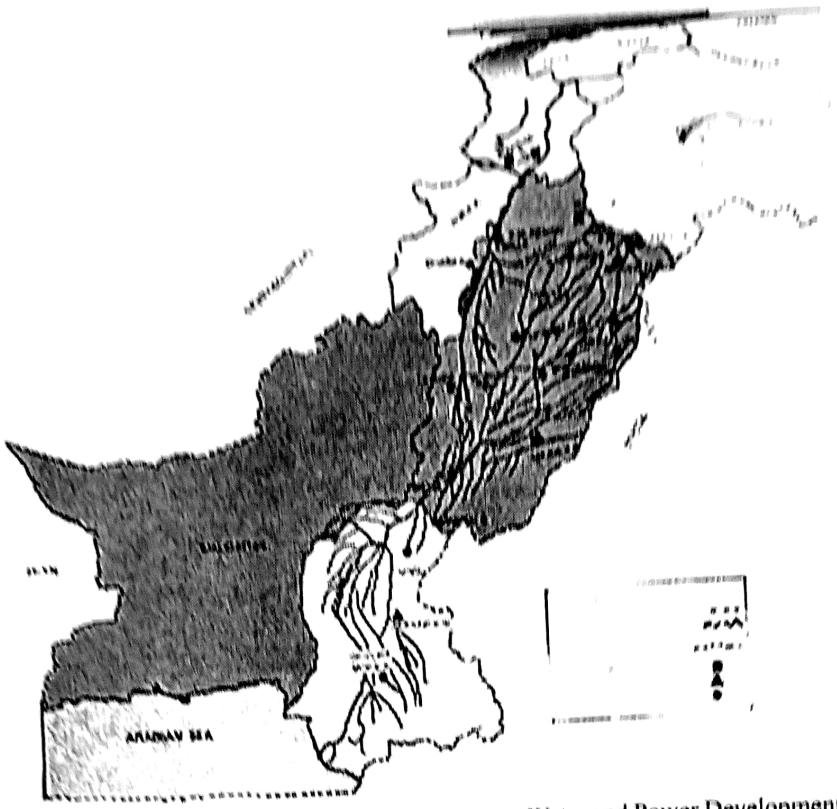

Fig. 22–1. Indus basin irrigation system in Pakistan. Source: Water and Power Development Authority (WAPDA), Pakistan.

INTRODUCTION

Pakistan is a large (80 Mha) and populous (140 Mn people) country of South West or South Asia, lying between 23°5′ and 36°5′ lat and between 61°2′ to 74°5′ long. It is an arid to semi-arid country with 22 Mha cultivated area, of which 5 Mha are rainfed. The country is fortunate to have the Indus basin irrigation system (Fig. 22–1), which is the largest contiguous canal network in the world. Consequently, irrigated agriculture is the mainstay of the country; yet, rainfed agriculture is crucially important because of its significant share in total production of a range of crops except wheat, which is mainly irrigated (Table 22–1). This is particularly so because,

Table 22–1. Rainfed agriculture's share in total crop production in Pakistan.

Crop	Total production	Rainfed	Total rainfed
	10^3 t		%
Guar-seed	181	181	100
Peanut	96	86	90
Mungbean and blackgram	543	438	81
Chickpea	411	316	77
Sorghum and millet	350	196	56
Barley	164	85	52
Maize	1 284	347	27
Rapeseed-mustard	242	61	25
Wheat	17 550	1 755	10

Source: GO P (2002).

