Annex D
Soils and Land Use

ANNEX D

SOILS AND LAND USE

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ANNEX D SOILS AND LAND USE

D.1 SOIL SURVEY

The Study Area has been surveyed by the Soil Survey of Pakistan (SSP) at reconnaissance level, Quetta & Pishin area in 1973 and Kalat area in 1978, respectively, and soil maps were prepared at a scale of 1:125,000. In these survey, the soils were grouped into soil associations. The survey covers whole area of Quetta, Pishin and Kalat Districts and the soil map is very general, however the report is the most authoritative soil data of the area.

A field survey was conducted by the Study team during the phase I period. The objectives of the survey was to explore and evaluate the land and soil resources of the Study Area. Prior to the field survey, the existing soil survey reports were studied in detail. On this basis, provisional soil map on the scale of 1:250,000 was prepared and used as field map. The soils were studied along the selected traverses with distance between observation points depending upon the complexity of the soil. The field work was started on 11th May 1996 and was completed on 10th June 1996.

Soil test pits upto 1.5m depth were excavated in the selected locations representing the soil mapping units for general morphological description and sampling of different horizon or layers. At each observation site, information recorded including soil texture, dry and moist Munsell color, depth and thickness of horizons or layers, structure and soil pH. The location of soil pits were recorded by a GPS receiver.

Auger boring

Field auger observations were made upto 1.5m depth in the area as required by change in soils and terrain conditions. At each auger hole, morphological and physical characteristic of the soils were studied and described. Soil pH was determined by thymol blue in the field.

Test pit

One hundred soil test pits upto 1.5m depth were excavated in the selected locations representing the soil mapping units for detailed morphological description and sampling of different horizon or layers. The profiles of the pits were described according to the USDA guidelines. The basic unit of classification was soil series constituting the soil mapping units as soil association that has two or more components. List of the test pits is shown in TABLE D.1.

Soil sampling

One hundred soil samples of the representative horizons were taken from 36 soil pits for physical and chemical characterizations in laboratory. These samples were sent to the NARC (National Agricultural Research Centre) laboratory in Islamabad for the analysis.

D.2 SOIL ANALYSIS

The one hundred samples collected from the different layers of thirty-six soil pits were analyzed in the NARC laboratory. The methods adopted for the analysis are described below. USDA Hand Book No.60 was also used as guideline during analysis of the soil samples. Major results of the chemical analysis is shown in Table D.2.

ITEM	METHOD
Physical Properties	
(1) Soil texture	Hydrometer method
(2) pF	Pressure plate method
(3) Bulk density	Gamma probe method
Chemical Properties	
(1) pH	pH meter using saturation extract
(2) Electrical conductivity	EC meter using saturation extract
(3) Total Nitrogen	Micro Kjeldahl method
(4) Total Carbon	Walkely Black method (Organic carbon), CO2 liberated by HCl (inorganic carbon)
(5) Available phosphorous	Olson method of bicarbonate extraction
(6) Gypsum (CaSO4)	Bower and Hess method
(7) Calcium carbonate (CaCO3)	HCl method (Acid treatment)
(8) Cation Exchange Capacity	NH4HCO3 absorption method

D.3 CHARACTERISTICS OF THE SOILS IN THE STUDY AREA

D.3.1 General Description of the Soils

Soils of the area are formed in five different types of parent material as follows; a) mainly limestone with some shells, b) red clay, silt, sandstone and conglomerates, c) old re-deposited loess, d) limestone, shales and volcanic rocks, and e) shale, sandstone and limestone. The following landforms in each parent material have been formed due to alluvial sorting out and/or decomposition; 1) alluvial fans, 2) piedmont plains, 3) basins, and 4) gently undulating loess plains.

Each of the first three physiographic units includes three groups of soils, differing from one another in parent materials. The groups are; i) consisting of soils formed in piedmont alluvium derived mainly from Jurassic limestone (massive) of Chiltan and Shirinab formations, ii) including soils formed in piedmont alluvium derived mainly from Tertiary shale (slaty) and

sandstone of Murgha Faqirzai and Shaigalu formations, and iii) comprising soils formed in piedmont alluvium derived mainly from Middle Pleistones red clays, silt, sandstone and conglomerates of Bostan and Urak formations. All these soil materials in addition contain some admixture of wind-laid dust (loess) carried down from mountains by rainwater and some outwashes from older alluvial deposits.

D.3.2 Principal Characteristics of the Soils

Soil Series	Soil Texture	FAO classification	USDA classification
MAJOR SOIL SERIES			
Barshore	Silt loam & very fine sandy loam	Haplic Yermosols	Typic Camborthids
Pinakai	Loam, very fine sandy loam & silt loam	Haplic Yermosols	Typic Camborthids
Pishin	Fine sandy loam and sandy loam	Haplic Yermosols	Typic Camborthids
Pringabad	Very fine sandy loam	Haplic Yermosols	Xerollic Camborthids
Sariab	Loam & silt loam	Haplic Yermosols	Typic Camborthids
Shabak	Gravely clay loam	Calcic Serosols	Xerollic Calciorthids
Shomozai	Silt loam, loam & very fine sandy loam	Haplic Yermosols	Typic Camborthids
Zard	Silt loam and very fine sandy loam	Haplic Yermosols	Typic Camborthids
MINOR SOIL SERIES			
Azam	Silty clay and clay	Haplic Yermosols	Typic Camborthids
Chiltan	Gravely loam	Haplic Yermosols	Typic Camborthids
Ghaza	Silty clay loam & clay loam	Orthic Solonchake	Salorthids
Hathiara	Silt loam and very fine sandy loam	Haplic Yermosols	Typic Eutrochrepts
Injira	Gravely loam	Haplic Yermosols	Xerollic Camborthids
Kaftari	Silt loam and very fine sandy loam	Haplic Yermosols	Typic Eutrochrepts
Lajwar	Silty clay loam & clay loam	Haplic Yermosols	Typic Camborthids
Maslakh	Gravely clay loam	Calcic Serosols	Xerollic Calciorthids
Quetta	Silty clay loam & clay loam	Haplic Yermosols	Typic Camborthids
Taleri	Loam and very fine sandy loam	Haplic Yermosols	Typic Camborthids
Toba	Gravely clay loam	Calcic Serosols	Xerollic Calciorthids

Azam Soil Series

The Azam series consist of deep to very deep, moderately well drained, strongly calcareous, fine textured soil developed in the parent material derived from mainly limestones with some shales. It occupies level areas in the piedmont basins/playas.

