS DEVELOPED FIELD AND SURVEY METHODS AND TECHNIQUES WHICH CAN BE TESTED FOR REPLICABILITY. THE EVALUATORS RECOMMENDED THAT TEN COMPONENTS OF THE CSU PROGRAM BE CONTINUED. THEY ALSO RECOMMENDED THAT: (1)TECHNICAL ASSISTANCE TO FACILITATE FORMATION OF FARMER ASSOCIATIONS AND (2)INPUTS OF FERTILIZER AND CREDIT BE PROVIDED. IN ADDITION, THEY POINTED OUT THAT THE GOVERNMENT OF PAKISTAN NEEDS AN ORGANIZATION WITH TRAINING AND WATER MANAGEMENT KNOWLEDGE OR THE LOAN EFFORT MAY FAIL.

DOCUMENT TYPE: SPECIAL EVALUATION REPORT — PUBLICATION DATE: 03/01/76

DOCUMENT TITLE: FIELD REVIEW AND ASSESSMENT OF WATER MANAGEMENT RESEARCH BY UTAH STATE UNIVERSITY — CALL NUMBER: LAT333.913U89B

AUTHOR(S): SHERDON,ERNEST; HAISE,HOWARD; CATON,DOUGLAS — ORGANIZATION:

CONTRACT: — OTHER ID:

PROJECT(S): 931048900 391040100 — PUBLICATION NO:

ABSTRACT: WORK UNDER THE PRESENT CONTRACT SHOULD BE CONTINUED AS PROGRAMMED. SUBSEQUENT TO THE COMPLETION OF THE PROJECT, MAJOR EFFORT SHOULD BE PLANNED DEALING WITH PROGRAMS TO ASSIST SMALL FARMERS IN ON-FARM WATER MANAGEMENT IN CENTRAL AND SOUTH AMERICA. IN ADDITION, THE SOCIO-POLITICAL STUDIES UNDERWAY SHOULD BE CONTINUED, BUT RESTRUCTURED ALONG SOCIO-ECONOMIC AND IMPACT ASSESSMENT LINES. IT APPEARS THAT WORK ON EVAPOTRANSPIRATION SHOULD NOT HAVE SUCH HIGH PRIORITY IN THE FUTURE. EARLY WORK HAD A LARGER COMPONENT IN FIELD DEMONSTRATION OF IRRIGATION METHODS AND PRACTICES. HOWEVER, THE PROJECT HAS DRIFTED FROM THE GOAL OF IMPROVING ON-FARM WATER MANAGEMENT. MORE EMPHASIS ON ADAPTIVE RESEARCH AND DEVELOPMENT AND "HOW TO" DEMONSTRATIONS SEEMS TO BE DESIRED. EACH INDIVIDUAL PROJET SHOULD RELATE TO OTHERS TO ENSURE A FOCUS OF ALL COMPONENT PROJECTS ON THE OBJECTIVE OF IMMEDIATELY IMPROVING FOOD PRODUCTION THROUGH BETTER ON-FARM WATER MANAGEMENT. RECOMMENDATIONS INCLUDE: (1)STRENGTHEN INTERNAL COMMUNICATION TO REDUCE CONFUSION AND PROBLEMS FOR THE CONTRACTORS; (2)STRENGTHEN AID'S ABILITY TO BETTER RELATE PROJECT SUBSTANCE TO PROJECT PURPOSE AND OBJECTIVES;

PROJECT EVALUATION DOCUMENTATION

COUNTRY/BUREAU: PAKISTAN
PROJECT TITLE: WATER MANAGEMENT
PROJECT: 3910401
INITIAL FY: 74 FINAL FY: 78

DOCUMENT TYPE: PROGRESS REPORT/INTERIM REPORT
DOCUMENT TITLE: PRECISION LAND LEVELING PROJECT, INTERIM EVALUATION REPORT-SIND PROVINCE
AUTHOR(S): DEMSTER,THOMAS,M.
CONTRACT:
PROJECT(S): 391040100

PUBLICATION DATE:
CALL NUMBER:
ORGANIZATION: USDA SOIL CONSERVATION SERVICE (PASA)
OTHER ID:
PUBLICATION NO:

ABSTRACT: PROBLEMS WERE ENCOUNTERED CONCERNING COLLECTION OF WATER MEASUREMENT DATA IN THE DEMONSTRATION AREAS, DEMONSTRATION PROGRAM WAS DISAPPOINTING SINCE WATER SAVINGS IS AN IMPORTANT ELEMENT OF THE PROJECT MEASURES. EXTENDED WORK IS NEEDED TO FURTHER SUPPORT WATER SAVINGS ASPECT OF PRECISION LAND LEVELING PROGRAM.

DOCUMENT TYPE: SPECIAL EVALUATION REPORT
DOCUMENT TITLE: ASSESSMENT AND FIELD REVIEW OF WATER MANAGEMENT RESEARCH BY COLORADO STATE UNIVERSITY
AUTHOR(S): HAISE,HOWARD
PEHLAN,JOHN
CATON,DOUGLAS
CONTRACT: AID/CSD-2162
PROJECT(S): 391040100 931048900

PUBLICATION DATE: 02/01/76
CALL NUMBER: PK333.913H153
ORGANIZATION:
OTHER ID:
PUBLICATION NO: PNAAC004-A1

ABSTRACT: THE CSU WATER MANGEMENT RESEARCH PROJECT CONSISTS OF SEVERAL SUBPROJECTS. THE PROJECT HAS HELD COURSES AND EACH PIECE OFWORK HAS FOCUSED ON THE TARGET OF RESEARCH ON ON-FARM WATER SUPPLY AND USE. THE CSU APPROACH IS BASED ON THE FOLLOWING CONCEPT: ON ONE SIDE THERE IS TECHNICAL AND SOCIO-ECONOMIC RESEARCH ON INFORMATION NEEDS OF FARMERS AND POLICY-MAKERS. ON THE OTHER SIDE, THERE ARE THE EXTENDERS WHO CARRY THE MESSAGE TO FARMERS. IN THE MIDDLE IS A "PACKAGE" OF KNOWLEDGE AND ACTIVITY. FARMERS, RESEARCHERS AND EXTENDERS ALL CONTRIBUTE TO AND DRAW UPON THIS PACKAGE. THE TEAM FOUND THE MIDDLE GROUND BETWEEN RESEARCH AND THE FARMERS. ITS EXPERIMENTS WERE CONDUCTED IN AN ACCEPTABLE AND INNOVATIVE MANNER WHICH LOCATED AND POINTED OUT THE NATURE OF TECHNICAL, SOCIAL, AND ECONOMIC CONSTRAINTS. CSU EFFORTS HAVE BEEN OF HIGH ORDER AND OF GREAT DEMONSTRATIONAL VALUE. THE PROJECT HAS DEVELOPED FIELD AND SURVEY METHODS AND TECHNIQUES WHICH CAN BE TESTED FOR REPLICABILITY. THE EVALUATORS RECOMMENDED THAT TEN COMPONENTS OF THE CSU PROGRAM BE CONTINUED. THEY ALSO RECOMMENDED THAT: (1)TECHNICAL ASSISTANCE TO FACILITATE FORMATION OF FARMER ASSOCIATIONS AND (2)INPUTS OF FERTILIZER AND CREDIT BE PROVIDED. IN ADDITION, THEY POINTED OUT THAT THE GOVERNMENT OF PAKISTAN NEEDS AN ORGANIZATION WITH TRAINING AND WATER MANAGEMENT KNOWLEDGE ON THE LOAN EFFORT MAY FAIL.

DOCUMENT TYPE: SPECIAL EVALUATION REPORT
DOCUMENT TITLE: FIELD REVIEW AND ASSESSMENT OF WATER MANAGEMENT RESEARCH BY UTAH STATE UNIVERSITY
AUTHOR(S): SMERDON,ERNEST
HAISE,HOWARD
CATON,DOUGLAS
CONTRACT:
PROJECT(S): 931048900 391040100

PUBLICATION DATE: 03/01/76
CALL NUMBER: LAT333.913U89s
ORGANIZATION:
OTHER ID:
PUBLICATION NO:

ABSTRACT: WORK UNDER THE PRESENT CONTRACT SHOULD BE CONTINUED AS PROGRAMMED. SUBSEQUENT TO THE COMPLETION OF THE PROJECT, MAJOR EFFORT SHOULD BE PLANNED DEALING WITH PROGRAMS TO ASSIST SMALL FARMERS IN ON-FARM WATER MANAGEMENT IN CENTRAL AND SOUTH AMERICA. IN ADDITION, THE SOCIO-POLITICAL STUDIES UNDERWAY SHOULD BE CONTINUED, BUT RESTRUCTURED ALONG SOCIO-ECONOMIC AND IMPACT ASSESSMENT LINES. IT APPEARS THAT WORK ON EVAPOTRANSPIRATION SHOULD NOT HAVE SUCH HIGH PRIORITY IN THE FUTURE. EARLY WORK HAD A LARGER COMPONENT IN FIELD DEMONSTRATION OF IRRIGATION METHODS AND PRACTICES. HOWEVER, THE PROJECT HAS DRIFTED FROM THE GOAL OF IMPROVING ON-FARM WATER MANAGEMENT. MORE EMPHASIS ON ADAPTIVE RESEARCH AND DEVELOPMENT AND "HOW TO" DEMONSTRATIONS SEEMS TO BE DESIRED. EACH INDIVIDUAL PROJET SHOULD RELATE TO OTHERS TO ENSURE A FOCUS OF ALL COMPONENT PROJECTS ON THE OBJECTIVE OF IMMEDIATELY IMPROVING FOOD PRODUCTION THROUGH BETTER ON-FARM WATER MANAGEMENT. RECOMMENDATIONS INCLUDE: (1)STRENGTHEN INTERNAL COMMUNICATION TO REDUCE CONFUSION AND PROBLEMS FOR THE CONTRACTORS; (2)STRENGTHEN AID'S ABILITY TO BETTER RELATE PROJECT SUBSTANCE TO PROJECT PURPOSE AND OBJECTIVES; AND (3)DEFINE "RESEARCH" SO IT HAS THE SAME MEANING FOR ALL PARTIES INVOLVED IN THE PROJECT.

PROJECT EVALUATION DOCUMENTATION

COUNTRY/BUREAU: PAKISTAN — PROJECT: 3910413

PROJECT TITLE: ON-FARM WATER MANAGEMENT II — INITIAL FY: 76 FINAL FY: 80

DOCUMENT TYPE: PROJECT EVALUATION SUMMARY
DOCUMENT TITLE: ON-FARM WATER MANAGEMENT
AUTHOR(S):
CONTRACT:
PROJECT(S): 391041300

PUBLICATION DATE: 03/31/80
CALL NUMBER:
ORGANIZATION: USAID/PAKISTAN
OTHER ID: USAID/PAKISTAN: 2
PUBLICATION NO:

