

Soil Resources of Khyber Pakhtunkhwa, major ailments and management strategies

> Prof. Dr Mohammad Jamal Khan, Sajida Perveen and Muzamil Shah

## Population Scenario of Khyber Pukhtunkhwa

| Census           | Population              | Urban   |
|------------------|-------------------------|---------|
| 1951             | 4,556,545               | 11.07 % |
| 1961             | 5,730,991               | 13.23%  |
| 1972             | 8,388,551               | 14.25%  |
| 1981             | 11,061,328              | 15.05%  |
| 1998             | 17,743,645              | 16.87%  |
| 2008 (estimated) | 20,215,000              | 18.17   |
| <u>Density</u>   | 271.3/km² (702.6/sq mi) |         |

Source: Khyber Pakhtunkhwa official Web Portal 2010

## Land Resources (Land Forms) Khyber Pukhtunkhwa

| Land Forms                            | Area (m ha) | %    |
|---------------------------------------|-------------|------|
| Residual Colluvial, fans and terraces | 50,598      | 49.8 |
| Alluvial Plains                       | 16,685      | 16.4 |
| Loess Plains                          | 25,604      | 5.5  |
| Miscellaneous (unfit for Agriculture) | 20,687      | 20.3 |
| Glaciers                              | 8,167       | 8.0  |

Source: Tahir et al (1990). Soil Survey of Pakistan

Major Land Uses in KPK



Land Use

## Land Capability

- Land capability classification is method of grouping the soils to show its relative potential for sustained crop production of common agriculture crops or for grazing or forestry. Land capability classification is different than soil taxonomic classes.
- Eight classes have been recognized (Class I to VIII)
- Soil in class I are very good agriculture land whereas the numbers proceeding "I" indicative of certain limitations. Soil of Class VIII is non agricultural soils

CLASS I VERY GOOD AGRICULTURAL LAND (187.3 thousand hectare)

| Class/subclass | Area (000 ha) | Major Limitation                                  | Agriculture Potential                                   |
|----------------|---------------|---|---|
| ir l           | 187.3         | No Significant limitation for general Agriculture | Very high for general agriculture,<br>moderate for rice |

### Class-II Good Agricultural Land (524.4 thousand ha)

| ir II e               | 68.7  | Slight erosion hazard or past erosion effect                                  | High for general agriculture,<br>moderate for rice  |
|-----------------------|-------|---|---|
| ir II r               | 4.1   | Difficulty in irrigation due to uneven surface                                | High in its present state, behaves as irl if leveled                                      |
| ir llw                | 36.9  | Waterlogging problem  | High in its present state, behaves as irl if drained                                      |
| ir IIs<br>(sandy)     | 56.7  | The coarse texture causing water and nutrients losses                         | High for general agriculture, low for rice  |
| ir IIs (clay)         | 325.1 | Clayey nature, difficult to work, low permeability leading to surface ponding | High for general agriculture, (very<br>high if mechanically tilled) very high<br>for rice |
| ir II a<br>(salinity) | 5.2   | Surface/patchy salinity/sodicity  | High for general agriculture and rice; very high if reclaimed                             |
| d II e                | 17.5  | Minor erosion hazard  | High for general rainfed agriculture  |
| d II c                | 10.2  | Somewhat erratic moisture availability from rains                             | High for general rainfed agriculture  |