Surface soil of Azam series is yellowish brown, friable, massive, strongly calcareous, pH 8.0, silt loam. Underlain B horizon is dark yellowish brown, firm, weak medium sub-angular blocky, strongly calcareous, pH 8.0, dense, silty clay and is more than 100 cm deep. The B horizon overlies, a yellowish brown, friable, massive strongly calcareous, pH 8.2 C horizon or a buried profile.

Barshore Soil Series

The Barshore series consist of moderately deep developed, well drained, strongly calcareous, medium textured soil developed in the parent material derived from red clays, silts, sandstone's and conglomerates. The soil occupies level to nearly level areas in the piedmont plains.

The soil has brown to dark brown, friable, massive, strongly calcareous, pH

8.2, very fine sandy loam surface. Underlain is 7.5 YR hue, friable, weak, coarse sub-angular blocky, strongly calcareous, pH 8.0 loam extending to less than 100 cm depth. The B horizon overlies the brown to yellowish brown, very friable, massive, strongly calcareous, stratified C horizon or a buried profile.

Chiltan Soil Series

The Chiltan series consists of moderately deep, somewhat excessively drained, strongly calcareous without lime-specks or nodules, moderately alkaline, gravelly loam soils developed in the parent material mainly derived from limestone's with some shales. It occupies nearly level to sloping areas in the young alluvial fan.

Chiltan soil has common to many, fine to coarse gravels and some stones on the surface and has brown, friable, massive, strongly calcareous pH 8.2, gravelly loam top soil. Underlain B horizon is brown, friable, very weak coarse sub-angular blocky, strongly calcareous without lime specks or nodules, pH 8.2 gravelly loam extending to about 50 cm depth. The B horizon overlies brown, very friable, massive, strongly calcareous, pH. 8.0, very gravelly loam C horizon extending to about 90 cm depth. This overlies either over a buried soils having silt loam to very fine sandy loam texture or the stratified substratum and comprises layers of gravels, on very gravelly loam/sandy loam (+) in texture.

Ghaza Soil Series

The Ghaza soil is very deep, well drained, strongly calcareous, having common to many fine gypsum specks in subsoil, pH 8.0, silty clay loam soils developed in the parent material derived from mainly limestone's with some shales. It occupies nearly level parts of basins/playas.

It has brown to yellowish brown, friable, massive, strongly calcareous, pH 8.0, silt loam surface underlain by yellowish brown to light yellowish brown, weak medium and fine sub-angular blocky, strongly calcareous, with common to many fine gypsum specks silty clay loam extending to about 140 cm depth. The B horizon overlies on the yellowish brown, friable, massive, strongly calcareous, without gypsum speck, pH 8.0 C horizon to 150 cm depth.

Hathiara Soil Series

The Hathiara series consists of deep to very deep, moderately deep developed, well drained, strongly calcareous, medium textured, moderately alkaline soil developed in the parent material derived from limestone, shales and volcanic rocks. It occupies level to nearly level areas in the piedmont plains.

It has brown, friable, massive, strongly calcareous, pH 8.4, very fine sandy loam topsoil underlain by yellowish brown to brown (10 YR to 7.5 YR hue), friable, weak coarse and medium sub-angular blocky, strongly calcareous, pH 8.2, silt loam B horizon extending to less than 100 cm depth. The B horizon overlies yellowish brown, friable, massive, silt loam/very fine sandy loam, strongly calcareous pH 8.2 C horizon or buried similar but comparatively older soil profile.

Injira Soil Series

The Injira series consists of moderately deep, somewhat excessively drained, strongly calcareous without lime-specks or nodules, moderately alkaline, very gravelly, very fine sandy loam soils developed in the parent material derived from mainly limestone's, shales and volcanic rocks. It occupies nearly level to sloping areas in the young alluvial fans.

It has common to many, fine to coarse gravels, and some stones on the surface. It has brown, friable, massive, strongly calcareous, pH. 8.2, slightly gravelly, very fine sandy loam surface soil underlain by dark yellowish brown, friable, weak coarse and medium sub-angular blocky, strongly calcareous without lime-specks or nodules, pH 8.2, gravelly very fine sandy loam to less than 50 cm depth B horizon. It overlies a gravel bed containing 10%, dark yellowish brown

loam or an eroded buried profile comprising mainly gravelly loam with common to many lime-specks and lime nodule.

Kaftari Soil Series

The Kaftari series consists of deep to very deep, moderately developed, well drained, strongly calcareous, medium textured, moderately alkaline soil developed in the parent material derived from shale, sandstone and limestone. It occupies level to nearly level areas in the piedmont plain.
It has yellowish brown, friable, strongly calcareous, pH 8.2, very fine sandy loam or silt loam in texture topsoil underlain by yellowish brown to dark yellowish brown, friable, weak coarse and medium sub-angular blocky, strongly calcareous, pH. 8.0 silt loam and very fine sandy loam B horizon extending to less than 100 cm depth. The B horizon overlies a buried soil of similar characteristics but of comparatively older age.

Lajwar Soil Series

The Lajwar series consists of deep to very deep, well to moderately well drained, strongly calcareous, moderately fine textured, moderately alkaline soil developed in the parent material derived from shale, sandstone and limestone. It occupies nearly level areas at the margin of the basin/playas.
It has brown to yellowish brown, friable, massive, strongly calcareous, medium textured, pH 8.2 top soil underlain by dark grayish brown (2.5 Y hue), friable, weak coarse and medium sub-angular blocky, strongly calcareous, pH 8.2 silty clay loam B horizon extending to more than 100 to 150 cm depth. It has strongly calcareous, pH 8.2 silty clay loam C horizon.

Pinakai Soil Series

The Pinakai series consists of deep to very deep, well drained, strongly calcareous, moderately alkaline, medium textured soil developed in the parent material derived from shale, sandstone and a little limestone. It occupies nearly level areas in the piedmont plain.
It has brown, friable, massive, strongly calcareous, pH 8.0, very fine sandy loam/silt loam top soil underlain by dark yellowish brown, friable, weak medium and fine sub-angular blocky, strongly calcareous, pH, 8.0, silt loam/very fine sandy loam B horizon extending to about 150 cm. The B horizon overlies, yellowish brown friable, massive, strongly calcareous, pH 8.2 C horizon.

Pishin Soil Series

The Pishin series consists of deep, somewhat excessively drained, strongly calcareous, moderately alkaline, moderately coarse textured soil developed in the parent material derived from red clays, silts, sand-stones and conglomerates. Pishine soils occupy nearly level to gently sloping surface in the gently undulating piedmont plain.
It has brown, friable, massive with some lamination, strongly calcareous, pH 8.0, loam tending to fine sandy loam top soils. Underlain B horizon is yellowish brown, very friable, weak, coarse angular and sub-angular blocky, pH 8.0, sandy loam extending to more than 100 cm depth. The B horizon overlies either a buried profile of similar characteristics but of comparatively older deposits or a stratified C horizon.