ABSTRACT: EVALUATES PROJECT TO IMPROVE ON-FARM WATER MANAGEMENT (OFWM) IN PAKISTAN DURING THE PERIOD 5/78-9/79. EVALUATION TEAM INTERVIEWED PARTICIPATING FARMERS AS WELL AS GOP, AID, AND OFWM PERSONNEL. IN PREPARATION FOR THIS EVALUATION, THE MISSION CONDUCTED IN-DEPTH STUDIES ON 2 MAJOR PROJECT COMPONENTS--WATERCOURSE IMPROVEMENTS AND PRECISION LAND LEVELING.
SLOW PROJECT START-UP AND PERSISTENT IMPLEMENTATION PROBLEMS RESULTED IN POSTPONEMENT OF THE SECOND INSTALLMENT ($15 MIL) OF THE $22 MILLION PROJECT LOAN. ALSO, APPLICATION OF SECTION 669 OF THE US ASSISTANCE ACT (NUCLEAR NON-PROLIFERATION) PROHIBITED THE MISSION FROM OBLIGATING ADDITIONAL FUNDS FOR A REDESIGNED OFWM PROJECT. HOWEVER, THE GOP AND MISSION AGREED (6/79) TO EXTEND THE TERMINAL DATE BY 1 YR. IT WAS DECIDED THAT THE SOIL CONSERVATION SERVICE (SCS) ADVISORS SHOULD FOCUS THEIR FUTURE EFFORTS ON COMPLETING FIELD TEAM MANUALS AND TRAINING. UNFORTUNATELY, THE PROJECT WAS FURTHER DISRUPTED WITH THE BURNING OF THE US EMBASSY AND SUBSEQUENT EVACUATION OF US EMPLOYEES. IN 3/80, 2 SCS ADVISORS RETURNED.
DESIGN AND IMPLEMENTATION PROBLEMS HAVE CONTINUED. PROJECT COSTS ARE HIGH AND THE PRECISION LAND LEVELING (PLL) COMPONENT HAS NOT BEEN WELL RECEIVED BY FARMERS. INCLUSION OF VERY SMALL FARMERS IN THIS PROJECT WAS DIFFICULT BECAUSE OF THEIR INABILITY TO OBTAIN CREDIT AND BECAUSE TRACTORS WERE NOT PROVIDED. EVALUATION COMMITTEE RECOMMENDED THAT THE PROJECT BENEFICIARIES BE CHANGED TO "RURAL POOR" WHICH WOULD INCLUDE VILLAGE ARTISANS, LABORERS, HAULERS, AND OTHERS. HOWEVER, THE MISSION BELIEVES THAT THE CHANGE WOULD BE INCONSISTENT WITH THE PROJECT GOAL OF INCREASING AGRICULTURAL PRODUCTION AND IMPROVING INCOMES OF LOW-INCOME FARMERS. PROJECT EXPERIENCE DEMONSTRATED THE NEED FOR WELL-THOUGHT OUT AND CAREFULLY ARTICULATED PLANS IN SELECTING TARGET GROUPS AND ASSIGNING RESPONSIBILITIES TO THE VARIOUS GOP UNITS INVOLVED IN OFWM ACTIVITIES. OVERALL, THE AUTHORS CONSIDER THE PROJECT TO BE A SUCCESS. A VIABLE OFWM ORGANIZATION--WITH TRAINING SCHOOLS AND MUCH SOUGHT AFTER FIELD SERVICES--HAS BEEN DEVELOPED. PES FACESHEET LISTS THE ABOVE, PLUS SOME ADDITIONAL RECOMMENDATIONS.

PROJECT DESIGN INFORMATION

COUNTRY/BUREAU: PAKISTAN
PROJECT TITLE: ON-FARM WATER MANAGEMENT

PROJECT: 3910413 SUB-PROJECT: 00
INITIAL FY: 76 FINAL FY: 80

PROBLEM: LOSSES OF WATER IN FARMER-OPERATED SECTION OF WATER DELIVERY SYSTEM, UNEVEN AND INEFFICIENT APPLICATION OF WATER ON FIELDS, AND FARMER CULTURAL PRACTICES NOT GEARED TO WATER ECONOMY ARE MAJOR CAUSES OF LOW FARM OUTPUT.

STRATEGY: LONG TERM, CAPITAL INTENSIVE APPROACH DEVELOPS NEW INSTITUTION IN PUBLIC SECTOR.

SUMMARY: LOAN TO PAKISTAN ESTABLISHES 5-YR PILOT PROGRAM TO DEVELOP CAPABILITY TO PLAN, DELIVER ON-FARM WATER MGMT SERVICES. ACTIVITIES ARE CONDUCTED IN ALL PROVINCES TO IMPROVE 1500 WATERCOURSES, LEVEL 425,000 A, AND PROVIDE DEMONSTRATIONS OF IMPROVED CROP & MGMT TECHNIQUES. FARMERS MUST FORM WATER USER ORGS TO APPLY/QUALIFY. IN EACH PROVINCE, WATER MGMT TEAMS OF 10 TECHNICIANS SELECT SITES AFTER EVALUATION OF APPLICATIONS AND AREA. EACH TEAM REHABILITATES CLUSTER OF 5 WATERCOURSE COMMANDS/YR AND SETS UP 1-3 DEMO PLOTS IN EACH COMMAND. MINISTRY OF FOOD & AGR ASSUMES OVERALL COORDINATION, WHILE PROVINCIAL AGR DEPARTMENTS SUPERVISE ACTIVITIES. ANNUAL EVALUATION ALLOWS MODIFICATION OF PROJECT. TEAMS TRAINED IN COUNTRY.

GOAL: INCREASED AGR PRODUCTION AND IMPROVED INCOME FOR LOW INCOME FARMERS IN PAKISTAN. SUB-GOAL: ON-FARM WATER MANAGEMENT CONCEPT IS FULLY APPRECIATED AND TAKEN ACCOUNT OF BY GOVERNMENT OF PAKISTAN IN AGR PLANNING AND PROJECT IS REPLICATED.

PURPOSE: PUBLIC AND PRIVATE SECTOR CAPABILITY IS ESTABLISHED TO PLAN AND DELIVER ON-FARM WATER MANAGEMENT SERVICES TO FARMERS AT ECONOMIC COSTS.

OUTPUTS: 1.PERSONNEL TRAINED. 2.TEAMS OPERATING IN THE FIELD. 3.CREDIT MECHANISMS ESTABLISHED FOR FARMERS. 4.CONTRACTORS IDENTIFIED. 5.PUBLICITY PROGRAMS BEING EXECUTED. 6.DATA FEEDBACK SYSTEM.

c. Rural Development Programs

PROJECT DESIGN INFORMATION

COUNTRY/BUREAU: PAKISTAN
PROJECT TITLE: AGRICULTURAL RESEARCH

PROJECT: 3910296 SUB-PROJECT: 02
INITIAL FY: 69 FINAL FY: 82

PROBLEM: LITTLE RESEARCH CONDUCTED IN PAKISTAN TO CONTINUE ADAPTATION OF NEW VARIETIES AND TECHNOLOGY OR TO DEVELOP NEW CROPS. INDIGENOUS SCIENTIFIC CAPABILITY UNABLE TO ASSURE THAT REQUIRED RESEARCH CAN BE EFFECTIVELY APPLIED.

STRATEGY: TECHNICAL AND FINANCIAL ASSISTANCE TO -VELOPMENT OF A COMPLEX OF PRIORITY-ORIENTED RESEARC COORDINATED THROUGH AGRIC RESEARCH COUNCIL (ARC) .D PROVINCIAL RESEARCH COORDINATION BOARDS AND CARR D OUT BY WEST PAKISTAN AGRIC UNIV (WPAU) ANDOTHER LEGES AND RESEARCH STATIONS. WPAU ASSISTED IN C ELOPING SUITABLE RESEARCH AND ACADEMIC STANDA S.

SUMMARY: ESTABLISHMENT OF AN ADMINISTRATIVE ORGANIZATION TO SET NATIONAL AND PROVINCIAL RESEARCH PRIORITIES AND TO ELOCATE RESOURCES TO MEET THEM. CONTINUED AND FURTHER DEVELOPMENT OF RESEARCH PROGRAMS FOR WHEAT, RICE, CORN, MILL T, OILSEEDS AND PULSES. COORDINATED RESEARCH DEVELOPED AT WPAU USING GRAIN LEGUME CROPS AS A MODEL. VARIETAL IMPROVEMENTS AND AGRONOMIC RECOMMENDATIONS FOR INCREASED PEANUT PRODUCTION. DEVELOPMENT OF PROCESSING AND MARKETING PROGRAM FOR EDIBLE OILS. IMPROVED UTILIZATION AND MANAGEMENT OF WATER ON THE FARM BY STUDIES AND ANALYSES OF PRESENT SYSTEMS AND COMPARATIVE ANALYSES OF NEW PRACTICES AND METHODS.

GOAL: INCRESED PRODUCTION OF FOOD GRAINS AND EXPORT CROPS IN WEST PAKISTAN. I

PURPOSE: GOVT OF WEST PAKISTAN HAS RESEARCH FOUNDATION NECESSARY TO SUSTAIN AND DIVERSIFY AGRICULTURAL PRODUCTION. I

OUTPUTS: ADMINISTRATIVE ORGANIZATION FOR CONDUCTING RESEARCH; RESEARCH PROGRAM FOR GAINS, OILSEEDS, PULSES; PROGRAM TO INCREASE PRODUCTION, PROCESSING AND MARKETING OF PEANUTS AND EDIBLE OILS; PROGRAM TO IMPROVE WATER MANAGEMENT. I

PROJECT DESIGN INFORMATION

COUNTRY/BUREAU: PAKISTAN
PROJECT TITLE: PRECISION LAND LEVELING

PROJECT: 3910401 SUB-PROJECT: 00
INITIAL FY: 74 FINAL FY: 78

PROBLEM: ON-FARM WATER MANAGEMENT PRACTICES ARE INEFFICIENT WHEN EVALUATED BY SOCIAL AND COST BENEFITS. TRADITIONAL IMPLEMENTS TO MOVE SOIL AND SMOOTH LAND GRADE ARE INEFFICIENT.

STRATEGY: PROVIDE SIMPLE PRECISION LAND LEVELING TOOLS AND TRAINED MANPOWER. DEVELOP AN INSTITUTIONAL STRUCTURE TO PROVIDE ADVISORY AND SUPPORT SERVICES.

SUMMARY: INTRODUCTION OF EXTENDED APPLICATION OF PRECISION LAND LEVELING AND RELATED AGRONOMIC KNOWLEDGE ON INDIVIDUAL FARMS WITHIN IRD AREAS INCLUDING FORMAL AND ON-THE-JOB TRAINING BY U S TECHNICIANS FOR PROVINCIAL GOVERNMENT AGRICULTURAL ENGINEERS AND PRIVATE ENTREPRENEURS. GRADUAL PARTICIPATION OF PRIVATE ENTERPRISE WITH PAKISTAN GOVERNMENT IN THE ESTABLISHMENT OF SMALL POOLS OF SIMPLE PRECISION LAND LEVELING EQUIPMENT WITHIN IRD AREAS. DEVELOPMENT OF A GOVERNMENT COST-SHARING PROGRAM TO ENCOURAGE AND BENEFIT SMALL FARMERS WHO WANT TO USE EQUIPMENT. (IRD) INTEGRATED RURAL DEVELOPMENT.

GOAL: ACCELERATION OF PRODUCTIVITY IN IRRIGATED AREAS.I

PURPOSE: IMPROVED ON-FARM WATER USE THROUGH PRECISION LAND LEVELING WHICH IS TECHNICALLY SUITED TO LOCAL LAND CONDITIONS, ECONOMICALLY VIABLE, INCOME DISTRIBUTIVE, AND ORGANIZATIONALLY APPLICABLE.I

OUTPUTS: ONGOING EXPERIMENTATION WITH AND ADOPTION OF PRECISION LAND LEVELING TECHNIQUES SUITED TO IRD (INTEGRATED RURAL DEVELOPMENT) AREAS; U S -TRAINED PROVINCIAL AGRICULTURAL TECHNICIANS AND SPECIALISTS; AN INSTITUTIONAL FRAMEWORK, WITH THE GRADUAL PARTICIPATION OF PRIVATE ENTERPRISE, TO PROVIDE SERVICES, MAINTAIN RESEARCH DATA AND CASE STUDIES ON SOCIAL AND COST BENEFITS, AND ADMINISTER SYSTEMS OF COST SHARING AND DATA ANALYSIS.I

PROJECT DESIGN INFORMATION

COUNTRY/BUREAU: PAKISTAN — PROJECT: 391-0403 SUB-PROJECT: 00
PROJECT TITLE: DRY LAND AGRI DEVELOPMENT — INITIAL FY: 79 FINAL FY: 79

PROBLEM: PAKISTAN'S ECONOMY IS AGRICULTURE BASED AND ITS POPULATION LARGELY RURAL WITH SMALL FARMS THAT ARE POORLY CAPITALIZED. MOST OF THE CROP AND PRODUCTION COMES FROM ITS 33 MILLION ACRES OF IRRIGATED LAND WHERE FARMERS HAVE BEGUN TO APPLY MODERNIZING INPUTS AND PRACTICES WHILE THE RAINFED AREAS ARE MUCH LESS ADVANCED, YIELDS ARE MUCH LOWER, TILLED ACREAGE PER FAMILY SMALLER, AND CONSEQUENTLY FARM INCOMES LOWER.

STRATEGY: BY PROVIDING NEEDED FINANCING THIS PROJECT INSURES THAT THE LOW INCOME FARMER WILL HAVE ACCESS TO ADEQUATE CREDIT, SUPPLIES OF PRODUCTION INPUTS AND SERVICES AND TO CASH MARKETS FOR INCREASED OUTPUT GENERATED.