### Class-III Moderate Agricultural Land (665.8 thousand ha)

| ir III e             | 31.7  | Moderate erosion hazard; uneven surface                                 | Moderate for common crops   |  |  |  |
|----------------------|-------|---|---|--|--|--|
| ir ll w              | 20.7  | Restricted aeration due waterlogging ; part with slight salinity        | Moderate for common crops, high for rice<br>low for cotton and orchards         |  |  |  |
| ir II w<br>(flooded) | 3.1   | Seasonal flooding by river/torrent water                                | Moderate to for few crops   |  |  |  |
| ir IIIs<br>(sandy)   | 47.8  | Too sandy/ gravelly causing undue loss of water & nutrients             | Moderate for general agriculture, no potential for rice                         |  |  |  |
| ir III a             | 25.7  | Salinity and sodicity problem   | Moderate for general agriculture & rice, low for pulses, sugarcane and orchards |  |  |  |
| d III e              | 246.9 | Moderate erosion hazard, low moisture availability                      | Moderate for rainfed agriculture.   |  |  |  |
| d III w              | 20.8  | Seasonal flooding by river or torrents Moderate for flood water winter  |   |  |  |  |
| d III s              | 54.6  | Too shallow or sandy/gravelly soils with low moisture availability.     | Moderate for rainfed agriculture.   |  |  |  |
| d III c              | 214.5 | Low moisture availability from rains or unfavorable temperature regime. | Moderate for rainfed agriculture.   |  |  |  |

## Class IV- Poor/Marginal Land

(581.6 thousand ha)

| ir IV s<br>(sandy) | 10.4  | Very sandy/gravelly or shallow soils                                       | Low for a few drought resistant crop only                                |
|--------------------|-------|--|--|
| ir IV a            | 0.9   | Salinity & sodicity with very slow permeability                            | Low for few salt tolerant<br>crops only                                  |
| d IV e             | 22.4  | Moderate to severe erosion   | Low for few rain fed crops only  |
| d IV w             | 0.9   | Restricted aeration due to<br>high water table or deep<br>flooding/ponding | Low for few dry farmed<br>crops resistant water<br>logging/flooding      |
| d IV s<br>(sandy)  | 126.8 | Too shallow or<br>sandy/gravelly soils, wind<br>erosion problems           | Low for few drought<br>resistant rain fed or some<br>forest species only |
| d IV c             | 420.2 | Very low erratic availability<br>of moisture from rains or<br>torrents     | Low for a few drought<br>resistant rainfed/torrent<br>watered crops only |

### Class V-Good Forest or Range Land (70.1 thousand ha)

| V               | 70.1        | No major limitation  | High for forestry or range land development         |
|-----------------|-------------|--|---|
| CL              | ASS VI- MOE | DERATE FOREST OR RANGLAN   | ID (827.0 thousand ha)                              |
| VIe             | 575.2       | Soil erosion hazard;<br>unfavorable relief/soil character<br>for arable use  | Moderate for forestry or rang land development only |
| VIw             | 15.8        | Too much saturation with water<br>through out the year for arable<br>use     | Moderate for rang land and wild life development    |
| VI s<br>(sandy) | 183.5       | Too sandy/gravelly/stony soils;<br>also unfavorable relief for<br>arable use | Moderate forestry or rang land development          |
| VIc             | 52.5        | Somewhat low availability of moisture; unfavorable relief for arable use     | Moderate for forestry or rang land development      |

### Class VII- Poor Forest or Range Land (2603.8 thousand ha)

| VIIe             | 1742.7 | Moderate erosion hazard;<br>soils too stony/gravelly or<br>unfavorable relief for<br>arable use | Low for forestry or rang land development only   |
|------------------|--------|---|--|
| VII w            | 12.0   | Restricted aeration in the root zone throughout the year.                                       | Low for rang land and wild life development only |
| VII s<br>(sandy) | 819.4  | Too shallow or<br>sandy/gravelly soils; slight<br>to moderate erosion<br>hazard                 | Low for forestry or rang land development only.  |
| VIIa             | 7.8    | Salinity and sodicity, partly with high water table   | Low for controlled grazing only                  |
| VII c            | 21.9   | Low and erratic moisture availability   | Low for forestry or rang land development only   |