Pringabad Series

The Pringabad series consists of deep to very deep, well drained, strongly calcareous, moderately alkaline, very fine sandy loam soil developed in the parent material derived from limestone with some shale and admixture of wind laid fine sand. It occur mainly on a high elevated piedmont terraces in nearly level area.
It has brown to dark yellowish brown, single grain, strongly calcareous, pH

8.2 loamy very fine sand top soil underlain by yellowish brown to dark yellowish brown, friable, weak coarse and medium sub-angular blocky, strongly calcareous, pH 8.2, very fine sandy loam B horizon extending to 150 cm depth.

Quetta Soil Series

The Quetta series consist of very deep, deeply developed, moderately fine texture, strongly calcareous, without lime-specks or nodules, moderately alkaline, friable soil. It is developed in parent material derived from lime-stones with little shale. It occurs in slight depressional areas or in broad basins.
Quetta soil has yellowish brown, massive, strongly calcareous, pH 8.0, silt loam surface soil. Underlain B horizon is dark yellowish brown, silty clay loam, friable, weak, medium and fine sub-angular blocky, strongly calcareous, without lime nodules or specks, pH 8.0 extending to more than 100 cm depth. The B horizon overlies a buried soil or C horizon having yellowish brown color, silty clay loam texture and pH 8.2, and is strongly calcareous massive. Quetta medium and saline surface phases have been recognized.

Sariab Soil Series

The Sariab series consists of deep, well drained strongly calcareous, without lime-specks or nodules, with few scattered gravels, moderately alkaline, medium textured soil developed in the parent material derived from limestone with some shale. It occupies nearly level position in the piedmont plains close to the aprons of the alluvial fans.
Sariab has brown, friable, strongly calcareous, pH 8.0, medium textured surface with few gravels, underlain B horizon is brown to yellowish brown, very weak coarse sub-angular blocky, strongly calcareous, pH 8.0 silt loam/very fine sandy loam, with few scattered gravels extending to about 110 cm depth. B horizon overlies a buried soil of gravel layers.

Shabak Soil Series

The Shabak series consists of moderately deep, well to somewhat excessively drained, gravelly clay loam, moderately alkaline, strongly calcareous with common soft lime-specks and hard lime nodules. The soil is developed in the parent material mainly derived from limestone's with some shales. It occupies nearly level to gently sloping position in the undulating alluvial fans.
Shabak soils contain many coarse gravels and stones on the surface. The soil has brown/dark brown (7.5 YR hue), friable, massive with somewhat platy structure, strongly calcareous, pH 8.2 gravelly loam surface. Underlain B horizon is brown (7.5 YR hue) friable, strongly calcareous with common to many lime-specks and lime nodule, weak medium and fine sub-angular blocky structure, pH 8.0, gravelly loam extending to less than 90 cm depth. B horizon overlies either a buried soil with similar characteristics but comparatively of older age or gravel beds or stratified layers containing gravels.

Shomozai Soil Series

The Shomozai series consists of deep to very deep, moderately deep developed, medium textured, strongly calcareous, without lime specks or nodules, moderately alkaline, friable soil. It is developed in parent material derived mainly from limestone's with some shales. It occupies nearly level to level position in the piedmont plain close to alluvial fan aprons at lower position then Sariab series.
Shomozai has brown to yellowish brown, massive, strongly calcareous, pH 8.0, very fine sandy loam/silt loam topsoil. Underlain B horizon is dark yellowish brown, friable, weak, coarse and medium sub-angular blocky, strongly calcareous, without lime nodules or lime specks, pH 8.0, extending to less than 100 cm depth. The B horizon over lies brown or yellowish brown,

friable, massive, strongly, very fine sandy loam /silt loam, calcareous, C horizon or a buried similar profile but of comparatively older age.

Taleri Soil Series

Taleri series consist of very deep, deeply developed, well drained, silt loam, moderately alkaline, strongly calcareous with few fine lime speck soil developed in redeposited loess. It occurs in dissected areas, at high elevations, surrounded by alluvial fans.

The surface soil is very fine sandy loam, massive, strongly calcareous, pH 8.4. Underlain B horizon is more than 100 cm, silt loam, weak coarse and medium sub-angular blocky, pH 8.4, strongly calcareous. It may contain few to common fine lime specks. The C horizon is silt loam, massive strongly calcareous, and yellowish brown.

Toba Soil Series

The Toba series consists of moderately deep, well to somewhat excessively drained, gravelly clay loam, moderately alkaline, strongly calcareous with common soft lime specks and hard lime nodules soil developed in parent material derived from volcanic rocks, shales and some lime-stones. It occupies nearly level to gently sloping position in the undulating alluvial fans.

The soil has common to many coarse gravels and stones on the surface. The soil has brown to dark brown (10 YR and 7.5YR hue) friable, massive, strongly calcareous, pH 8.4, gravelly loam top soil. Underlain B horizon is dark yellowish brown (10 YR and 7.5 YR hue), friable, gravelly loam, strongly calcareous, having common to many soft lime specks and hard lime nodules, pH 8.2. The C horizon is usually at less than 60 cm depth and is very gravelly sandy loam. This overlies gravel bed.

Zard Soil Series

The Zard series consists of very deep to deep, deeply developed medium textured, strongly calcareous, without lime nodule, moderately alkaline, very friable soil. It is developed in parent material derived mainly from lime-stones and shales. It occupy level position in the piedmont plain close to playas if occur.

Zard soil series has yellowish brown, massive, strongly calcareous, pH 7.9, very fine sandy loam/silt loam surface soil, underlain by B horizon with is dark yellowish brown to yellowish brown, very friable, weak medium and fine sub-angular blocky, strongly calcareous, with lime nodule or specks, pH 7.9 extending to more than 100 cm depth. The B horizon overlies yellowish brown, friable massive, strongly calcareous, very fine sandy loam/silt loam C horizon close to 150 cm depth.

D.3.3 Physical and Chemical Properties of the Soils

Soil properties are the basic attributes which influence its behavior toward management. Estimates are made of the physical and chemical properties and of the features of the whole soil. For soil management, particle size distribution (texture), saturated hydraulic conductivity, soil moisture retention, bulk density, soil color, organic matter, pH, Electrical conductivity, SAR, CEC, available N, available P are important parameters.

D.3.3.1 Physical Properties

Particle Size Distribution (Soil Texture)

In Tirkha, Sanlzali and Amach area, fine sandy loam, sandy loam and loamy sand occur. In these areas water intake rate is very high, permeability rapid, water holding capacity very low. Instead of pores, voids are present in the soil. These soils have very low organic matter. In Amach and Sakhul areas wind blown deposits on the higher terrace in the form of dunes occur which create hazard of burial of crop under the wind blown sand. The water holding capacity of soils in such areas is very low. The gravely and very gravely loamy and silty soils in the alluvial fan create tilling problem and makes these unsuitable for arable farming.