SUMMARY: THE GOVERNMENT OF PAKISTAN AND AID AGREED TO CARRY OUT A MAJOR PROGRAM TO INCREASE AGRICULTURAL PRODUCTION AND INCOMES ON SMALL FARMS WHICH PREDOMINATE IN THE HIGHER RAINFED UNIRRIGATED AREAS OF PAKISTAN, BY ESTABLISHING THE NECESSARY CONDITIONS FOR WIDESPREAD PRODUCTION AND INCOME-INCREASING PRACTICES. THESE INCLUDE: IDENTIFICATION OF FACTORS THAT MOTIVATE FARMERS TO ADOPT IMPROVED AGRICULTURAL PRACTICES, IMPROVEMENTS NEEDED IN MARKETING, AND PRODUCTION-INCREASING INPUTS; PROVISION OF ADEQUATE, AVAILABLE FUNDING; AND, IDENTIFICATION TESTING AND DEMONSTRATION OF PRODUCTION AND INCOME-INCREASING CROPS AND PRACTICES.

GOAL: 1. INCREASE PRODUCTION OF PRINCIPAL FOOD COMMODITIES. 2. INCREASE INCOMES OF THESE LOW INCOME BARANI FARM FAMILIES.

PURPOSE: ESTABLISH A SET OF CONDITIONS SUFFICIENT TO BRING ABOUT WIDESPREAD ADOPTION OF PRODUCTION AND INCOME INCREASING PRACTICES ON SMALL BARANI FARMS.

OUTPUTS: 1.STUDIES OF SOCIOECONOMIC AND MOTIVATIONAL CHARACTERISTICS OF SMALL BARANI FARMERS COMPLETED. ADOPTION CRITERIA ESTABLISHED. 2.TESTED AND PROVEN PRODUCTIVITY-INCREASING VARIETIES AND PRACTICES ARE SCREENED FOR SUITABILITY. 3.ADAPTIVE AND VERIFICATION TRIALS WILL BE CONDUCTED. 4.WIDESPREAD DEMONSTRATIONS OF ACCEPTABLE PRODUCTIVITY-INCREASING VARIETIES PRODUCED. 5.TRAINED EXTENSION PERSONNEL. 6.AVAILABLE CREDIT. 7.COORDINATION AND LINKAGE BETWEEN RESEARCH AND OUTREACH AGENCIES.

PROJECT DESIGN INFORMATION

COUNTRY/BUREAU: PAKISTAN — PROJECT: 391-0406 SUB-PROJECT: 00
PROJECT TITLE: RURAL CLEAN WATER — INITIAL FY: FINAL FY:

PROBLEM: AT PRESENT, ONLY 14% OF PAKISTAN'S RURAL POPULATION IS BEING SERVED BY GOP EFFORTS TO PROVIDE ADEQUATE SUPPLIES OF CLEAN WATER. THE PREPONDERANCE OF THIS ASSISTANCE IS FOCUSSED ON COMMUNITIES WITH POPULATIONS OF 10,000 TO 25,000. SMALLER RURAL COMMUNITIES, CONSEQUENTLY, ARE LEFT TO FACE A VARIETY OF WATER SUPPLY PROBLEMS, INCLUDING INADEQUATE SUPPLY AND DISPOSAL SYSTEMS, INADEQUATE SYSTEM MAINTENANCE, AND IMPURE WATER. WATER-BORNE AND HYGIENE-RELATED DISEASES ARE ACCORDINGLY WIDE SPREAD.

STRATEGY: FOUR-YEAR PROJECT CONSISTS OF A LOAN AND A GRANT PROVIDING TECHNICAL ADVISORY ASSISTANCE, WATER SUPPLY AND DRAINAGE EQUIPMENT AND CONSTRUCTION SERVICES, AND IN-COUNTRY TRAINING TO UPGRADE RURAL WATER SUPPLIES. HOST COUNTRY PROVIDES OVERALL PROJECT ADMINISTRATION AND LONG-TERM MAINTENANCE.

SUMMARY: LOAN AND GRANT PROVIDED TO THE GOVERNMENT OF PAKISTAN TO IMPROVE THE WATER SUPPLY SYSTEMS OF RURAL COMMUNITIES (PRIMARILY COMMUNITIES WITH POPULATIONS OF 1000-5000) IN THE PROVINCES OF PUNJAB, SIND, BALUCHISTAN, AND THE NORTHWEST FRONTIER.
LOAN FUNDS WILL BE DISBURSED IN THREE SEQUENTIAL TRANCHES SPANNING A PERIOD OF 9 YEARS. ACTIVITIES TO BE IMPLEMENTED UNDER THE FIRST TRANCHE INCLUDE: (1)CONSTRUCTION OF APPROXIMATELY 200 VILLAGE PIPED WATER SUPPLY AND WASTEWATER DRAINAGE SYSTEMS; (2)THE INSTALLATION OF 28,000 HAND PUMPS; (3)THE EXECUTION OF 400 SIMPLE WATER SUPPLY IMPROVEMENT SCHEMES, INCLUDING KAREZ IMPROVEMENT, PROTECTION OF OPEN WELLS, AND THE PROVISION OF SMALL STORAGE TANKS WITH FILTERS FOR SPRING WATER.
GRANT WILL BE USED SOLELY TO COVER TECHNICAL ASSISTANCE EXPENSES. SHORT AND LONG-TERM ADVISORS WILL BE ASSIGNED THE FOLLOWING TASKS: (1)ASSIST THE GOP WITH THE IMPLEMENTATION OF PILOT PROJECTS ON HEALTH/SANITATION MEASURES EFFECTIVE IN PAKISTAN, EXCRETA DISPOSAL, AND COMMUNITY MOTIVATION; (2)ADVISE PROVINCIAL IMPLEMENTING AGENCIES ON SIMPLE, LOW-COST, LOW-MAINTENANCE WATER SUPPLY SCHEMES, AND/OR METHODS FOR DESIGNING AND PROMOTING HEALTH/SANITATION ACTIVITIES;

(3)ASSIST THE GOP WITH FEASIBILITY STUDIES ON THE POSSIBLE LOCAL MANUFACTURE OF HAND PUMPS AND OTHER TYPES OF WATER SYSTEM HARDWARE AND SUPPLIES; (4)ADVISE THE GOP ON IMPROVED WATER SYSTEMS DESIGN (PARTICULARLY LOW OPERATION AND MAINTENANCE DESIGNS) AND THE IMPLEMENTATION OF SELECT HEALTH/SANITATION ACTIVITIES; (5)DEVELOP A PROGRAM TO STRENGTHEN PRE-SERVICE AND IN-SERVICE TRAINING FOR SANITARIANS AT AN IN-COUNTRY INSTITUTE OF HYGIENE AND PREVENTIVE MEDICINE. TO FURTHER STRENGTHEN AN INDIGENOUS CAPABILITY IN HEALTH AND SANITATION, 32 ENGINEERS FROM THE FOUR PROVINCES WILL BE TRAINED IN SANITATION ENGINEERING, SOURCE AND STORAGE FACILITIES ENGINEERING, WASTEWATER TREATMENT, WATER AND FOOD HYGIENE, AND GENERAL SANITATION AT THE UNIVERSITY OF ENGINEERING AND TECHNOLOGY IN LAHORE. ALSO, FOUR PROVINCIAL TRAINING CENTERS WILL BE ESTABLISHED TO PROVIDE PRE-SERVICES AND INSERVICE TRAINING TO TECHNICAL PERSONNEL IN THE OPERATION/MAINTENANCE OF RURAL WATER SYSTEMS.

GOAL: REDUCTION IN THE INCIDENCE OF WATER-RELATED ILLNESSES AMONG THE RURAL POPULATION OF PAKISTAN.

PURPOSE: 1.INCREASE THE QUANTITY OF WATER AVAILABLE TO AND USED BY THE RURAL POOR IN PAKISTAN FOR DRINKING,WASHING,AND BATHING IN AREAS WHERE AVAILABLE SUPPLIES ARE INSUFFICIENT. 2.IMPROVE THE QUALITY OF WATER WHICH IS USED FOR THESE PURPOSES IN THOSE RURAL AREAS WHERE WATER IS ABUNDANT BUT OF POOR BACTERIOLOGICAL QUALITY.

OUTPUTS: 1.HANDPUMPS. 2.VILLAGE PIPED WATER AND DRAINAGE SCHEMES. 3.SMALL WATER IMPROVEMENT SCHEMES. 4.WATERWORKS OPERATORS TRAINING CENTERS. 5.GRADUATE PROGRAM IN SANITARY ENGINEERING. 6.PILOT STUDIES CARRIED OUT. 7.SELECTION CRITERIA AND MAINTENANCE PLAN ADOPTED.

PROJECT DESIGN INFORMATION

COUNTRY/BUREAU: PAKISTAN — PROJECT: 391-0419 SUB-PROJECT: 00

PROJECT TITLE: PAKISTAN-AGRICULTURAL INPUTS — INITIAL FY: 76 FINAL FY: 80

PROBLEM: SINCE 1970, AGRICULTURAL PRODUCTION IN PAKISTAN HAS NOT MET THE NEEDS OF THE GROWING POPULATION. MAJOR CONSTRAINTS TO INCREASED PRODUCTION ARE: THE FAILURE TO OPTIMIZE MANAGEMENT OF THE COUNTRY'S AMPLE LAND AND WATER RESOURCES, ABSENCE OF AN EFFECTIVE SEED MULTIPLICATION AND DISTRIBUTION SYSTEM, AND A SERIOUSLY INADEQUATE USE OF CHEMICAL FERTILIZER AND OTHER PRODUCTION INPUTS.

STRATEGY: EXTEND LOAN TO GOVT OF PAKISTAN TO FINANCE AGRICULTURAL INPUTS PROGRAM.

SUMMARY: LOAN IS EXTENDED TO GOVT OF PAKISTAN TO INSURE INCREASED AND BETTER BALANCED USE OF FERTILIZER AND OTHER AGRICULTURAL PRODUCTION INPUTS BY PAKISTANI FARMERS. GOVERNMENT EFFORTS TO ASSIST SMALL FARMERS WITH CREDIT AND TECHNICAL INFORMATION CAN SUCCEED ONLY IF REQUIRED AGRICULTURAL INPUTS ARE ALSO PROVIDED. COMMODITIES PURCHASED WITH LOAN FUNDS INCLUDE: FERTILIZER, SEED AND SMALL SCALE FARM EQUIPMENT. THESE COMMODITIES ARE MADE AVAILABLE TO FARMERS THROUGH A NETWORK OF RETAIL SALES POINTS.

GOAL: INCREASED AGRICULTURAL PRODUCTION AND INCREASED FARM INCOMES.

PURPOSE: INCREASED AND BETTER BALANCED USE OF FERTILIZER AND OTHER AGRICULTURAL PRODUCTION INPUTS BY ALL FARMERS, ESPECIALLY LOW INCOME FARMERS.

OUTPUTS: 1.NETWORK OF RETAIL SALES POINTS FOR AGRICULTURAL PRODUCTION INPUTS THROUGH-OUT THE COUNTRY. 2.SUPPLIES OF PHOSPHATIC AND NITROGEN FERTILIZER AND HYV SEEDS AVAILABLE AT EACH RESPECTIVE RETAIL-SALES POINT ADEQUATE TO MEET ALL EFFECTIVE DEMAND AT THAT SALES POINT (I E, NO EXCESS DEMAND AT REASONABLE PRICES). 3.ADEQUATE FARMGATE PRICES FOR FARM PRODUCTS.

PROJECT DESIGN INFORMATION

COUNTRY/BUREAU: PAKISTAN
PROJECT TITLE: FAUJI-AGRICO FERTILIZER PROJECT

PROJECT: 3910432 SUB-PROJECT: 00
INITIAL FY: 77 FINAL FY: 82

PROBLEM: PAKISTAN'S DOMESTIC PRODUCTION OF THE FERTILIZER NECESSARY FOR ITS AGRICULTURAL PRODUCTION HAS HISTORICALLY BEEN BELOW DOMESTIC CONSUMPTION. THIS HAS LED THE GOVT OF PAKISTAN (GOP) TO IMPORT FERTILIZER ON A LARGE SCALE. GOP HAS RECENTLY EMBARKED ON A PROGRAM OF EXPANDED PRODUCTION OF FOOD GRAINS. AT THE SAME TIME, HOWEVER, THERE HAS BEEN A WORLDWIDE AND PROHIBITIVE INCREASE IN FERTILIZER PRICES. PAKISTAN'S DOMESTIC PRODUCTION OF FERTILIZER MUST THEREFORE BE INCREASED IF ITS NEW AGRICULTURAL GOALS ARE TO BE MET.