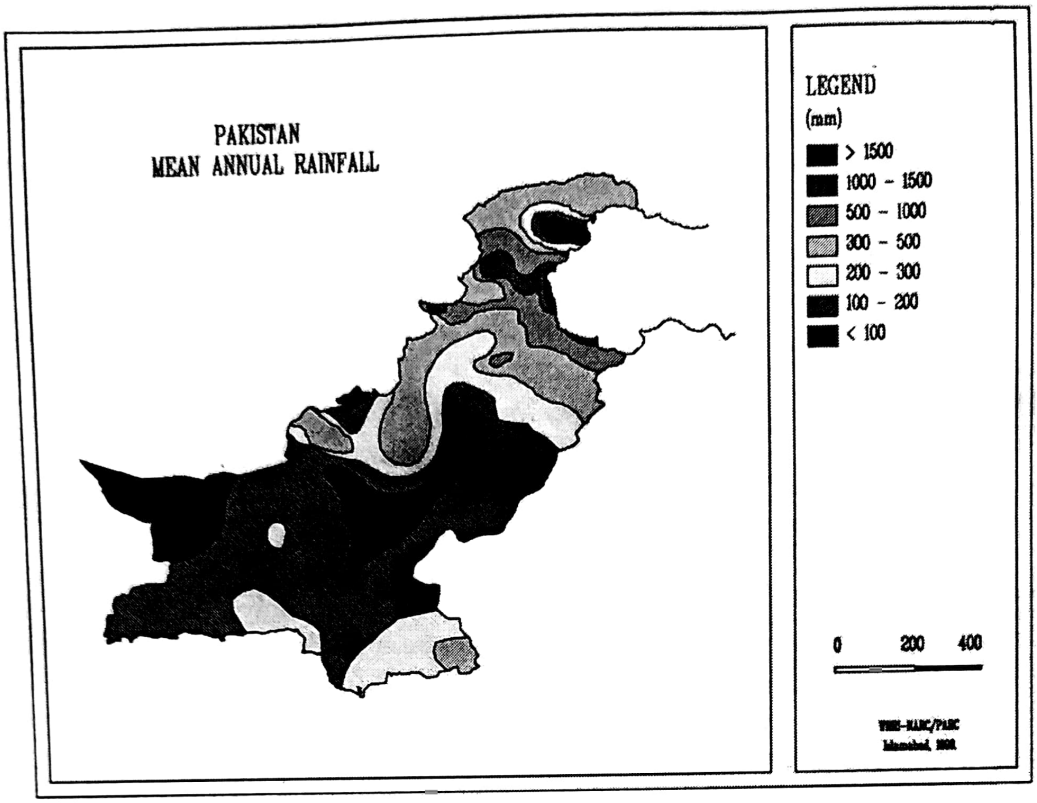

Fig. 22–2. Mean annual rainfall regions in Pakistan.

with a fast growing population, the country is experiencing a rapid decline in per capita of grain-producing land, that is, 0.58 ha in 1950, 0.25 ha in 1980, and 0.18 ha in 2000. However, better dryland productivity can be achieved with careful management of rainfed resources. This would help ease pressure on the irrigated sector, which can consequently be better utilized for cash crops for improving the overall economic well-being of rural communities.

Rainfall

Pakistan is one of the drier countries of the world as indicated by a rainfall map of the country (Fig. 22–2) that shows limited areas in the northern part with favorable rainfall (>1000 mm yr^{-1}), but most of the country with <200 to 300 mm. The gradations in rainfall are more clearly illustrated in a map depicting aridity (Fig. 22–3). Thus, only limited areas are *humid* and *subhumid* (>500 mm), while the vast majority of the land surface is *arid* (<300 mm), especially the vast area of Balochistan, or *semi-arid* (300–500 mm). An analysis of the relative amounts of total rainfall with respect to surface area (Fig. 22–4) area shows that 20% of the country receives <125 mm yr^{-1}, while almost half the country receives between 125 and 250 mm on a yearly basis.

While irrigation water from the Indus counteracts the country's lack of rainfall, the focus of dryland farming is exclusively on areas that are not too dry, that is, semi-arid, where rainfall is sufficient to produce a crop in most seasons. Thus, it is important to examine the seasonal rainfall distribution, which provides for a

Fig. 22–3. Aridity map of Pakistan based on average annual rainfall.

"window of opportunity" in terms of crop planting to harvest. An example for the rainfed Potohar plateau (Fig. 22–5) shows that rainfall has a *bi-model* pattern, being mainly monsoonal, and highly erratic. These characteristics dictate the agricultural productivity in areas dependent exclusively on rainfall and indeed the viability of dryland communities.

Dryland Characteristics

Dryland soil and crop management practices are mostly primitive, coupled with handicaps of precipitation uncertainty/moisture stress, soil erosion, and nutrient depletion. In this high-risk environment, use of agricultural inputs is minimal: fertilizers and improved seed are scarcely used (Rashid et al., 2002a, 2002b). Crop residues are used primarily as a source of feed for animal, and as a fuel by rural communities (Fig. 22–6). The economic value of such residues, used as feed, can equal or exceed that of the seed, particularly in 'poor' rainfall years (Rees et al., 1991). Uncertain rainfall is the major cause of low productivity and/or of crop failures. For example, in (arid to semi-arid) upland Balochistan, the farmers expect

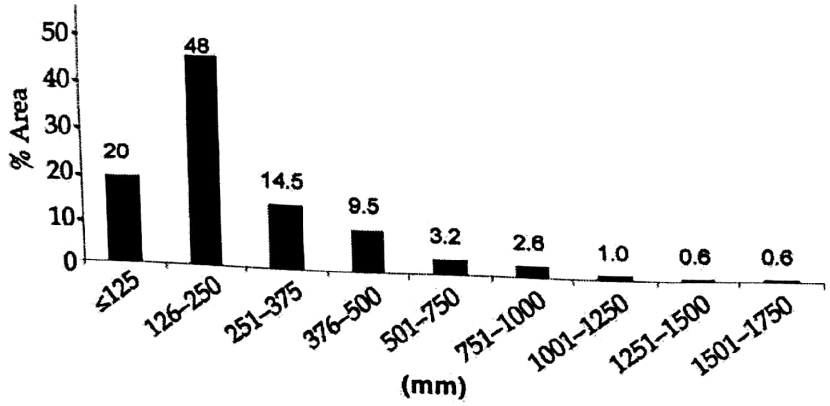

Fig. 22–4. Mean annual rainfalls with corresponding geographical areas in Pakistan.