In the Marium and Murghi Kotal areas, fine textured soils are present. The fine texture soils pose problem to agricultural development. The soils have poor aeration, water intake rate is very low, permeability very low, due to denseness the bulk density is high (1.7) and root penetration is a problem. The runoff is collected during rainy season.

Saturated Hydraulic Conductivity

The Shomozai and Pishin soil series occurring in the study area have very high infiltration rate. Shomozai in the Ghutia Shella area has infiltration as high as 0.4 cm h-1 . There was very little change in infiltration rate with profile depth the sandy loam soils. The Zard and Barshore soils have moderate infiltration. Barshore soils in the Tirkha area has 0.1 to 0.2 cm h-1 infiltration rate. The Lajwar, Azim, and Pinakai soils had the lowest infiltration ranging from 0.01 to 0.1 cm h-1 . Variations in infiltration rate with profile depth was more pronounced in the Zard and Barshore type of soils where profile development has changed the pore and ped size distribution. On the other hand, in the very coarse textured shamozai and Pishine infiltration rate did not vary drastically with profile depth. In the soil ped genesis is slow and pore and ped size distribution did not vary with profile depth due to sandy nature of the parent material. In the very fine textured Azim, Lajwar, and Pinakai soils infiltration decreased with profile indicating extreme slow permeability of the profiles.

The Shomozai and Pishin soil series have the highest hydraulic conductivity (kfs) and matrix flux potential (m). The Azim, Lajwar, and Pinakai soils had the lowest kfs and m. The information has practical significance in irrigation management schemes. In the Shamozai and Pishine soils flood irrigation will be not economical. While in Azim, Lajwar and Pinakai soils have heavy irrigation will cause ponding of water.

Soil Moisture Retention Characteristic

Soil water retention characteristics were determined for well over 100 samples representing different genetic horizons of selected soil profiles. Detailed data are presented in Annexure IV and depth of plant available water in upper 75 cm of profile is presented in Table 4. The reason for calculating plant available water to 75 cm depth was that in most of soils upper three genetic horizon felled in the upper 75 cm profile depth.

Plant available water over 20 cm in the 150 cm profile depth (10 cm / 75 cm) is considered as an optimum value. The study revealed that the water holding capacity of all the soils in the old as well as young alluvial fan is low to very low. The piedmont plain covering Sanalzai, Sakhul, and Amch areas has very low to low plant available water ranging from 2 to 4 cm of water in the upper 75 cm profile depth. The low plant available water is due to their coarse texture. The water holding capacity of most deep soil is high to very high. The Arambi, Bostan, Jigda, Kad Kocha, Wali Dad, Bruwary, and Dara sites have optimum plant available water capacity.

Bulk Density

The clay and silty clay Azam, Lajwar, and Pinakai soils have high bulk density, an average value varying in the range of 1.6 to 1.66 g / cm3 . The Zard, Shomozai, and Barshore soils have bulk density 1.42 to 1.55 g / cm3 . The Kaftari and Ghaza also have high bulk density.

Bulk density is an indicator of how well plant roots are able to extend into the soil. In general, resistance to root penetration is high with the combination of fine texture, high bulk density and weak, massive, or platy structure. Bulk density would be lower if structural expression increases. In the area most soils have bulk density ranging from 1.3 to 1.5 g cm-3 . In the Murghi Kotal area in the clayey texture (Azim soil). The bulk density is around 1.72 to 1.74 g/cm. The silty clay loam porous soils in Dara, Khor Manda and Tirkha have bulk density ranging from 1.62 to 1.68 g/cm3 which is slightly higher (1.60 g/cm3 normal) than normal.

Soil Color

Soil color is the most obvious and easily determined soil characteristic. Although it has little direct influence on the functioning of the soil, yet, one may infer a great deal about a soil from color. The color of most soils in the area fall in 10 YR, 7.5YR and 2.5YR hue. The soils in the old alluvial fan usually have 7.5YR color which is red. This color of the soil is generally related to un-hydrated iron oxide, although manganese dioxide and partially hydrated iron oxide may also contribute this color. Since un-hydrated iron oxide is relatively unstable under moist conditions red color indicate good drainage and good aeration. The red color also shows intense weathering for considerable time. Gray color (2.5 Y hue) of the soils is caused by several substances, mainly quartz, carbonates of lime and magnesium and compounds of

ferrous ions (Jigda, Murghi Kotal area). A light gray color also indicates very low content of organic matter and iron.

Mottling indicates cyclic fluctuation of water table in the profile. The distinct gray and yellow mottles in Iskalkoo area show imperfectly drained condition while presence of mottling in Ghutia Shella area indicates restricted drainage in the past.

Soil Organic Matter

The soils in the Balochistan area generally have low organic matter content except for those which are moderate to fine texture and are under irrigated cultivation. Majority of the soils have organic matter content between 0.2 to 0.3%. The whole range of soil organic matter in the area varied from 0.04 to 0.69%. The soils in Sanzali and Aamch specially have very low organic mater (0.04 to 0.20%). Therefore, there is no soil granulation and the soils are subject to wind erosion. The soils in the Murghi Kotal area have higher bulk density and workability problem partly because of low organic matter (0.3 to 0.4%). As most soils in the area have silt loam texture and low organic matter content (0.4 to 0.6%), these are susceptible to soil crusting which promotes erosion and decreases infiltration.

D.3.3.2 Chemical Properties

Soil pH

With few exceptions, explainable in most cases, the soil's pH varies between 8.0 and 8.2. None of the samples had pH < 7.0 suggesting alkaline nature of the soils. Soil parent material in area is invariably calcareous. The soils in equilibrium with calcium carbonate should have pH value of 8.2. Un-cultivated sites with some salt accumulation at the surface have slightly greater pH than irrigated counter parts. One of (Tirkha, Khora Manda, and Murgi Kotal are examples). The pH values greater than 8.2 indicates presence of excessive Na in the soil system. Irrigated sites had pH around 8.0.

In the Ghutai Shella dam area the site Gsl-4 at about 100 cm depth had pH around 7.1. The low pH is due to specific chemistry of the soil. This has severe iron manganese mottling at that depth. In the paleo-pluvial climate oxidation reduction cycles and leaching of calcite has resulted in lowering of pH. Except in uncultivated saline soils, pH at the surface is one or two tenth of the unit less than the sub-surface horizons. Probably this phenomenon is due to washing of salts with continuos low pH irrigation water. Only few soils had greater pH at the surface than the sub-surface.