### Class VIII-Non Agricultural Land (22974.0 thousand ha)

| VIII e               | 1527.9      | Severe erosion / gulling wind blowing) hazard  | No potential for any type of economic agriculture                      |
|----------------------|-------------|--|--|
| VIII w               | 10.0        | Permanent marshy conditions or open water lakes  | No potential for agriculture,<br>moderate for wildlife<br>preservation |
| VIII s<br>(sandy)    | 1201.7      | Very sandy/gravelly/stony or<br>very shallow/patchy soils slight<br>to moderate erosion hazard | No potential for any type of economic agriculture                      |
| VIII a               | 8.9         | Sever salinity/sodicity very slow permeability   | No potential for any type of economic agriculture                      |
| VIII c               | 0.2         | Extremely low and erratic availability of moisture   | No potential for any type of economic agriculture                      |
| VIII z               | 225.3       | Snow/ice/glacial cover or<br>permafrost conditions   | No potential for any type of economic agriculture                      |
| UNCLASSI<br>GRAND TC | FIED<br>TAL | 704.9 thousand ha<br>9138.9 thousand ha  | Source: Soil survey of Pakistan  |

**Characteristics AEZ-A** Dry, Cold Climate: Rain Fall: 350-700 mm/y 300-450 mm Rabi: Kharif: <150-300 mm **Temp: 16-20 °C** Summer: 20-30 °C Winter: 0-10 °C Altitude: 600-1200+ m Soil Type: Loamy, shallow Cult. Area: 381000 ha **Irrigated:** 54% Farm Size: 1 ha **Crop. Pattern: Mono & Double Cropping system** Maize, Rice, Wheat, Vegetables, O/seed, **Orchards** Population: 15-150 p/Km2





#### **Agro-Eco.** Zones

#### Characteristics <u>AEZ-C</u>

**Climate:** Warm, Sus-Humid **Rain Fall:** 400-700 mm/y Rabi: 250-300 mm Kharif: 200-220 mm **Temp:** 30+ °C **10 °C** Summer: Winter: **10 °C** Altitude: 600+ m Soil Type: Loam Cult. Area: 400.000 ha **Irrigated: 64%** Farm Size: 1.7 ha **Crop. Pattern: Double Cropping system** Maize, Wheat, Vegetables, O/seed, **Orchards**, S/cane Population: 550 p/Km2