STRATEGY: LOAN TO GOVT OF PAKISTAN FOR FAUJI-AGRICO FERTILIZER PROJECT WILL ASSIST IN FINANCING, DESIGN, AND CONSTRUCTION OF A MODERN FERTILIZER PLANT IN PAKISTAN. FAUJI-AGRICO FERTILIZER LTD, A NEW COMPANY CO-OWNED BY FAUJI FOUNDATION OF PAKISTAN AND AGRICO CHEMICAL COMPANY OF TULSA, OK, WILL IMPLEMENT PROJECT. AGRICO WILL ALSO PROVIDE TECHNICAL ASSISTANCE AND EQUITY. OTHER PROJECT FINANCING WILL BE BY IBRD AND BY KREDITANSTALT FUER WIEDERAUFBAU OF THE FEDERAL REPUBLIC OF GERMANY.

SUMMARY: LOAN TO THE GOVERNMENT OF PAKISTAN (GOP) WILL ASSIST FAUJI-AGRICO FERTILIZER LIMITED, A NEW COMPANY CO-OWNED BY FAUJI FOUNDATION IN PAKISTAN AND AGRICO CHEMICAL COMPANY OF TULSA, OK, TO DESIGN AND CONSTRUCT A MODERN FERTILIZER PLANT IN PAKISTAN AND THEREBY INCREASE PAKISTAN'S DOMESTIC PRODUCTION OF FERTILIZER.
NEW FACILITY, TO BE BUILT IN THE PUNJAB PROVINCE, APPROXIMATELY 375 MILES FROM KARACHI, WILL INCLUDE A 1,725 TON PER DAY (TPD) UREA PLANT WITH AN INTERMEDIATE AMMONIA PRODUCTION PLANT OF 1,000 TPD, ALONG WITH ALL NECESSARY ANCILLARY FACILITIES. ON THE BASIS OF 315 DAYS PER YEAR ON-STREAM TIME, THE PLANT WILL HAVE ANNUAL CAPACITIES OF APPROXIMATELY 543,000 TONS OF UREA OF 244,000 NUTRIENT TONS OF NITROGEN, WITH INTERMEDIATE PRODUCTION CAPACITY OF 315,000 TONS OF AMMONIA. THE RAW MATERIAL FOR THE PLANT WILL BE NATURAL GAS TO BE BROUGHT TO THE PLANT SITE VIA A 30 MILE PIPELINE THAT WILL BE CONSTRUCTED AS PART OF THE TOTAL PROJECT. ALSO INCLUDED IN THE TOTAL PROJECT ARE A POWER GENERATING CAPACITY, AN EMERGENCY DIESEL GENERATOR, A COOLING WATER SYSTEM, A WATER TREATMENT SYSTEM, AND A STEAM GENERATION SYSTEM.
RECRUITMENT OF QUALIFIED PROJECT PERSONNEL WILL BE BY THE FAUJI FOUNDATION. AGRICO COMPANY WILL DESIGN AND SUPERVISE A TRAINING PROGRAM FOR KEY PERSONNEL IN SPECIFIC PROJECT REQUIREMENTS AND WILL ALSO NOMINATE, FROM ITS OWN PERSONNEL, INDIVIDUALS TO FILL THE POSITIONS OF DEPUTY MANAGING DIRECTOR, DIRECTOR OF OPERATIONS, AND DEPUTY DIRECTORS OF FINANCE, ADMINISTRATION AND MARKETING.
ADDITIONAL DONORS IN THE PROJECT ARE IBRD AND THE KREDITANSTALT FUER WIEDERAUFBAU OF THE FEDERAL REPUBLIC OF GERMANY. LOAN FUNDS OF $40 MILLION, WHICH WILL PROVIDE 16.5% OF TOTAL PROJECT ESTIMATED COST OF $246.7 MILLION, WILL BE USED TO FINANCE ONLY FOREIGN EXCHANGE COSTS OF GOODS AND SERVICES.

GOAL: AVAILABILTIY OF FERTILIZER ON RELIABLE BASIS AND AT REASONABLY DEPENDABLE ECONOMIC COSTS.

PURPOSE: INCREASED DOMESTIC PRODUCTION OF FERTILIZER.

OUTPUTS: 1. PLANT WITH RATIO CAPACITY OF 543,000 TONS OF UREA WILL PRODUCE AT 90% OR HIGHER.

Table 2. Other Projects, by Title

Project Number	Old Project Number	Project Title	Date Started	Date Completed
3910011	3911218011	Karachi Fish Harbor	53	59
3910013	39112120013	Soil Mechanics & Hydraulics Lab	53	62
3910015	39111110015	Locust Control	53	59
3910016	39112120016	Bolan Dam	53	59
3910022	39111130022	Plant Protection	54	62
3910027	39111120027	Soil & Water Conservation	54	62
3910028	39112120028	Taunsa Barrage	54	62
3910030	39111120030	Soil & Water Conservation	54	59
3910031	39111120031	Soil & Water Conservation	54	62
3910035	39111120035	Ground Water Survey, West Pakistan	54	69
3910237	39112520237	Karachi Water Supply	54	63
3910054	39111180054	Fisheries, West Pakistan	55	62
3910058	39111120058	Water Resources Advisory	55	59
3910096	39111180096	Fisheries Development	55	62
3910017	39112120017	Makhi Dhand Reclamation	56	59
3910080	39112520080	Village Water Supply	56	62
3910018	39111120018	Ground Water Exploration	57	59
3910024	391225200240	Water Sewage Disposal	58	70
3910166	391521201660	SCARP No. 1	59	68
3910145	39111110145	Agricultural Area Development, West Pakistan	63	72
3910151	39111170151	Forest & Range Management	63	70
3910167	391521201670	Salinity Control & Reclamation--SCARP 2-A	63	68

Project Number	Old Project Number	Project Title	Date Started	Date Completed
3910160		Coastal Embankments	63	74
3910008	39111120008	Waterlogging, Pakistan	65	67
3910253	39111210253	Mineral Resources Appraisal	66	72
3910221		Irrigation Project, Chaj Doab	66	75
3910254	39111120254	Land & Water Use	67	72
3910257	39111120257	Hydrological Monitoring & Research	67	73
3910143		Ground Water Survey	69	74
3910182		Indus Basin Development Fund	72	74
3911820		Indus Basin	76	81
3910447		Water Management Research	79	80

Appendix IX

U.S. Department of Agriculture Programs of Environmental Significance

Appendix IX. Table of Contents

Table 1. Completed Agricultural Research Grants, 1961-1980 (Source: U.S. Dept. of Agriculture 1980a)

Table 2. Current Agricultural Research Grants (Source: U.S. Dept. of Agriculture 1980b)

Table 1. Completed Agricultural Research Grants, 1961-1980

A17-ENT-5 (FG-Pa-106)
Studies on scale insects, fruit flies, and mites and their natural enemies in Pakistan.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED June 23, 1966.

A17-ENT-7 (FG-Pa-108)
Investigations on the natural enemies of corn borers.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED December 7, 1966.

A17-ENT-8 (FG-Pa-110)
Studies on the natural enemies of insect pests of rice.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED December 7, 1966.

A17-ENT-9 (FG-Pa-101)
Studies on insect enemies of noxious weeds in Pakistan.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED July 21, 1965.

A17-ENT-10 (FG-Pa-114)
Studies of the oriental leafhoppers (Typhlocybinae).
University of Karachi, Karachi.
COMPLETED February 29, 1968.

A17-ENT-13 (FG-Pa-117)
Insects, other plant-feeding organisms or plant diseases which attack Eurasian watermilfoil (Myriophyllum spicatum), an aquatic weed.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED May 31, 1970.

A17-ENT-14 (FG-Pa-120)
Biologies and host-plant ranges of insects that attack noxious weeds common to Pakistan and the United States.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED September 15, 1970.

A17-ENT-15 (FG-Pa-123)
Basic studies of parasites of the green peach aphid in northern Pakistan.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED June 23, 1971.

A17-ENT-16 (FG-Pa-124)
Relations between the parasite-predator complex and the host plants of scale insects in Pakistan.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED June 23, 1971.

A17-ENT-18 (FG-Pa-133)
A revision of the genus Tricentrus Stal (treehoppers encountered at U.S. ports of entry) from Pakistan.
University of Karachi, Karachi.
COMPLETED December 31, 1971.

A17-ENT-19 (FG-Pa-126)
Parasites, predators, and pathogens of stink bugs (Pentatomidae) that attack weedy and cultivated graminaceous plants.
Commonwealth Institute of Biological Control, Rawalpindi.
TERMINATED December 31, 1969.

A17-ENT-20 (FG-Pa-125)
Natural enemies of forage and grain legume aphids in Pakistan.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED December 31, 1971.

A17-ENT-21 (FG-Pa-127)
Studies on the ecology of some important species of fruit flies and their natural enemies in Pakistan.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED October 31, 1972.
Cooperating Scientist: Dr. A. K. Burditt, Jr., SEA, Miami, Florida.

A17-ENT-22 (FG-Pa-134)
A study of the parasites of grasshoppers in Pakistan.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED March 31, 1974.
Cooperating Scientist: Mr. Norman Rees, SEA, Bozeman, Montana.

A17-ENT-23 (FG-Pa-148)
Evaluation of sterile male technique in the control of fruit flies (Dacus spp.).
Atomic Energy Agricultural Research Centre, Tandojam.
COMPLETED April 14, 1974.
Coooperating Scientist: Dr. Roy Cunningham, SEA, Honolulu, Hawaii.

A17-ENT-25 (FG-Pa-132)
Taxonomic studies of Deltocephalinae: Cicadellidae of Pakistan and adjoining countries of the Oriental Region.
University of Karachi, Karachi.
COMPLETED February 28, 1973.
Cooperating Scientist: Dr. James P. Kramer, SEA, Washington, D.C.

A17-ENT-26 (FG-Pa-144)
Taxonomic studies of the mites belonging to the families Tetranychidae, Phytoseiidae, Tenuipalpidae, and Stigmaeidae.
University of Agriculture, Faisalabad.
COMPLETED December 1, 1973.
Cooperating Scientist: Dr. Edward W. Baker, SEA, Beltsville, Maryland.

A17-ENT-28 (FG-Pa-150)
Systematic studies on Pyralidae (a family of moths).
Agricultural Research Institute, Peshawar.
COMPLETED January 31, 1976.
Cooperating Scientist: Dr. Douglas Ferguson, SEA, Washington, D.C.

A17-ENT-29 (FG-Pa-178)
Insect and spider mite pests of cotton in Pakistan.
University of Agriculture, Faisalabad.
COMPLETED February 8, 1977.

A17-ENT-30 (FG-Pa-158)
Studies of biology, ecology, life history, and control of Typhlocybine leafhoppers in Pakistan.
Karachi University, Karachi.
COMPLETED October 10, 1973.
Cooperating Scientist: Mr. Ralph D. Guetin, SEA, Brookings, South Dakota.

A17-ENT-32 (FG-Pa-151)
Investigation on natural enemies of some flies that breed in dung and vegetable refuse.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED December 31, 1974.
Cooperating Scientist: Dr. R. R. Blume, SEA, College Station, Texas.

A17-ENT-33 (FG-Pa-164)
Search in West Pakistan for parasites, predators, and pathogens of the pink bollworm, Pectinophora gossypiella, and their introduction into infested areas of the U.S.A.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED June 23, 1976.

A17-ENT-34 (FG-Pa-156)
Laboratory testing and evaluation of insect enemies of Halogeton and Russian thistle research on biological control of weeds common to Pakistan and the United States.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED September 15, 1975.
Cooperating Scientists: Drs. Lloyd A. Andres, SEA, Albany, California, and Kenneth E. Frick, SEA, Stoneville, Mississippi.