Electrical Conductivity

A vast majority of the soils are *normal* with respect to salinity hazard (US Salinity Laboratory Staff, 1954). The un-cultivated soils generally had greater ECe than that of their cultivated counterparts even in the same vicinity. In light textured soils continuos irrigation has leached down the soluble salts resulting in low ECe. The Tirkha site Trk-1 has ECe as high as 5.3 mS/cm. Similarly in Murghi Kotal area which receives no irrigation water has ECe close to 6.5 mS/cm. The Mangi site Mgi-4 also has high ECe.

The soils of the area are mostly non saline < 2 mS cm-1 or very slightly saline 2-4 mS cm-1. Very small area in Iskalku site 1, Tirkha site Trk 1, and Ghutai Shela Gsl 3 and Gsl 4 fall in the range. Murghi Kotal Mgk 1 and Mgk 4 are slightly saline in some parts of profile ECe 4 to 8 mS/cm. This shows that salinity is not a severe problem in most of the surveyed area.

Soluble Cations and Sodium Adsorption Ratio (SAR)

From the saturated paste extract, soluble cations, Na, K , Ca, and Mg were determined. Data of the soluble cations are being presented in Annexure V. In majority of the soils Ca and Mg are the dominant cation in the soil solution. Ghutia Shella dam at site Gsl-3 and Gsl-4, Murghi Kotal at site Mgk-1 and Mgk-2, and Mangi at site Mgi-4 have relatively high Na in soil solution.

Sodium adsorption ratio was calculated from the soluble cations (US Salinity Laboratory Staff, 1954). Majority of the soils have SAR value below 15 suggesting that the soils have no hazard of sodium. As in case of salinity, SAR is high in those soils which are presently not under cultivation. The sites in the Dam area of Murghi Kotal, Mangi, and Ghutia Shella have high SAR. In some soils there is a combination of low ECe (<2 mS/cm) and high SAR (Tirkha - 2, for example). Such soils should not pose any hazard especially if they are of light texture

Cation Exchange Capacity (CEC)

Cation exchange capacity of the soils varied with soil texture and a soil organic matter content. The clay and silty clay Azim, Lajwar, and Panakai soils have CEC in the range of 10 to 15 Cmol /kg soil. The sandy loam Shamozai, especially those of occurring in un-irrigated cultivated area have very low CEC. In these soils CEC generally ranged from 3 to 5 Cmol /kg soil . The low CEC will result in depletion of plant nutrients due to cropping as well lose through leaching with heavy irrigation.

Cation exchange capacity increased toward the surface which due to slightly greater organic matter at the surface especially in the cultivated soils under irrigation.

Total Nitrogen

The soils in all the dam sites are poor in total N. Total N ranged from < 0.001 to 0.1%. The un-cultivated soils have extremely low total N. The irrigated soils under orchards, fodder, or cash crops have greater total N than the similar soils in un-irrigated conditions. Total N decreased with profile depth.

Plant Available Phosphorus

The data revealed that majority of the soils have low to very low plant available P. Majority of the soils have < 2 mg / kg soil plant available P. Few soils in the beneficiary area of Wali Dad, Jigda, and Murghi Kotal dams have medium P fertility level. Plant available P decreased with profile depth.

Plant Available Micro-nutrients

Critical values for AB-DTPA extractable soil Zn are <1 mg/liter low, 1-1.5 medium and >1.5 mg/liter high. Most of soil samples from irrigated areas of Wali Dad, Brewery, Tirkha, Bostan, and Arambi have medium to high level of plant available Zn. There would not be any need of Zn application. Soils in the Ghutai Shella, Dara, Jigda, Iskalkoo, Mangi, Amach, and Kad Kocha are deficient in Zn. These soils are deficient in plant available Zn.

Critical value of soil Cu are <0.2 mg/liter deficient, 0.3 to 0.5 mg/liter medium and >0.5 mg/liter high. The soils in the Ghutai Shella Tirkha, Barshore, and Khora Manda area are deficient in Cu. Rest of the dam sites have moderate to high level of plant available Cu.

Critical value of soil AB-DTPA extractable Fe are <3 mg/liter low, 3 to 5 medium and >5 mg/liter high. The soils in the Ghutai Shella, Tirkha, Sanzali, Arambi (Amb-2), Kad Kocha (Kdk-2) are deficient in plant available Fe. Many other soils including those from Wali Dad, Murgi Kotal, Dara, Jigda, Sakhol, Laghmgir dam sites have high level of plant available Fe.

Critical value of plant available Mn are < 0.5 mg/liter low, 0.5 to 1.0 medium, and >1.0 mg/liter soil high. The Ghutai Shella site Gsl-4 has <0.5 mg/liter soil Mn indicating deficiency of this element. Few sites in Arambi, Marium, and Iskalkoo have Mn deficiency. It is apparent that micro-nutrient recommendations should base on test value for specific site and it is difficult to give any blanket recommendation for micro-nutrient for these soils. Nevertheless N and P deficiency is wide spread and 95% of the soils need fertilizer application containing N and P. Soil analysis for K and B will complete the range of nutrient generally one should be conscious about when dealing soils in the region.

D.4 LAND CAPABILITY CLASSIFICATION

D.4.1 Method of Classification

Land capability classification is a method of grouping the soils of an area to show their relative suitability for sustained production of common agriculture crops, or for grazing or forestry. It takes into account general agricultural use, but not special crops or the urban or industrial uses.

The classification outlined below is designed to suit the agricultural conditions of Pakistan. It is similar in basic structure to the U.S. Soil Conservation Service Classification, U.S.D.A. (1961), but the definition of the classes has been modified and the number of subclasses extended to suit the conditions of Pakistan. Soils placed in the highest class (I) have the least limitations for agriculture use and relatively little effort is required to produce high crop yields. In successively lower classes there are increasingly severe limitations for agricultural use and increasingly greater effort is required to produce high crop yields Soils in the lowest class are unfit for agricultural use.

Land capability of the area was estimated with and without irrigation conditions. Land capability class is shown as below;

Class I	Very good agricultural land
Class II	Good agricultural land
Class III	Moderate agricultural land
Class IV	Poor (marginal) agricultural land
Class VI	Land with fair grazing or wood land potential
Class VII	Land with poor grazing or wood land potential
Class VIII	Agriculturally unproductive land

Class I has the least limitation for agricultural use, and relatively little effort is required to produce high yields of wide range of crops. The suitability decreases gradually in accordance with increase in class number. Class IV is recognized as agriculturally unproductive. No irrigation is assumed in class VI to VIII.