### LAND USED STATISTICS 2006-07

Area in hectares

|                   |                           | Cult                                 | ivated Area    |                   | Сторрес                        | Area                           |  | Uncultiva           | ted Area |                                     |
|-------------------|---------------------------|--------------------------------------|----------------|-------------------|--------------------------------|--------------------------------|--|---------------------|----------|-------------------------------------|
| District          | Total<br>Reported<br>Area | Total<br>Cultivated<br>Area<br>(4+5) | Net Sown       | Current<br>Fallow | Total<br>Cropped Area<br>(4+7) | Area sown<br>More than<br>once | Total<br>Uncultivated<br>Area(9+10+11) | Culturable<br>Waste | Forest   | Not Available<br>for<br>Cultivation |
| 1                 | 2                         | 3                                    | 4              | 5                 | 6                              | 7                              | 8                                      | 9                   | 10       | 11                                  |
| Peshawar          | 126661                    | 78892                                | 77106          | 1786              | 78641                          | 1535                           | 47769                                  | 19678               | 105      | 27986                               |
| Charsadda         | 98641                     | 73441                                | 52938          | 20503             | 89664                          | 36726                          | 25200                                  | 9099                | 0        | 16101                               |
| Nowshera          | 169470                    | 52532                                | 23754          | 28778             | 50759                          | 27005                          | 116938                                 | 47133               | 9120     | 60685                               |
| Mardan            | 162085                    | 112834                               | 82592          | 30242             | 126661                         | 44069                          | 49251                                  | 3138                | 7932     | 38181                               |
| Swabi             | 148689                    | 87046                                | 76822          | 10224             | 105402                         | 28580                          | 61643                                  | 26630               | 26505    | 8508                                |
| Kohat             | 295070                    | 71213                                | 19210          | 52003             | 38420                          | 19210                          | 223857                                 | 32834               | 7213     | 183810                              |
| Hangu             | 132265                    | 27250                                | 14269          | 12981             | 24824                          | 10555                          | 105015                                 | 12155               | 9820     | 83040                               |
| Karak             | 265215                    | 75646                                | 40252          | 35394             | 40325                          | 73                             | 189569                                 | 14032               | 8349     | 167188                              |
| Mansehra          | 4394 <del>2</del> 3       | 80747                                | 68605          | 12142             | 105815                         | 37210                          | 358676                                 | 17702               | 332252   | 8722                                |
| Battagram         | 92997                     | 24173                                | 21897          | 2276              | 29907                          | 8010                           | 68824                                  | 26748               | 37983    | 4093                                |
| Abbottabad        | 178401                    | 55550                                | 49767          | 5783              | 57242                          | 7475                           | 122851                                 | 20391               | 83210    | 19250                               |
| Haripur           | 186182                    | 76909                                | 73731          | 3178              | 84054                          | 10323                          | 109273                                 | 28771               | 57415    | 23087                               |
| Kohistan          | 758116                    | 36749                                | 27860          | 8889              | 29135                          | 1275                           | 721367                                 | 117249              | 216699   | 387419                              |
| Malakand          | 52134                     | 45680                                | 36184          | 9496              | 56185                          | 20001                          | 6453                                   | 1023                | 4405     | 1025                                |
| Swat              | 506528                    | 98054                                | 97675          | 379               | 186005                         | 88330                          | 408474                                 | 84524               | 136705   | 187245                              |
| Bunir             | 172431                    | 55457                                | 50530          | 4927              | 98749                          | 48219                          | 116974                                 | 5550                | 40983    | 70441                               |
| Shangla           | 137434                    | 41712                                | 40185          | 1527              | 80370                          | 40185                          | 95722                                  | 49359               | 39848    | 6515                                |
| Dir Lower         | 147138                    | 47479                                | 41428          | 6051              | 58191                          | 16763                          | 102251                                 | 678                 | 96042    | 5531                                |
| Dir Upper         | 126500                    | 41255                                | 37030          | 4225              | 51660                          | 14630                          | 80601                                  | 1025                | 79299    | 277                                 |
| Chitral           | 98671                     | 22552                                | 19129          | 3423              | 23310                          | 4181                           | 76119                                  | 3884                | 41949    | 30286                               |
| D.I.Khan          | 730575                    | 239617                               | 94033          | 145584            | 107147                         | 13114                          | 490958                                 | 354071              | 3909     | 132978                              |
| Tank              | 165599                    | 49661                                | 9925           | 39736             | 10323                          | 398                            | 115938                                 | 63373               | 45411    | 7154                                |
| Bannu             | 118958                    | 74129                                | 64054          | 10075             | 69060                          | 5006                           | 44829                                  | 16123               | 160      | 28546                               |
| Lakki Marwat 👘    | 314973                    | 116900                               | 45347          | 71553             | 47270                          | 1923                           | 198073                                 | 85920               | 0        | 112153                              |
| Total S.Districts | 5624156                   | 1685478                              | 1164323        | 521155            | 1649119                        | 484796                         | 3936625                                | 1041090             | 1285314  | 1610221                             |
| %age              | 100%                      | <b>29.97</b> %                       | <b>20.70</b> % | <b>9.27</b> %     | <b>29.32</b> %                 | 8.62%                          | 69.99%                                 | 18.51%              | 22.85%   | 28.63%                              |

# SALIENT FEATURES OF AGRICULTURE IN KPK

- 44% of rural population Lives below poverty line.
- More than 92% land owners are characterized as small farmers
- Out of 5.624 m. hectares about 1.7 m hectares area is cultivated.
- 18.51% land area is cultivable waste.
- About 53% of cultivated area is rain-fed.
- KPK is wheat deficit and domestic requirement is met through import from other provinces or abroad.
- KPK possesses comparative advantage in the production of fruits and vegetables.
- Frequent droughts and floods.