A17-ENT-35 (FG-Pa-165)
Insects and other phytophagous organisms which attack Florida elodea (Hydrilla verticillata) in Pakistan.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED March 31, 1976.

A17-ENT-37 (FG-Pa-181)
Systematics and biology of pentato-monorphous superfamilies Coreoidea and Pentatomoidea of Pakistan.
Karachi University, Karachi.
COMPLETED December 31, 1977.
Cooperating Scientist: Dr. J. L. Herring, SEA, Washington, D.C.

A17-ENT-43 (FG-Pa-189)
Studies on parasite-predator complex and important species of Coccinellids on scale insects in Pakistan.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED October 31, 1977.
Cooperating Scientist: Mr. Allen Selhime, SEA, Orlando, Florida.

A17-ENT-44 (FG-Pa-191)
A systematic survey and study of plant hoppers of superfamily fulgoroidea, including observations on host plant relations, immature stages, and bioclimatic effects on populations in Pakistan.
Karachi University, Karachi.
COMPLETED December 31, 1977.
Cooperating Scientist: Dr. J. P. Kramer, SEA, Washington, D.C.

A17-ENT-46 (FG-Pa-183)
Natural enemies of graminaceous aphids.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED January 23, 1977.
Cooperating Scientist: Mr. George W. Angalet, SEA, Newark, Delaware.

A17-CR-3 (FG-Pa-112)
Fundamental studies on rusts and smuts of small grains in Pakistan.
Cereal Rusts Laboratory, Murree.
COMPLETED December 31, 1971.

A17-CR-5 (FG-Pa-111)
New crops screening of native plants of Pakistan of potential use in the agriculture of the United States.
Gordon College, Rawalpindi.
COMPLETED January 11, 1967.

A17-CR-6 (FG-Pa-116)
Collection and identification of fungi of Pakistan.
Government College, Lahore.
COMPLETED May 14, 1968.

A17-CR-7 (FG-Pa-121)
Flora of Pakistan.
Gordon College, Rawalpindi.
COMPLETED September 11, 1971.

A17-CR-10 (FG-Pa-136)
Flora of Pakistan.
University of Karachi, Karachi.
COMPLETED November 21, 1973.
Cooperating Scientist: Dr. Quentin Jones, SEA, Beltsville, Maryland.

A17-CR-21 (FG-Pa-149)
Studies on the performance of exotic species of Atriplex and certain grasses in the saline arid condition.
Sind University, Jamshoro.
COMPLETED August 31, 1975.
Cooperating Scientist: Dr. A. T. Bleak, SEA, Logan, Utah.

A17-CR-22 (FG-Pa-146)
Collection and identification of fungi of Pakistan.
Panjab University, Lahore.
COMPLETED December 31, 1975.
Cooperating Scientist: Dr. Lakh R. Batra, SEA, Beltsville, Maryland.

A17-CR-27 (FG-Pa-159)
Biology of farm weeds.
University of Agriculture, Faisalabad.
COMPLETED June 30, 1977.
Cooperating Scientist: Dr. R. B. Taylorson, SEA, Beltsville, Maryland.

A17-CR-37 (FG-Pa-179)
Survey of the useful plants of Pakistan.
Pakistan Council of Scientific and Industrial Research Laboratories, Lahore.
COMPLETED March 31, 1977.
Cooperating Scientist: Dr. James A. Duke, SEA, Beltsville, Maryland.

A17-CR-40 (FG-Pa-171)
Taxonomic studies of economically important plant familes of Pakistan.
National Herbarium Agricultural Research Council, Rawalpindi.
COMPLETED September 14, 1976.
Cooperating Scientist: Dr. Quentin Jones, SEA, Beltsville, Maryland.

A17-PSR-1 (FG-Pa-182)
Improved resistance in grain crops to rusts and smuts in Pakistan.
Department of Plant Protection, Islamabad.
COMPLETED March 13, 1977.
Cooperating Scientist: Dr. R. A. Kilpatrick, SEA, Beltsville, Maryland.

A17-PSR-8 (FG-Pa-187)
Studies on the biological control of sclerotial fungi.
Karachi University, Karachi.
COMPLETED October 31, 1978.
Cooperating Scientist: Dr. George C. Papavizas, SEA, Beltsville, Maryland.

A17-AH-17 (FG-Pa-190)
Replacement of fat-tailed sheep with thin-tailed sheep for increased mutton and wool production.
University of Agriculture, Faisalabad.
COMPLETED January 28, 1979.
Cooperating Scientist: Dr. C. E. Terrill, SEA, Beltsville, Maryland.

A17-AH-19 (FG-Pa-157)
Studies on morphological and physiological characteristics of basic breeds of cattle and buffaloes in Pakistan.
University of Karachi, Karachi.
COMPLETED December 31, 1976.
Cooperating Scientist: Dr. Ronald D. Plowman, SEA, Logan, Utah.

A17-AE-1 (FG-Pa-118)
Development of solar powered equipment for operating a small irrigation pump.
Atomic Energy Centre, Lahore.
COMPLETED October 31, 1967.

A17-SWC-2 (FG-Pa-147)
Effect of salinity on the nutrition patterns and developmental physiology of crops and the exploration of ameliorative measures.
Atomic Energy Agricultural Research Centre, Tandojam.
COMPLETED February 9, 1975.
Cooperating Scientist: Dr. George A. Pearson, SEA, Georgetown, Delaware.

A17-MQ-1(b)(1) (FG-Pa-141)
Application of gamma rays for the control of some major stored-grain pests.
Ministry of Agriculture and Works, Karachi.
COMPLETED June 4, 1975.
Cooperating Scientist: Mr. Elvin W. Tilton, SEA, Savannah, Georgia.

A17-MQ-2(b)(1) (FG-Pa-145)
Control of Khapra beetle (Trogoderma granarium).
Ministry of Agriculture and Works, Karachi.
COMPLETED February 28, 1975.

A17-MQ-6(b)(1) (FG-Pa-161)
Scheme for research on stored-grain pests in Pakistan.
University of Agriculture, Faisalabad.
COMPLETED February 28, 1977.
Cooperating Scientist: Dr. Lee A. Bulla, SEA, Manhattan, Kansas.

UM-A17-(10)-12 (FG-Pa-170)
Collection, isolation, and classification of molds in Pakistan belonging to the order Mucorales, as potential agents for the conversion of farm-produced raw materials, to useful products.
University of Agriculture, Faisalabad.
COMPLETED February 27, 1978.
Cooperating Scientist: Dr. C. W. Hesseltine, SEA, Peoria, Illinois.

PK-ARS-1 (FG-Pa-237)
Effect of different kinds and degrees of pollution on the aquatic organisms of Pakistan.
Gordon College, Rawalpindi.
COMPLETED December 30, 1977.
Cooperating Scientist: Mr. Robert J. Davis, SEA, Durant, Oklahoma.

PK-ARS-2 (FG-Pa-227)
Effect of fertilizers on the nutritional quality of vegetables and grain crops.
Punjab Agricultural Research Institute, Faisalabad.
COMPLETED July 9, 1978.
Cooperating Scientist: Dr. M. J. Silbernagel, SEA, Prosser, Washington.

PK-ARS-3 (FG-Pa-221)
Availability status of micronutrients in the soils of Pakistan and the role and behavior of selected micronutrients in the nutrition of crops.
Nuclear Institute for Agriculture and Biology, Faisalabad.
COMPLETED July 30, 1980.
Cooperating Scientist: Dr. Glen Leggett, SEA, Kimberly, Idaho.

PK-ARS-4 (FG-Pa-220)
Biosystematics of leafhopper pests of vegetables and fruit trees in Pakistan.
Karachi University, Karachi.
COMPLETED October 10, 1978.

PK-ARS-6 (FG-Pa-224)
Studies on soil sealants for lining of earthen channels.
Irrigation Research Institute, Lahore.
COMPLETED April 30, 1979.
Cooperating Scientist: Dr. Allen R. Dedrick, SEA, Phoenix, Arizona.

PK-ARS-7(N) (FG-Pa-222)
Investigations on the natural enemies of marijuana, Cannabis sativa, and opium poppy Papaver somniferum.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED July 13, 1978.
Cooperating Scientist: Dr. Paul L. Lentz, SEA, Beltsville, Maryland.

PK-ARS-9 (FG-Pa-226)
Systematic study of important plant families of Pakistan.
Karachi University, Karachi.
COMPLETED November 21, 1978.
Cooperating Scientist: Dr. James A. Duke, SEA, Beltsville, Maryland.

PK-ARS-11 (FG-Pa-206)
Studies on the crystalliferous bacteria infecting lepidopterous pests of Pakistan.
University of Karachi, Karachi.
COMPLETED September 15, 1978.
Cooperating Scientist: Dr. Howard T. Dulmage, SEA, Brownsville, Texas.

PK-ARS-15 (FG-Pa-232)
A revision of leafhoppers (Cicadellidae) of Pakistan and adjoining countries of the oriental region.
Karachi University, Karachi.
COMPLETED August 31, 1979.
Cooperating Scientist: Dr. James P. Kramer, SEA, Washington, D.C.

PK-ARS-16 (FG-Pa-213)
Taxonomy and biology of Hieroglyphus sp. (Acrididae:Acridoidea:Orthoptera) a serious pest of sugarcane and paddy in Pakistan.
Sind University, Jamshoro, Sind.
CANCELED November 12, 1973.

PK-ARS-18 (FG-Pa-210)
Effect of naphthenates on growth, yield, fibre quality, and physiology of cotton.
Atomic Energy Agricultural Research Centre, Tandojam.
COMPLETED April 13, 1976.
Cooperating Scientist: Dr. Jack R. Mauney, SEA, Phoenix, Arizona.

PK-ARS-19(N) (FG-Pa-218)
Pharmacognostic studies of selected indigenous plants of Pakistan.
Pakistan Forest Institute, Peshawar.
COMPLETED October 31, 1978.
Cooperating Scientist: Dr. James A. Duke, SEA, Beltsville, Maryland.

PK-ARS-20 (FG-Pa-212)
Survey of grasshoppers in arid and semi-arid regions of Pakistan.
Department of Plant Protection, Malir Halt, Karachi.
COMPLETED September 15, 1980.
Cooperating Scientist: Dr. David A. Nickle, SEA, Washington, D.C.

PK-ARS-22 (FG-Pa-219)
Management of high bicarbonate irrigation waters.
University of Agriculture, Faisalabad.
COMPLETED August 6, 1979.
Cooperating Scientist: Dr. James D. Rhoades, SEA, Riverside, California.

PK-ARS-30 (FG-Pa-228)
Studies on the predatory leaf-inhabiting mites of Pakistan.
University of Agriculture, Faisalabad.
COMPLETED December 1, 1978.
Cooperating Scientist: Dr. E. W. Baker, SEA, Beltsville, Maryland.

PK-ARS-49 (FG-Pa-242)
Taxonomy of cellulolytic fungi isolated from saline and sodic soils.
Nuclear Institute for Agriculture and Biology, Faisalabad.
COMPLETED July 7, 1980.
Cooperating Scientist: Dr. L. R. Batra, SEA, Beltsville, Maryland.

PK-ARS-53 (FG-Pa-240)
Investigation of the resistance of indigenous (Desi) fowl to Marek's disease and leucosis.
Poultry Research Institute, Karachi.
COMPLETED June 3, 1977.
Cooperating Scientist: Dr. J. M. Sharma, SEA, East Lansing, Michigan.

PK-ARS-56 (FG-Pa-245)
A revision of the superfamily Membracoidea of Pakistan.
Karachi University, Karachi.
COMPLETED November 29, 1979.
COOPERATING Scientists: Drs. Ronald W. Hodges, SEA, Washington, D.C., and Dennis D. Kopp, SEA, Fargo, North Dakota.

PK-ARS-63(N) (FG-Pa-249)
Screening of sugar beet germplasm for bolting resistance, disease and insect resistance and developing improved varieties and their seed production at higher elevations.
Agricultural Research Institute, Tarnab, Peshawar.
COMPLETED November 11, 1979.
Cooperating Scientist: Dr. J. S. McFarlane, SEA, Salinas, California.