D.4.2 Outline of Classification

Two levels of generalization are recognized; land capability class and land capability subclass. The first and broadest grouping, land capability class, are identified by the Roman numerals I to V. The letters "ir" or "d" preceding the class number are indicated "irrigation" or "dry

farming", respectively. The soils within each land class have limitations of about the same degree. Class I has the least limitations for crop production. Class IV is considered unfit for economic production of agricultural crops. The kinds of limitations may vary, however, within each class.

The land capability subclass is designated by small letters following the class number, which shows soils having the same kinds of limitations for agricultural use. The following subclasses are recognized.

- e : Soils restricted in use due to erosion hazard or past erosion.
- w : Soils restricted in use due to excess water because of poor drainage, high water table or overflow.
- s : Soils restricted in use due to limitations inherent in the soil profile such as shallow soil depth, stoniness, slowly permeable layers or low moisture holding capacity.
- a : Soils restricted in use due to salinity and/or alkalinity.
- c : Soils restricted in use due to unfavorable climate.

Class and Sub-class Description

The class and sub-class descriptions have been kept as specific as possible by restricting generalization referring to conditions actually encountered in Pakistan. There are some specific terms: The term *traditional management* means use of local seed and the traditional bullock-drawn country plow, a low level of manuring, inadequate cultural practices, absence of drainage or flood control, and presence of irrigation (applicable in the sub-classes 'ir'). The term 'modern management' implies use of an improved steel plow, use of good quality seed, and optimum application of fertilizer, in addition to plant protection, appropriate cultural practices including soil conservation measures, local drainage and protection against runoff from the surrounding land. The term modern management may be used under irrigated or non-irrigated conditions, as indicated by the prefix 'ir' or 'd', respectively, used with the land capability sub-class designation.

D.4.3 Description of the Land Capability Classification

Class I. Very Good irrigable land

Soils in this class have little or minor limitations for crop production throughout the year and have the widest range of agricultural use. This class occurs only as *irrigated* or *irrigable* land in the survey area.

irI

Soils in this sub-class have no or only slight limitations for crop production throughout the year and have the widest range of agricultural use. They are level to very gently undulating, deep and well drained, have high water holding capacity, and moderate to moderately slow permeability. These soils are easily worked to good physical condition, favorable for the germination and growth of plants. The surface texture is loamy or silty. Lime concretions are not present in such a quantity as to interfere with root penetration.
Under traditional management and with sufficient irrigation water these soils can be used for crop production throughout the year and are at least moderately productive. With modern management and with sufficient irrigation water they are capable of giving very high yields of a wide range of crops throughout the year.

Class II. Good irrigable land

Soils in this class have moderate limitations for crop production throughout the year, or severe limitations during one season, or have a very limited range of suitable crops. This class only occurs as irrigated or irrigable land in the area. Soils in this class have minor limitations for crop production throughout the year, or moderate limitations for part of the year or a narrower range of suitable crops than the soils in Class I. Remedial measures are easy to apply, or management adapted to the limitations easy to practice.

The irrigated soils in this class have one or more of the following limitations: Moderately rapid permeability and a moderately low water-holding capacity or slow permeability and short periods of excessive wetness, or a minor problem of workability and seedbed preparation. Minor surface salinity and alkali problem associated with low irrigation intensity may exist.

irIIr

The soils in this sub-class are gently sloping to gently undulating. The land has irregular relief which creates hindrance in layout of irrigation system. The soils are deep, loamy or silty and have no or slight limitations for crop production throughout the year and have the widest range of agricultural use. The extent of the land is limited. These are presently well drained, mottled, have high water holding capacity and moderate permeability.
With modern management and with sufficient irrigation water and special irrigation techniques. The soils are capable of producing high yields of a wide range of crops.

irIIs

The soils in this sub-class have one or more of the following combinations of limitations. Medium textured to moderate depth over fine textured material, or medium texture alternating with fine textured strata, having few pores and very slow permeability, the subsoil becomes saturated for a few days after irrigation. Fine textured topsoil making seedbed preparation difficult and limiting the choice of crops or requiring extra inter-tillage operations to maintain aeration. Moderately coarse texture; a higher permeability and lower water holding capacity than soils in Class I: and medium or moderately fine texture and moderate depth over coarse textured material.
Under traditional management and with irrigation most of these soils are used for high value crops (fruits and vegetables) as are soils in Class I, but crop yields are lower or less certain. With sufficient irrigation water and under

modern management, including local drainage and extra care in seedbed preparation on clayey soils, or frequent and light irrigation's on soils with a relatively low water-holding capacity, the soils could have the same productivity and generally the same choice of crops as soils in Class I. Management costs would, however, be higher.

Class III. Moderate irrigable land

Soils in this class have severe limitations for crop production and may have very narrow range of agricultural use. These limitations are mainly due to shortage of soil moisture because of their coarse texture and arid climate, which make crop production very hazardous.

This class includes only irrigated or irrigable land in the survey area. Soils in this class have moderate limitations for crop production throughout the year or have a very limited range of suitable crops. Part of the limitations can be removed at relatively high cost and require special management or selection of suitable crops for attaining high productivity.

The irrigated soils in this class have the limitations of rapid permeability and low water-holding capacity resulting in wasteful use of irrigation water.

irIIIw

Soils in this subclass are nearly level, clayey and imperfectly drained. The constraints are seasonal high water table and clayey texture.
Under traditional management the soils are used for restricted cropping and the yield are moderate. With modern management, specially, measures to lower water table, the yield are close to irIIs.

irIIIs

Soils in this sub-class have relatively rapid permeability and low water-holding capacity resulting in wasteful use of irrigation water. They are moderately coarse textured and moderately deep over coarse material. They may be slightly saline in addition.
Under traditional management most of these soils are used for limited general cropping, as are many good irrigated soils. Crop yields are low and relatively uncertain and a part of the irrigation water is lost through rapid percolation. Part of this land is used at present for poor dry-farming or for poor grazing. With modern management, including split application of fertilizers and judicious application of irrigation water, this land could produce yields quite close to those on good land, but at a relatively high cost.

Class IV. Poor (marginal) agricultural land

Land in this class dose not have a potential for agriculture, grazing or forestry. Some parts may need afforestation or other measure to protect adjoining agricultural and, but this is not expected to yield economic returns of wood or other products. This class occurs under both irrigation and under dry-farming. Soils in this class have severe limitations for crop production and may have a very narrow range of suitable crops. Improvement to a high level of productivity may or may not be technically feasible. It would require prohibitively high expenditure for development or maintenance.