# Major Problems/Constraints of Soil Resources

## A-Soil Erosion

1: Moderate to Sever water Erosion =

0.8 m ha (of cultivated land of Pakistan)15 m ha (Forest and Range land in hilly and mountains(36 % of cultivated soil of KPK)

2: Wind Erosion=

Over 8 m ha (40 % of KPK by Wind)

B: Soil Salinity and Sodicity (Area in 000 ha)

 Soil with surface/Patchy salinity and sodicity=
 Porous saline sodic soil
 Dense saline sodic soils

5.2 (of irrigated area)25.70.89

## **C-** Restricted Drainage

Water logging problem is restricted to specific land form and is not wide spread as commonly believed. About 3700 ha (4.5 % of irrigated land) has restricted drainage problems.

#### D: Low Soil Fertility

| Organic Matter deficient (low) = | 61 % |
|----------------------------------|------|
| N deficient =                    | 93 % |
| P deficient soils =              | 44 % |
| K deficient =                    | 21 % |
| B deficient =                    | 50 % |
| Cu deficient =                   | 6 %  |
| Fe deficient =                   | 26 % |
| Zn deficient =                   | 21 % |

Bhatti (1993) and Khattak (1995). The values are based on the number of soil samples analyzed.

## E- Soil Texture Problems

(Values based on the total no. samples analyzed)

- Difficult tillage due to surface clayeyness and surface crusting = 48%

12 %

- Very Coarse texture (Having very low or no water holding) =

The Instant Dangers
A: Exploitation of ground water for Irrigation.
Most of the water is of low to moderate quality adversely affecting the

chemistry of soils.

**B: Conversion of Agriculture land for non agriculture purposes:** 

The most fertile land is disappearing and converted to non farm uses such as townships, factories, roads. Top soil is removed for bricks making, unplanned excavation and horizontal expansion.

## **C-The Recent Flood**

- The recent flood has offset the many statistics of the past and surface removal upstream and clay deposition in plain and low lying area made the soil difficult to work.
- The irrigation system has been severely affected.
- Disputes on land demarcation among the community became very

common thus created socio-political problems.



# **Rehabilitation Strategies**

### A: Soil conservation strategies:

 Both Engineering and Agronomic needed to be adopted

### • B: Sound fertility program:

Balance use of fertilizers and organic farming

### C: Salinity and waterlogging reclamation measure:

- Using biosaline agriculture approach in addition to hydro-technical and chemical methods.
- D: Mechanized farming.:

 Areas having texture problems can be reclaimed through using deep ploughing.

### Effect of Different Tillage Practices on Wheat Yield Under Rainfed Condition of D.I.Khan

| Treatment                   | Grain Yield (kg/ha) |
|-----------------------------|---------------------|
| Cultivator (Control)        | 1650 e              |
| Cultivator (60-40-0)        | 1930 d              |
| Cultivator (90-60-0)        | 2047 d              |
| Disc Plough (Control)       | 2016 d              |
| Disc Plough (60-40-0)       | 2466 c              |
| Disc Plough (90-60-0)       | 2643 ab             |
| Mouldboard plough (Control) | 2033 d              |
| Mouldboard plough (60-40-0) | 2533 bc             |
| Mouldboard plough (90-60-0) | 2750 a              |

#### E: Water Management and Rain Water Harvesting:

- There is a great potential for harnessing of hill torrents (especially in rainfed area of southern districts of KPK). Flood management of hill torrents studies indicate that the water potential of KPK is as much as 3, 740 m<sup>3</sup> of average annual runoff.
- Depending upon the physiographic, demographic and climatic condition of the province, four strategies can be adopted for harnessing the hill torrents:
- A: Diversion and dispersion structures
- B: Detention dams
- C: Storage dames
- D: Channelization



Soil represents the single most important natural resource on which human existence and prosperity depends.

- Limited area (only 15 % of total) of KPK has the potential for agriculture with minor limitation while there is scope for bringing more land under the class II and III.
- Soil Erosion, unavailability of water and low soil fertility are the major problems.
- Water Management and rainwater harvesting needs to be addressed adequately.