PK-ARS-65(N) (FG-Pa-255)
Accelerated gram (chickpeas) production in North West Frontier Province, Pakistan.
Agricultural Research Institute, Tarnab, Peshawar.
TERMINATED August 31, 1979.

PK-ARS-66 (FG-Pa-248)
To study the impact of the use of herbicides to control weeds for the increased agricultural production.
Sind Agriculture College, Tandojam.
COMPLETED September 27, 1977.
Cooperating Scientist: Dr. C. G. McWhorter, SEA, Stoneville, Mississippi.

PK-ARS-67 (FG-Pa-268)
Studies of ectoparasites of livestock.
University of Sind, Jamshoro.
COMPLETED August 31, 1980.
Cooperating Scientist: Dr. Roger O. Drummond, SEA, Kerrville, Texas.

PK-ARS-68(N) (FG-Pa-247)
Improvement of pome and nut fruits in northern region of North West Frontier Province.
Agricultural Research Institute, Peshawar.
COMPLETED November 26, 1979.
Cooperating Scientist: Dr. Miklos Faust, SEA, Beltsville, Maryland.

PK-ARS-70 (FG-Pa-250)
Studies on ecology, biology, and behavior of some important parasites of grasshoppers in Pakistan.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED February 28, 1978.
Cooperating Scientist: Mr. Norman E. Rees, SEA, Bozeman, Montana.

PK-ARS-81 (FG-Pa-259)
Investigations on the insect enemies of Abutilon, Amaranthus, Rumex, and Sorghum in Pakistan.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED September 15, 1980.
Cooperating Scientist: Dr. Kenneth E. Frick, SEA, Stoneville, Mississippi.

PK-ARS-91 (FG-Pa-261)
Investigations on the natural enemies of Lygus spp., and other plant bugs.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED November 30, 1978.
Cooperating Scientist: Dr. H. M. Graham, SEA, Tucson, Arizona.

PK-ARS-92(N) (FG-Pa-280)
Research on honey bee management in Pakistan.
Agricultural Research Council, Islamabad.
COMPLETED October 28, 1979.
Cooperating Scientist: Dr. Gordon D. Waller, SEA, Tucson, Arizona.

PK-ARS-96 (FG-Pa-265)
Further studies on parasite host relationships in relation to control of insect crop pests.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED February 14, 1979.
Cooperating Scientist: Dr. Edgar King, SEA, Stoneville, Mississippi.

PK-ARS-110 (FG-Pa-279)
Studies on climatic physiology of cattle and buffaloes.
Livestock Production Research Institute, Bahadurnagar (Okara).
COMPLETED December 31, 1979.
Cooperating Scientist: Dr. Douglas Bolt, SEA, Beltsville, Maryland.

A17-ERS-3 (FG-Pa-139)
Economics of groundwater development and use as related to agricultural needs and productivity in the Punjab area of Pakistan.
Irrigation and Power Department of Pakistan, Lahore.
COMPLETED September 3, 1972.

A17-ERS-14 (FG-Pa-173)
Impact of land reforms on agricultural productivity.
University of Agriculture, Faisalabad.
COMPLETED January 31, 1973.
Cooperating Scientist: Dr. G. L. Wunderlich, ESCS, Washington, D.C.

A17-ERS-15 (FG-Pa-172)
Derivation of fertilizer crop response and the optimum level of fertilization for various crops and areas.
University of Agriculture, Faisalabad.
COMPLETED October 7, 1977.
Cooperating Scientist: Dr. David M. Harrington, ESCS, Washington, D.C.

A17-ERS-18 (FG-Pa-197)
To study the role of migratory farm labor in farm production in Sind Province of Pakistan.
Sind Agriculture University, Tandojam.
COMPLETED January 31, 1980.
Cooperating Scientist: Dr. Ward W. Bauder, ESCS, Ithaca, New York.

A17-ERS-19 (FG-Pa-198)
Studies on the economics of groundwater development, quality of water and its effects on the agricultural productivity in the Punjab area of Pakistan.
Irrigation Research Institute, Lahore.
COMPLETED September 1, 1978.
Cooperating Scientist: Dr. Charles V. Moore, ESCS, Davis, California.

A17-FS-1 (FG-Pa-105)
Survey of insect fauna of the forests of Pakistan.
Forest Research Institute, Peshawar.
COMPLETED November 30, 1965.

A17-FS-2 (FG-Pa-109)
Investigation and evaluation of factors influencing the absorption and penetration of preservatives in tropical timber.
Wood Preservation and Wood Chemistry Division, Chittagong.
TERMINATED July 31, 1967.

A17-FS-5 (FG-Pa-100)
Investigations on the predators of Adelges (balsam woolly aphid) on fir trees in Pakistan, and their possible use in the U.S. for biological control of this insect.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED March 16, 1965.

A17-FS-6 (FG-Pa-104)
Studies on the natural enemies of insect pests of Pakistan forests.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED June 23, 1966.

A17-FS-7 (FG-Pa-113)
The collection of authentic wood samples and herbarium materials of trees in Pakistan.
East Pakistan Forest Research Laboratory, Chittagong.
COMPLETED October 9, 1968.

A17-FS-9 (FG-Pa-119)
Biology and ecology of important predators of spruce and fir aphids.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED March 16, 1970.

A17-FS-10 (FG-Pa-122)
Ecology, biology and behavior of the principal natural enemies of major pests of important forest plants common to Pakistan and the United States.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED June 23, 1971.

A17-FS-11 (FG-Pa-130)
Study of population dynamics of two-poplar defoliators.
Pakistan Forest Institute, Peshawar.
COMPLETED February 28, 1973.

A17-FS-12 (FG-Pa-131)
Termites of Pakistan - identity, distribution, and ecological relationships.
Pakistan Forest Institute, Peshawar.
COMPLETED October 18, 1972.

A17-FS-13 (FG-Pa-128)
Genetical variations of natural stands of Himalayan blue pine (Pinus griffithii).
Pakistan Forest Institute, Peshawar.
COMPLETED July 2, 1970.

A17-FS-14 (FG-Pa-129)
Survey and regeneration of medicinal plants in Pakistan.
Pakistan Forest Institute, Peshawar.
COMPLETED February 28, 1973.

A17-FS-15 (FG-Pa-138)
Survey of the diseases of conifers and selected hardwoods in Pakistan.
Pakistan Forest Institute, Peshawar.
COMPLETED December 31, 1973.

A17-FS-18 (FG-Pa-163)
Establishment of provenance trials; intrespecific hybridization amongst provenances, of the Himalayan blue pine (Pinus wallichiana A. B. Jacks; Syn P. griffithii).
Pakistan Forest Institute, Peshawar.
COMPLETED August 31, 1976.
Cooperating Scientist: Dr. Peter W. Garrett, FS, Durham, New Hampshire.

A17-FS-19 (FG-Pa-202)
Investigations on primary mortality-causing agents affecting sawflies populations in high altitude forests in Pakistan.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED October 31, 1978.
Cooperating Scientist: Dr. Louis F. Wilson, FS, East Lansing, Michigan.

A17-FS-22 (FG-Pa-204)
Study of wildlife and natural ecological environment in the Indus-Delta of Pakistan.
Karachi University, Karachi.
COMPLETED February 19, 1978.
Cooperating Scientist: Dr. Ardell J. Bjugstad, FS, Rapid City, South Dakota.

A17-FS-23 (FG-Pa-208)
A survey of occurrence of endotrophic mycorrhizae and ectogone spores in soils of Pakistan and their effects on growth of plants, especially crops.
Quaid-i-Azam University, Islamabad.
COMPLETED March 26, 1979.
Cooperating Scientist: Dr. Edward Hacskaylo, FS, Beltsville, Maryland.

A17-FS-24 (FG-Pa-186)
Investigations on the natural enemies of dwarf-mistletoes, Arceuthobium spp., and other forest weeds common to Pakistan and the United States.
Commonwealth Institute of Biological Control, Rawalpindi.
COMPLETED February 14, 1976.
Cooperating Scientist: Dr. R. E. Stevens, FS, Fort Collins, Colorado.

A17-FS-25 (FG-Pa-188)
Introduction of fast growing forest species of industrial importance.
Forest Research Division, Hyderabad.
COMPLETED November 3, 1977.
Cooperating Scientist: Dr. D. T. Cooper, FS, Stoneville, Mississippi.

A17-FS-28 (FG-Pa-200)
Ecology and control of economically important termite species of Pakistan.
Pakistan Forest Institute, Peshawar.
COMPLETED November 26, 1977.
Cooperating Scientist: Dr. Joseph K. Mauldin, FS, Gulfport, Mississippi.

A17-FS-29 (FG-Pa-205)
Ecological studies on the stem borers of poplars.
Pakistan Forest Institute, Peshawar.
COMPLETED February 28, 1978.
Cooperating Scientist: Dr. James D. Solomon, FS, Stoneville, Mississippi.

PK-FS-31 (FG-Pa-209)
Investigations on red ring rot of conifers in Pakistan.
Pakistan Forest Institute, Peshawar.
COMPLETED December 31, 1979
Cooperating Scientist: Dr. Paul E. Aho, FS, Corvallis, Oregon.

PK-FS-35 (FG-Pa-243)
The biological, behavioral, and habitats studies of Urial, (Ovis orientalis punjabiensis) Chinkara deer (Gazelle gazelle), and Nilgai (Boselaphus tragocamelus) in the Punjab.
Forestry and Wildlife Department, Lahore.
COMPLETED June 24, 1979.
Cooperating Scientist: Dr. Jack W. Thomas, FS, La Grande, Oregon.

PK-FS-36 (FG-Pa-238)
Insect enemies attacking tamarisk, Tamarix spp., in Pakistan.
Commonwelath Institute of Biological Control, Rawalpindi.
COMPLETED June 24, 1980.
Cooperating Scientist: Dr. Charles F. Tiernan, FS, Missoula, Montana.

PK-FS-41 (FG-Pa-277)
A survey of socio-economic conditions of manpower engaged in forest and wood-based industry in Pakistan.
Pakistan Forest Institute, Peshawar.
COMPLETED February 29, 1980.
Cooperating Scientist: Dr. Dean M. Quinney, FS, Washington, D.C.

PK-FS-43 (FG-Pa-283)
Collection and seed of different seed sources and establishment of provenance trials of Himalayan blue pine (Pinus wallichiana A.B. Jacks. Syn. Pinus griffithii).
Pakistan Forest Institute, Peshawar.
COMPLETED July 30, 1980.
Cooperating Scientist: Dr. Peter W. Garrett, FS, Durham, New Hampshire.

Table 2. Current Agricultural Research Grants

Animal and Plant Health Inspection Service

PK-APHIS-1 (FG-Pa-276)
Studies on Newcastle disease vaccines.
Poultry Research Institute, Karachi.
Executed June 17, 1976. Duration: 5 years.
Amount: 1,458,848 Pakistani rupees ($147,358. equivalent).
Principal Investigators: Dr. Y. M. Eissa and Mr. Asaddus Zafar
Cooperating Scientists: Drs. Eugene Gill, APHIS, Hyattsville, Maryland, and Charles W. Beard, SEA, Athens, Georgia.

Science and Education Administration

PK-ARS-28 (FG-Pa-311)
Bionomics and control of Coccids in Baluchistan.
Agricultural Research Institute, Sariab, Quetta, Baluchistan.
Executed January 21, 1978. Duration: 3 years.
Amount: 577,800 Pakistani rupees ($[illegible],364. equivalent).
Principal Investigator: Mr. Abdul Hameed Bajoi
Cooperating Scientist: Dr. Jerry A. Payne, SEA, Byron, Georgia.

PK-ARS-42 (FG-Pa-288)
Salmonellae in poultry, poultry products, poultry feed, and feed ingradients.
University of Karachi, Karachi.
Executed November 2, 1976. Duration: 5 years.
Amount: 774,106 Pakistani rupees ($78,192. equivalent).
Principal Investigator: Dr. Y. M. Eissa
Cooperating Scientist: Dr. J. E. Williams, SEA. Athens, Georgia.