The irrigated soils in this class have a severe hazard due to coarse texture causing great waste of irrigation water and/or thin root zones.

irIVs

Soils in sub-class are level to very gently undulating loamy sands or sandy in texture with a shallow medium textured topsoil, have rapid permeability, and low water-holding capacity. Under traditional management, part of this land supports poor dry-land crops or poor grazing. Part of this land is used for irrigated agriculture with great loss of water by seepage in the distribution system and on the land. The sub-class produces generally moderate crops at high costs to the economy.
With modern and intensive management involving high expenditure for tubewell irrigation high yields of some special and high-value crops could be obtained. Irrigation of this land for general agriculture use would not be economical. The non-irrigated soils in this class have severe limitation due to arid climate.

irIVx

The soils in this subclass are nearly level loamy and deep. Because of high wind velocity, the sands from the high-lying close by terrace is deposited in the cultivated area. Presently, measure to control wind erosion in the area are operative but still threat to standing crop is serious.

dIVc

Soils in this sub-class are level to very gently undulating and sloping, medium to fine textured and occur in an arid climate. Their overriding limitation is lack of moisture and severe cold winter.
Under traditional management this land is dry-farmed to wheat in years of favorable rainfall. In droughty years the land remains fallow and natural vegetation provide poor grazing for the livestock. The response to modern management under dry-farming is expected to be low. With irrigation and modern management, part of this land would produce two good crops and have a relatively wide choice of crops.

Class VII. Land with a Poor Grazing or Woodland Potential

Soils in this class do not have a potential for dry-farming but could produce poor grazing for part of the year or poor firewood.

VIIs

This sub-class comprises coarse textural soils with shallow medium topsoils having very low water-holding capacity and very rapid permeability.
Traditionally, these soils have sparse vegetative cover of shrubs, grasses and forbs, and are used for poor grazing by livestock. This land could continue to produce poor grazing provided that modern management including planned rotational grazing, is adopted.

VIIc

Soils in this sub-class are: (a) level to very gently undulating coarse to fine textured in the piedmont plains and (b) nearly level to gently sloping, gravely loam to gravely clay loam in gravely fans aprons, and some subjacent gravely fans receive runoff water from the adjacent hills, thereby, increasing the moisture in the soil.
These soils are covered with sparce vegetation of shrubs with some grasses and forbs of low forage value, and are used for grazing. The plants of better forage value have been destroyed due to overgrazing.

Class VIII Agriculturally unproductive land

This land could produce poor seasonal grazing with modern management including development of watering points for livestock, water harvesting by small check dams, and rotational grazing.

VIIIe

The area comprises of shifting sand dunes, gullied land or silty severely dissected land. This land is not fit for agricultural purposes but its improvement/ reclamation is necessarily to avoid further degradation of land.

D.5 CROP SUITABILITY

D.5.1 Outline of Crop Suitability Classification

Crop suitability classification is a method of rating soils in terms of their relative suitability for the sustained production of specified crops. Sustained production does not necessary mean that the same crop should be produced on the same piece of land year after year. In most cases, the crop should be produced in rotation with other crops. The ratings are called crop suitability classes and range from Class 1 (S1) for the most suitable soils to Class 4 (NS) for the least suitable.

These ratings are similar to land capability classes, but two important differences should be noted. A crop suitability class is a rating for individual crops, whereas a land capability class is a rating for overall crop production. Moreover, a crop suitability rating takes into account only the most favorable season of the year for the soil-crop combination under consideration, whereas a land capability rating is based on the limitations of a soil for crop production throughout the year.

Each soil has certain physical and chemical characteristics that affect its response to management and influence yields. For instance, soils best suited for cotton production are well drained, medium textured and fertile or responsive to fertilizer applications. Other crops such as paddy has different requirements. Therefore, soils in the same land capability class may be differently rated for crop suitability.

The soils are rated according to their present condition or that expected to exist for the next ten years or so under traditional or modern management. Whenever capital improvements are made, for example, by providing drainage or large scale irrigation, then a revised rating of crop suitability will be needed for the new situation. Similarly, changes may need to be made with improvement in agricultural technology, for instance, the introduction of drought resistant varieties of crops.

D.5.2 Definition of the Class

The four classes are defined as follows;

Class 1 (S1) : well suited

Under traditional management, the crops grow well and produce high yields. For the crops under consideration, the soil has favorable physical, chemical and drainage characteristics; a moderate or high fertility level; and is responsive to good management. Under modern management, the crops would produce high or very high yields.

Class 2 (S2) : moderately suited

Under traditional management, the crops produce moderate to poor yields or are subject to occasional hazard of failure. For the crops under consideration, the soil has somewhat unfavorable physical or drainage characteristics; a medium or low level fertility level. Under modern management, the crop yields would be moderately high. Except where climate is limiting, moderate expenditure to overcome limitations and/or a relatively high intensity of management would enable the crop to produce very high yields.

Class 3 (S3) : poorly suited

Under traditional management, the crops produce poor yields or would be subject to great hazard of failure For the crops under consideration, the soil has unfavorable drainage; unfavorable physical or chemical characteristics; low fertile, not easy corrected. The response to management is generally low. Intensive modern management together with major expenditure for drainage, erosion control and/or correction of unfavorable soil conditions would be required for the crops to give moderate to high yields. If the climate is unsuitable, high yields can not be obtained. Generally, the crop must be considered as marginal and is not recommended for the soil under consideration.

Class 4 (NS) : not suited

Under traditional management, little production may be expected from the crops. The soil has severe physical, chemical or drainage limitations for the crops under consideration or a severe erosion hazard. Only with prohibitive expenditure foe major improvements and under very intensive or special management, moderate or good crop yield could be expected in some cases. This would be uneconomical.

Crop suitability classification of the soils in the Study Area is described in TABLE D.3.

D.5.3 Crop Suitability Ratings

Although knowledge of the soil and environmental requirements of some crops is still incomplete, an estimate has been made of the suitability of the soils of the area for a number of common crops. The list of crops is not exhaustive and the ratings are not final. This classification can be of value to agriculturists and economic planners in considering alternative crops or cropping systems for a given area under changing economic conditions. The ratings under irrigation and dry-farming are presented in Table +++ by arranging various soil series in alphabetic order.

D.6 CHARACTERISTICS, POTENTIAL, PROBLEMS AND RECOMMENDATIONS FOR SOIL IMPROVEMENT OF THE SOILS IN EACH BENEFICIARY AREA

D.6.1 Existing Dam Sites

Khora Monda

The area is gently sloping and terraced. It comprises of the soil mapping unit Zard, Shamozai and Ghaza's non-saline non-sodic variant. Zard is the dominant soil mapping unit and has very deeply developed, well drained, silt loam soils. The Shamozai soil mapping unit contains very deep to moderately deep developed and well drained soil which overlies soil of similar characteristics but comparatively of older age. The Ghaza, non-saline, non-sodic variant has very small extent. The soil is deeply developed gypsiferous silty clay loam. The ECe of the soil is 2 mS/cm and pH ranging from 7.7 to 8.0

Soils of these mapping units are highly susceptible to surface crusting because of low organic matter and fine silt particles. Therefore, soil erosions, specially sheet erosion, active in the area. Close to stream, rill erosion is also present. Nutrient content of the soil is low. Small area is occupied by Ghaza's non-saline, non-sodic variant which has moderately slow permeability. It poses slight workability and seedbed preparation problem. The rest of the area is well drained, has moderate permeability, and high water holding capacity.