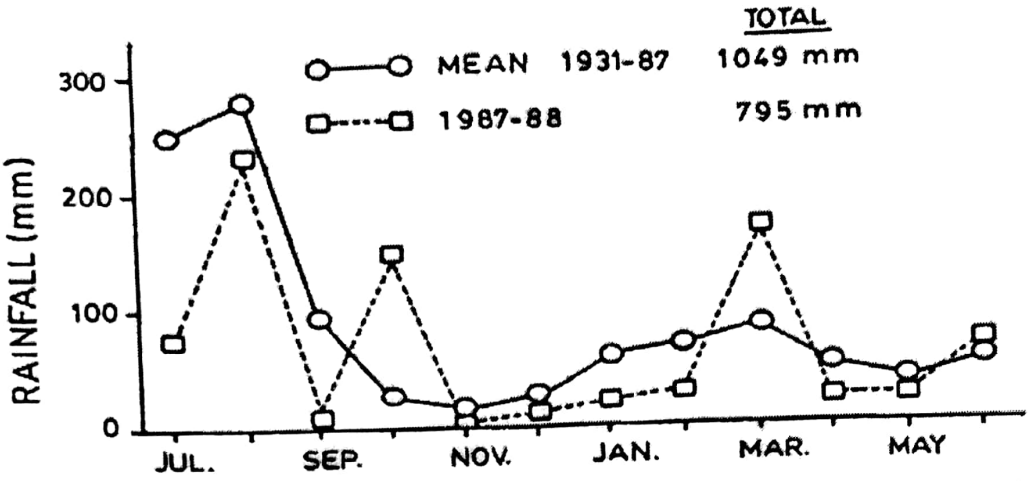

Fig. 22–5. Mean and seasonal rainfall in Potohar plateuau of Pakistan—depicting bimodal and erratic patterns.

a crop failure in 3 to 5 yr out of 10, and even in 'good' rainfall years (2 to 3 out of 10) wheat yields are only 400 to 800 kg ha^{-1} (Rees et al., 1988). Thus, Pakistan's dryland agriculture is a high-risk, low-input enterprise for resource-poor farmers; most dryland holdings are small, and frequently fragmented, a factor which militates against progress. Consequently, crop yields are much below their demonstrated achievable potential. In addition, dryland cropping intensity is expected to increase in the future because of increased demand for food, feed, and fiber for a rapidly increasing population.

Fig. 22–6. Livestock feeding on scarce vegetation in a semi-arid ranglenad of Pakistan.

Table 22–2. Land capability classification of Pakistan's drylands.

Land class	Limitations	Mha
Class d II	Cropland with minor limitations	
d II c	Moisture shortage, irregular rainfall, and	
d II e	Sloping land, vulnerable to erosion	0.23
Total		
Class d III	Cropland with moderate potential	0.42
d III e	Sloping soils	0.79
d III c	Inadequate rainfall	0.86
d III w	Flood watered land	2.07
Total		
Class d IV	Poor dry farmed, economically marginal	1.65
d IV c	Severe moisture shortage	0.48
d IV s	Sandy/gravelly or shallow soils	0.09
d IV e	Sloping soils	0.08
d IV x	Unstable soils	0.07
d IV w	Flood watered land	2.37
Total		

This chapter is not exhaustive, but rather offers a perspective of major features of dryland agriculture in the country, summarizing prevalent situations, issues, and practices, listing suggestions for improvement, and highlighting efforts of development agencies to improve Pakistan's dryland sector.

RAINFED SOIL RESOURCES AND FARMING SYSTEMS

Soils

Pakistan is endowed with a rich soil resource base. The *U.S. Soil Taxonomy* soil orders prevalent in the drylands of Pakistan include Aridisol, Entisol, Inceptisol, and Alfisol (Rafiq, 1996). Though dryland soil productivity is less than in irrigated areas, it is primarily because of moisture constraints rather than poor soil resources per se. Land capability classification of Pakistan's drylands and their use potential is given in Table 22–2. Of the total dryland area, the highest proportion of the land is severely limited, poorly farmed, and economically marginal (2.4 Mha). A slightly smaller fraction (2.07 Mha) has moderate development potential. However, only a tiny fraction (0.23 Mha) is considered as having only minor production limitations.