PK-ARS-46 (FG-Pa-246)
Pest management studies and research for the development of integrated pest control programme, for major field - paddy maize, cotton, and sugarcane crops.
Pakistan Agricultural Research Council, Islamabad.
Executed July 8, 1974 (eff. 10/1/74). Duration: 6 years, 3 months.
Amount: 3,795,065 Pakistani rupees ($383,340. equivalent).
Principal Investigator: Dr. M. N. Beg
Cooperating Scientists: Drs. T. J. Henneberry, SEA, Phoenix, Arizona; H. Koike, SEA, Houma, Louisiana; and R. J. Smith, SEA, Stuttgart, Arkansas.

PK-ARS-54 (FG-Pa-284)
Control and eradication of aquatic weeds in lakes and impounded waters.
Directorate of Fisheries, Government of Sind, Karachi.
Executed August 4, 1976 (eff. 1/3/77). Duration: 5 years.
Amount: 767,610 Pakistani rupees ($77,536. equivalent).
Principal Investigators: Mr. Moinuddin Ahmed and Mr. A. Yunus Khan
Cooperating Scientist: Dr. Richard D. Comes, SEA, Prosser, Washington.

PK-ARS-69 (FG-Pa-251)
Estimation of consumptive use of water of major crops in Pakistan under optimum management conditions.
Pakistan Agricultural Research Council, Islamabad.
Executed January 2, 1975. Duration: 6 years.
Amount: 577,448 Pakistani rupees ($58,328. equivalent).
Coordinator: Dr. Baz Mohammad Khan
Cooperating Scientists: Drs. D. T. Westermann, SEA, Kimberly, Idaho, and Marvin E. Jensen, SEA, Beltsville, Maryland.

(a) Punjab Agricultural Research Institute, Faisalabad.
Executed January 2, 1975. Duration: 6 years.
Amount: 696,317 Pakistani rupees ($70,335. equivalent).
Principal Investigator: Ch. Hayat Mohammad Bhatti

(b) Agricultural Research Institute, Tarnab.
Executed January 2, 1975. Duration: 6 years.
Amount: 847,684 Pakistani rupees ($85,625. equivalent).
Principal Investigator: Mr. Abdul Hamid

(c) Sind Agricultural University, Tandojam.
Executed January 2, 1975. Duration: 6 years.
Amount: 1,450,603 Pakistani rupees ($146,526. equivalent).
Principal Investigators: Mr. Ghulam Nobi Kalwar and Mr. Meshon Khan Abbasi

(d) Mono Reclamation Experimental Project, WAPDA, Mona Colony, Bhalwal.
Executed July 1, 1975. Duration: 5½ years.
Amount: 1,078,806 Pakistani rupees ($108,970. equivalent).
Principal Investigators: Mr. Bashir Ahmad and Mr. Mohammad Sharif Tabassam

PK-ARS-72 (FG-Pa-271)
Control of aquatic weeds.
Institute of Chemistry, Punjab University, Lahore.
Executed April 13, 1976. Duration: 5 years.
Amount: 2,601,260 Pakistani rupees ($262,754. equivalent).
Principal Investigator: Dr. Muhammad Z. Iqbal
Cooperating Scientist: Dr. Richard D. Comes, SEA, Prosser, Washington.

PK-ARS-76 (FG-Pa-266)
Quantity of water of different qualities required to grow successful arable crops and keep a healthy salt balance in the soil.
Punjab Agricultural Research Institute, Faisalabad.
Executed January 31, 1976 (eff. 7/1/76). Duration: 5 years.
Amount: 888,541 Pakistani rupees ($89,752. equivalent).
Principal Investigator: Mr. Hayat Muhammad Bhatti
Cooperating Scientist: Dr. J. D. Rhoades, SEA, Riverside, California.

PK-ARS-78 (FG-Pa-267)
Survey and evaluation of effectiveness of the parasites, predators, and pathogens of cutworms affecting fruits, vegetables, field crops, and grasses.
Commonwealth Institute of Biological Control, Rawalpindi.
Executed November 1, 1976 (eff. 11/1/78). Duration: 3 years.
Amount: 718,208 Pakistani rupees ($72,546. equivalent).
Principal Investigator: Dr. A. I. Mohyuddin
Cooperating Scientist: Dr. J. Franklin Howell, SEA, Yakima, Washington.

PK-ARS-79 (FG-Pa-258)
Biology and ecology of principal natural enemies of some flies that breed in dung and vegetable refuse in Pakistan.
Commonwealth Institute of Biological Control, Rawalpindi.
Executed May 16, 1975 (eff. 4/1/76). Duration: 5 years.
Amount: 888,630 Pakistani rupees ($89,761. equivalent).
Principal Investigator: Dr. A. I. Mohyuddin
Cooperating Scientist: Dr. Richard R. Blume, SEA, College Station, Texas.

* PK-ARS-82 (FG-Pa-335)
Mycotoxins in food and feedstuffs.
Pakistan Council of Scientific and Industrial Research, Lahore.
Executed Duration: 4 years
Amount: 902,940 Pakistani rupees ($91,206. equivalent).
Principal Investigators: Drs. F. H. Shah and A. Salam Sheikh
Cooperating Scientist: Dr. C. W. Hesseltine, SEA, Peoria, Illinois.

PK-ARS-83 (FG-Pa-270)
Investigations on the biological control of *Rhizoctonia solani* and *Fusarium oxysporum f. lini* causing root rot and wilt diseases in cotton and linseed crops respectively.
Punjab Agricultural Research Institute, Faisalabad.
Executed May 14, 1976. Duration: 5 years.
Amount: 609,520 Pakistani rupees ($61,568. equivalent).
Principal Investigator: Dr. Muhammad Akhtar
Cooperating Scientist: Dr. Jack A. Lewis, SEA, Beltsville, Maryland.

PK-ARS-100 (FG-Pa-275)
Further taxonomic studies of economically important families in the flora of Pakistan.
Stewart Herbarium, Pakistan Agricultural Research Council, Islamabad.
Executed June 1, 1976. Duration: 5 years.
Amount: 1,492,326 Pakistani rupees ($150,740. equivalent).
Principal Investigators: Dr. E. Nasir and Mr. Yasin J. Nasir
Cooperating Scientist: Dr. Edward E. Terrell, SEA, Beltsville, Maryland.

PK-ARS-106 (FG-Pa-272)
Studies on the biology, phenology, and field behavior of natural enemies of the pink bollworm *Pectinophora gossypiella* (Saund) in Pakistan.
Commonwealth Institute of Biological Control, Rawalpindi.
Executed June 24, 1976. Duration: 5 years.
Amount: 1,133,754 Pakistani rupees ($114,520. equivalent).
Principal Investigator: Dr. A. I. Mohyuddin
Cooperating Scientist: Dr. H. M. Graham, SEA, Tucson, Arizona.

PK-ARS-114 (FG-Pa-294)
Screening of germplasm of Oleiferous Brassicae for resistance to aphids.
Nuclear Institute for Agriculture and Biology, Faisalabad.
Executed August 16, 1977. Duration: 5 years.
Amount: 709,380 Pakistani rupees ($71,655. equivalent).
Principal Investigators: Drs. Nasrullah Chatha and Munir Ahmad Bhatti
Cooperating Scientist: Dr. E. V. Wann, SEA, Charleston, South Carolina.

PK-ARS-119 (FG-Pa-285)
Investigations on nematodes parasitic on insect pests.
Commonwealth Institute of Biological Control, Rawalpindi.
Executed January 24, 1977. Duration: 5 years.
Amount: 1,109,300 Pakistani rupees ($112,051. equivalent).
Principal Investigator: Dr. A. I. Mohyuddin
Cooperating Scientist: Dr. William R. Nickle, SEA, Beltsville, Maryland.

PK-ARS-122 (FG-Pa-293)
Insect pests on stored cereal grains and their control in Pakistan.
University of Agriculture, Faisalabad.
Executed April 17, 1977. Duration: 5 years.
Amount: 916,230 Pakistani rupees ($92,548. equivalent).
Principal Investigator: Dr. Hafiz Abdul Qayyum
Cooperating Scientist: Dr. Lee A. Bulla, SEA, Manhattan, Kansas.

* PK-ARS-125(N) (FG-Pa-329)
Integrated control of aphids on cruciferous crops in Pakistan.
Pakistan Agricultural Research Council, Islamabad.
Executed Duration: 5 years.
Amount: 904,000 Pakistani rupees ($91,313. equivalent).
Principal Investigator: Mr. Umar Khan Baloch
Cooperating Scientist: Dr. George Tamaki, SEA, Yakima, Washington.

PK-ARS-128 (FG-Pa-296)
Investigations on the natural enemies of Epilachna spp. in Pakistan.
Commonwealth Institute of Biological Control, Rawalpindi.
Executed June 1, 1977 (eff. 12/1/78). Duration: 2 years.
Amount: 433,692 Pakistani rupees ($43,807. equivalent).
Principal Investigator: Dr. A. I. Mohyuddin
Cooperating Scientist: Dr. Robert Schroder, SEA, Beltsville, Maryland.

PK-ARS-131 (FG-Pa-305)
Studies on incidence, epizootiology, and development of effective vaccines for the control of contagious caprine pleuropneumonia and contagious agalactia in sheep and goats in Baluchistan.
Animal Husbandry Department, Baluchistan.
Executed November 1, 1977. Duration: 5 years.
Amount: 1,562,180 Pakistani rupees ($157,796. equivalent).
Principal Investigator: Mr. Munir Ahmad Tariq
Cooperating Scientist: Dr. A. H. Dardiri, SEA, Greenport, New York.

PK-ARS-132 (FG-Pa-328)
Development of procedures for using Apanteles flavipes in periodic releases for control of stalk borers feeding on sugarcane and other graminaceous plants.
Commonwealth Institute of Biological Control, Rawalpindi.
Executed Duration: 5 years.
Amount: 1,879,360 Pakistani rupees ($189,834. equivalent).
Principal Investigator: Dr. A. I. Mohyuddin
Cooperating Scientist: Dr. Edgar G. King, Jr., SEA, Stoneville, Mississippi.

PK-ARS-135 (FG-Pa-306)
Studies on rinderpest-like diseases prevalent in livestock at Landhi cattle colony, Karachi.
Livestock Experiment Station, Karachi.
Executed March 1, 1978 (eff. 5/15/80). Duration: 5 years.
Amount: 1,713,500 Pakistani rupees ($173,081. equivalent).
Principal Investigator: Dr. S. M. Athar
Cooperating Scientist: Dr. A. H. Dardiri, SEA, Greenport, New York.

PK-ARS-137 (FG-Pa-299)
Studies on the storage stability of pesticides and their residues on crops in Pakistan.
Pakistan Agricultural Research Council, Malir Halt, Karachi.
Executed July 26, 1977 (eff. 7/10/78). Duration: 5 years.
Amount: 1,191,600 Pakistani rupees ($120,465. equivalent).
Principal Investigator: Mr. Mirza Mohammad Hussain Baig
Cooperating Scientist: Dr. Robert J. Argauer, SEA, Beltsville, Maryland.

PK-ARS-146 (FG-Pa-317)
Investigations on new strains of Bacillus thuringiensis (BT) affecting lepidopterous crop pests.
University of Karachi, Karachi.
Executed September 28, 1978. Duration: 5 years.
Amount: 1,021,662 Pakistani rupees ($103,198. equivalent).
Principal Investigator: Mr. Abdul Farid Khan
Cooperating Scientist: Dr. Clayton C. Beegle, SEA, Brownsville, Texas.

PK-ARS-147 (FG-Pa-315)
Investigation of the resistance of indigenous (desi) fowls to Leukosis and determination of the relative resistance to Marek's disease of crosses and reciprocal crosses of desi and exotic breeds of chicken.
Poultry Research Institute, Karachi.
Executed June 24, 1978 (eff. 11/1/78). Duration: 2 years.
Amount: 319,132 Pakistani rupees ($32,236. equivalent).
Principal Investigator: Dr. S. M. Athar
Cooperating Scientist: Dr. J. M. Sharma, SEA, East Lansing, Michigan.

PK-ARS-150 (FG-Pa-324)
Studies on biosystematics and control of mites of field crops, vegetables, and fruit plants in Pakistan.
University of Agriculture, Faisalabad.
Executed November 30, 1978. Duration: 5 years.
Amount: 1,300,429 Pakistani rupees ($131,356. equivalent).
Principal Investigator: Dr. Wali M. Chaudhri
Cooperating Scientist: Dr. Edward W. Baker, SEA, Beltsville, Maryland.