Rainfed Agriculture and Livestock

Non-irrigated farming systems in Pakistan are variable and are categorized as:

- *Barani*, which is entirely dependent upon rainfall, and mainly characteristic of the *Potohar* plateau and the northern mountains.
- *Sailaba*, which is based on residual moisture from summer floods and rains, and is practiced in riverine areas and active floodplains of the major rivers.

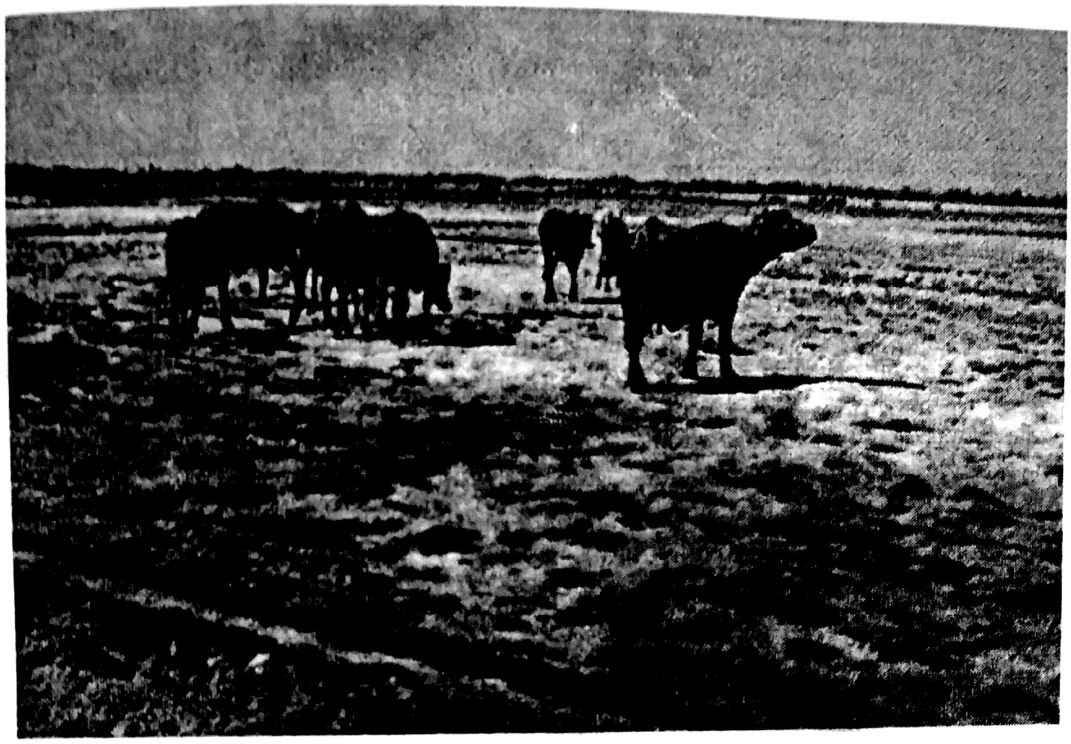

Fig. 22–7. Exploitation of overgrazed rangeland for fuel by the poverty-stricken inhabitants.

- Dry farming *Khushkaba*, which is based on diverting runoff from large, uncultivated fields, and is characteristic of the cooler, western highlands of Balochistan.

Livestock, mainly cattle (*Bos taurus*) and to a lesser extent, sheep (*Ovine vignei*) and goats (*Caprine hircus*), are a major component of Pakistan's agriculture, including rainfed farming systems, and are closely integrated with crop production. As about 70% of dryland areas are rangelands, drylands support a major segment of total livestock population in the country. Though rangelands are generally overgrazed, a significant livestock population is sustained by drylands (Fig. 22–7). For example, in Punjab alone, 3.4 Mha of arid Cholistan Desert, and other rainfed areas amount to 7.3 Mha, of which 3.9 Mha are rangelands. This area supports 13 Mn head of cattle and poultry stock. The principal dryland agricultural activity in upland Balochistan (having hyper-arid to semi-arid continental climate, with 50–400 mm annual rainfall) is small-ruminant production (Buzdar et al., 1989; Rafiq, 1976), with rangeland grazing providing most of the animal feed.

ISSUES AND CHALLENGES OF RAINFED AGRICULTURE

Dryland crop production is confronted with both biophysical and socio-economic constraints. The foremost obstacle hampering dryland crop productivity is low, badly distributed, and erratic rainfall. While nothing can be done to influence rainfall, the only option is to manage its impact so as to increase its efficiency and reduce its potential degradation effects. Heavy monsoon showers, during hot months of July and August, are hardly beneficial for agriculture. Rather, these heavy downpours, cause soil erosion and floods and experience heavy evaporation losses.