PK-SEA-152 (FG-Pa-320)
Studies on the integrated control of sclerotial fungi.
University of Karachi, Karachi.
Executed October 26, 1978. Duration: 5 years.
Amount: 1,002,208 Pakistani rupees ($101,233. equivalent).
Principal Investigator: Dr. Abdul Ghaffar
Cooperating Scientist: Dr. Jack A. Lewis, SEA, Beltsville, Maryland.

PK-SEA-154 (FG-Pa-319)
Ecology of leafhopper pests of vegetables and fruit plants of Pakistan.
University of Karachi, Karachi.
Executed October 11, 1978. Duration: 5 years.
Amount: 1,377,324 Pakistani rupees ($139,124. equivalent).
Principal Investigator: Dr. Manzoor Ahmad
Cooperating Scientist: Dr. M. W. Nielson, SEA, Tucson, Arizona.

* PK-SEA-159(N) (FG-Pa-334)
Project for the evaluation of introduced scion and rootstock cultivars, selection for expansion of persimmon, pome, and nut fruits project in northern areas of NWFP (Pakistan).
Agricultural Research Institute, Tarnab.
Executed Duration: 5 years.
Amount: 2,261,390 Pakistani rupees ($228,423. equivalent).
Principal Investigator: Prof. M. S. Roghani
Cooperating Scientist: Dr. Miklos Faust, SEA, Beltsville, Maryland.

Economics, Statistics, and Cooperatives Service

PK-ARS-85 (FG-Pa-286)
Melon fruit fly and its control in (NWFP) Pakistan.
Agricultural Research Institute, Tarnab.
Executed February 14, 1977. Duration: 5 years.
Amount: 852,280 Pakistani rupees ($86,089. equivalent).
Principal Investigator: Dr. Sharfuddin Khan
Cooperating Scientist: Dr. Ernest J. Harris, SEA, Honolulu, Hawaii.

PK-ARS-87 (FG-Pa-260)
Studies on the long term effects of gamma rays on some important pests of stored cereals.
Pakistan Agricultural Research Council, Malir Halt, Karachi.
Executed June 1, 1975. Duration: 5½ years.
Amount: 665,603 Pakistani rupees ($67,233. equivalent).
Principal Investigators: Drs. Hafiz Ahmed and Muhammad Allahdad Khan
Cooperating Scientist: Mr. Elvin W. Tilton, SEA, Savannah, Georgia.

PK-ARS-88 (FG-Pa-263)
Investigations on the insect enemies of Chenopodium spp. (album, murale, and botrys) and Kochia scoparia in Pakistan and supply of specific insect enemies of Salsola and Halogeton to the U.S.A.
Commonwealth Institute of Biological Control, Rawalpindi.
Executed July 1, 1976 (eff. 3/1/78). Duration: 5 years.
Amount: 1,107,380 Pakistani rupees ($111,857. equivalent).
Principal Investigator: Dr. A. I. Mohyuddin
Cooperating Scientists: Mr. Paul Dunn and Dr. Lloyd A. Andres, SEA, Albany, California.

PK-ARS-89 (FG-Pa-264)
Studies on potential biological control agents of white flies in Pakistan.
Commonwealth Institute of Biological Control, Rawalpindi.
Executed July 1, 1976 (eff. 3/1/79). Duration: 3 years.
Amount: 383,460 Pakistani rupees ($38,733. equivalent).
Principal Investigator: Dr. A. I. Mohyuddin
Cooperating Scientist: Dr. Dial F. Martin, SEA, Stoneville, Mississippi.

PK-ARS-90 (FG-Pa-273)
Investigations on the natural enemies of selected lepidopterous pests of crucifers and feasibility studies of mass-rearing and releases of promising species for the control of these pests.
Commonwealth Institute of Biological Control, Rawalpindi.
Executed November 1, 1976 (eff. 3/1/78). Duration: 5 years.
Amount: 1,054,200 Pakistani rupees ($106,485. equivalent).
Principal Investigator: Dr. A. I. Mohyuddin
Cooperating Scientist: Dr. George Tamaki, SEA, Yakima, Washington.

Forest Service

PK-FS-32 (FG-Pa-231)
A survey of occurrence and structure of root nodules in non-leguminous Angiosperms of Pakistan and their ecological and economic significance in reforestation and soil/plant conservation as providers of atmospheric nitrogen.
Quaid-i-Azam University, Islamabad.
Executed January 1, 1974. Duration: 7 years.
Amount: 2,342,248 Pakistani rupees ($236,591. equivalent).
Principal Investigator: Dr. A. H. Chaudhary
Cooperating Scientist: Dr. Edward Hacskaylo, FS, Beltsville, Maryland.

PK-FS-33 (FG-Pa-257)
Management study of hybrid poplar.
Pakistan Forest Institute, Peshawar.
Executed March 3, 1975 (eff. 9/1/75). Duration: 5 years, 5 months.
Amount: 333,973 Pakistani rupees ($33,735. equivalent).
Principal Investigator: Mr. Mahmood Iqbal Sheikh
Cooperating Scientist: Dr. D. T. Cooper, FS, Stoneville, Mississippi.

PK-FS-39 (FG-Pa-256)
Selection of suitable poplar clones for large scale poplar plantation in the Punjab.
Silvicultural Research Forest Division, Lahore.
Executed April 3, 1975 (eff. 1/1/76). Duration: 5 years.
Amount: 767,991 Pakistani rupees ($77,575. equivalent).
Principal Investigator: Mr. Muhammad Attaullah Rana
Cooperating Scientist: Dr. M. E. Demeritt, FS, Durham, New Hampshire.

PK-FS-42 (FG-Pa-291)
Genetic improvement and breeding of three poplar species.
Pakistan Forest Institute, Peshawar.
Executed February 2, 1977. Duration: 5 years.
Amount: 588,975 Pakistani rupees ($59,492. equivalent).
Principal Investigator: Dr. K. M. Siddiqui
Cooperating Scientist: Dr. M. E. Demeritt, FS, Durham, New Hampshire.

PK-FS-46 (FG-Pa-312)
Effect of fertilizer on the rate of growth of forest trees.
Pakistan Forest Institute, Peshawar.
Executed January 26, 1978 (eff. 5/20/78). Duration: 5 years.
Amount: 417,875 Pakistani rupees ($42,210. equivalent).
Principal Investigators: Mr. Mahmood I. Sheikh and Mr. Raja Walayat Hussain
Cooperating Scientist: Dr. David L. Graney, FS, Fayetteville, Arkansas.

PK-FS-47 (FG-Pa-322)
Utilization of poor quality woods growing in Pakistan for the manufacture of panel products.
Pakistan Forest Institute, Peshawar.
Executed December 2, 1978 (eff. 3/26/79). Duration: 3 years.
Amount: 330,000 Pakistani rupees ($33,333. equivalent).
Principal Investigator: Dr. K. M. Siddiqui
Cooperating Scientist: Mr. John A. Youngquist, FS, Madison, Wisconsin.

PK-FS-48 (FG-Pa-323)
Investigation of anatomical, physical, and mechanical properties of exotic and indigenous poplars grown in Pakistan.
Pakistan Forest Institute, Peshawar.
Executed December 2, 1978 (eff. 3/26/79). Duration: 3 years.
Amount: 338,300 Pakistani rupees ($34,172. equivalent).
Principal Investigator: Dr. K. M. Siddiqui
Cooperating Scientist: Dr. Martin Chudnoff, FS, Madison, Wisconsin.

PK-FS-49 (FG-Pa-308)
Growth and management of fast growing tree species in Sind.
Silvicultural Research Division, Hyderabad, Sind.
Executed November 5, 1977. Duration: 5 years.
Amount: 1,175,306 Pakistani rupees ($118,718. equivalent).
Principal Investigator: Mr. Ali Gul Lakho
Cooperating Scientist: Dr. Donald T. Cooper, FS, Stoneville, Mississippi.

PK-FS-50 (FG-Pa-313)
Effect of natural enemies and silvicultural practices on poplar borer populations.
Pakistan Forest Institute, Peshawar.
Executed February 15, 1978. Duration: 5 years.
Amount: 1,094,925 Pakistani rupees ($110,598. equivalent).
Principal Investigators: Mr. Ismail Chaudhry and Mr. M. I. Ahmad
Cooperating Scientist: Dr. James D. Solomon, FS, Stoneville, Mississippi.

PK-FS-51 (FG-Pa-326)
Study of size, placement, and composition of windbreaks for optimum production on annual crops and woods.
Pakistan Forest Institute, Peshawar.
Executed March 26, 1979 (eff. 12/1/79). Duration: 5 years.
Amount: 1,347,500 Pakistani rupees ($136,111. equivalent).
Principal Investigator: Dr. G. M. Khattak
Cooperating Scientist: Dr. David F. Van Haverbeke, FS, Lincoln, Nebraska.

PK-FS-52 (FG-Pa-316)
To develop techniques for utilizing arid and semi-arid lands through planning under dry conditions.
Pakistan Forest Institute, Peshawar.
Executed August 26, 1978 (eff. 1/1/79). Duration: 5 years.
Amount: 1,727,614 Pakistani rupees ($174,506. equivalent).
Principal Investigator: Mr. Mahmood Iqbal Sheikh
Cooperating Scientist: Dr. Stanley L. Krugman, FS, Washington, D.C.

PK-FS-54 (FG-Pa-321)
Bio-ecology of avian fauna in the Sind Province of Pakistan.
University of Karachi, Karachi.
Executed June 9, 1979. Duration: 4 years.
Amount: 1,635,460 Pakistani rupees ($165,198. equivalent).
Principal Investigator: Mr. Perwaiz A. Siddiqui
Cooperating Scientist: Dr. Ardell J. Bjugstad, FS, Rapid City, South Dakota.

PK-FS-55 (FG-Pa-327)
Survey and control of mistletoes in Pakistan
Pakistan Forest Institute, Peshawar.
Executed March 11, 1979 (eff. 8/6/79). Duration: 5 years.
Amount: 1,293,000 Pakistani rupees ($130,606. equivalent).
Principal Investigator: Mr. Zakaullah
Cooperating Scientist: Dr. Frank Hawksworth, FS, Fort Collins, Colorado.

PK-FS-56 (FG-Pa-318)
Ecology and control (microbial and hormonal) of termites in Pakistan.
University of Punjab, Lahore.
Executed October 1, 1978. Duration: 5 years.
Amount: 1,949,500 Pakistani rupees ($196,919. equivalent).
Principal Investigator: Dr. Muzaffer Ahmad
Cooperating Scientist: Dr. J. K. Mauldin, FS, Gulfport, Mississippi.

PK-FS-57 (FG-Pa-325)
Intensive resin extraction methods for *Pinus roxburghii*.
Pakistan Forest Institute, Peshawar.
Executed February 18, 1979. Duration: 4 years.
Amount: 515,359 Pakistani rupees ($52,056. equivalent).
Principal Investigator: Mr. Mahmood Iqbal Sheikh
Cooperating Scientist: Mr. Robert D. McReynolds, FS, Olustee, Florida.

* PK-FS-59 (FG-Pa-331)
National research program of tree improvement and introduction.
Pakistan Forest Institute, Peshawar.
Executed Duration: 5 years.
Amount: 4,509,000 Pakistani rupees ($455,455. equivalent).
Principal Investigator: Dr. K. M. Siddiqui
Cooperating Scientist: Dr. Peter W. Garrett, FS, Durham, New Hampshire.

* PK-FS-60 (FG-Pa-332)
Preparation of monographs on (i) *Eucalyptus camaldulensis*, Dehn, (ii) *Eucalyptus microtheca*, F.V.M., (iii) *Eucalyptus tereticornis*, Sm.
Pakistan Forest Institute, Peshawar.
Executed Duration: 1 year.
Amount: 138,000 Pakistani rupees ($13,393. equivalent).
Principal Investigator: Mr. Mahmood Iqbal Shiekh
Cooperating Scientist: Dr. Stanley L. Krugman, FS, Washington, D.C.

Appendix X

Selected Bibliography

Appendix X. Bibliography

1. General and Land Use
2. Water Resources
3. Other Physical Resources
4. Vegetative Resources and Management
5. Faunal Resources and Management
6. Pollution and Health Problems
7. Legislation and Planning

Appendix X. Bibliography

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