The land has a very high potential for irrigated agriculture (irI). The crop suitability classification of the soil is *well suited* suggesting that all types of crops, vegetables and orchards can be grown in the area. It has good irrigation suitability considering the features important in design, construction, and management of irrigation system. However, a small area covered by Ghaza non-saline, non-sodic variant may have problem in performance of irrigation system.

Marium

The main soil mapping units are: man made soils and Taleri. The man-made soil material in the valley is mostly transported from out side. However, the surrounding area comprises of limestone's with some shells and conglomerates.

The man-made material occurs mainly at the foot of the mountain on gently sloping, terraced area in a narrow valley. The transported material is taken from developed soils. At places, it contains silt loam texture and is deep. Presently, it is well drained, has moderate permeability and high water holding capacity. Total plant available water in profile is limited by depth of bed rock. The second place of observations contain clayey material underlain by gravel bed at about 60 cm depth. The soil is well to moderately well drained, has moderate to moderately rapid permeability, moderately high water holding capacity. The third point of observation is clayey soil which has few to common mottles and water table at about 100 cm depth. All the three sites have silt loam soil at the plowing depth.

The first observation point has no limitation. It has high potential for irrigated cultivation (irI). According to crop suitability classification, it is well suited soil (Class I) to all types of crops, vegetables, and orchards. It also has good irrigation suitability. The second observation point is moderately deep and has clayey material after plowing depth. It has a high potential (irIIs) for irrigated cultivation. It is well suited (Class I) to all types of crops and vegetables but moderately well suited for orchards. It also has good irrigation suitability. The third observation point has water table at about 100 cm depth. It has moderate potential (irIIIw) for irrigated cultivation. It is moderately well suited for crop and vegetable but poorly suited for orchards. Its irrigation suitability is moderate if drainage is provided.

The soil mapping unit Taleri occurs in small patches surrounded by severely dissected alluvial fans. The soil has no limitation except being occurring in small scattered patches. The land has very high potential under irrigation (irI) and marginal potential (dIVc) under dry-farming. Presently, there is no economical way to provide irrigation to Taleri area because of occurrence of suitable soil in small patches.

Bostan

The area is gently sloping and terraced. It comprises of soil mapping units Zard, Shamozai, and Chiltan soil series. The Chiltan soil mapping unit occurs on young alluvial fans. The surface is slightly dissected and is gravelly with some stones. The soils are shallow to moderately deep over gravels. Due to limited soil depth, gravelly nature of the soil, having moderately rapid to rapid permeability, low water holding capacity, and somewhat excessive drainage, the Chiltan is not suitable for arable cultivation.

The soils of the Zard and Shamozai soil mapping units are very deep and well drained. Both the soils have moderate permeability and high water holding capacity. Because of low organic matter and fine silt particles, these mapping units are highly susceptible to surface crusting. Therefore, sheet erosion is active in the area. Close to *lora* rill erosion is also present. Due to traditional method of cultivation nutrient deficiency is present in the soils. Small areas close to *lora* has Shamozai soil overlying a stratified clayey material from the red clay, silt, and sandstone's parent material.

The Bostan area is moderately well drained and has moderately slow permeability. Major part of the cultivated area has very high potential (irI) for irrigated crops, vegetables, and orchards. It is well suited to all types of crops and orchard according to crop suitability classification. The area has no problem in design, construction, management, and performance of irrigation system.

Tirkha

The area comprises of soil mapping units Barshore, Barshore moderately fine variant and Pishine. The Barshore moderately fine variant occupies somewhat depressional area near Killi Mandan and Yaroo. Barshore soil mapping unit occupies piedmont plain which is nearly level near Haderzai. The soil mapping unit Pishine occupies gently undulating area dissected by small torrential streams. It occupies area around Chimney near Yaroo village.

The soils are developed in the parent material which is derived from red clay, silt, conglomerate and sandstone occurring as bad land in the area. The salt on surface in the uncultivated parts and in bad land show that ECe will be close to 4 and may be somewhat high. The Barshore soil mapping unit is well drained, has moderate permeability and high water holding capacity. The Barshore moderately fine variant has somewhat restricted drainage. The land in these units has very high potential (irI) to high potential (irIIs) under irrigation. It is well suited to all types of crops, vegetables, and orchards.

The land occupied by Pishine soil mapping unit has poor to marginal potential under irrigated cultivation because of moderately coarse texture, somewhat excessive drainage, moderately rapid permeability, and moderately low water holding capacity. Furthermore, irrigated cultivation will be problematic because of gently undulating landscape as well.

Amach

The area comprises of soil mapping unit Chottak, Zard, and Pringabad coarse and Pringabad moderately coarse variants.

The soil mapping unit Chottak comprises of deep / very fine sandy loam soils having common lime specks and few medium and coarse lime concretion. The mapping unit occupies elevated, severely dissected uneven surface. Karaze water cannot be used for irrigation because of land scape position. The land has a poor grazing potential (class VIIc). Rotational grazing and reseeding of forage species improve rangeland condition and check further erosion.

The Pringabad coarse variant occurs around Killi Akhana area. Presently it is level and under dry farming. The soil has rapid permeability, very low water holding capacity, and is excessively drained. The land has a poor to marginal potential for irrigated agriculture (irIVs). Irrigation of the area is not recommended due to limited water resources.

Pringabad moderately coarse variant occupies gently undulating area around the village Shamsabad. The soil has rapid permeability, high infiltration rate, and low moisture holding capacity. The area is spotted with sand dunes. The land has a high potential (irIIs) under irrigated cultivation. Presently the area is subject to severe wind erosion. Irrigation is difficult due to land scape position.

The Pringabad soil mapping unit occur on high elevated terraces as well as lower terraces. The higher terrace is dotted with sand dunes and is presently being used for cultivation of dry-farmed crops such as wheat and watermelon. Part of the Pringabad is being used as grazing land which is subject to severe wind erosion. The lower terrace is under irrigated cultivation. This part of the land has very high potential under irrigated cultivation (irI). It is well suited to all types of crops, vegetables, and orchards. However, irrigation requirement will be high. Frequent but light irrigation may be efficient and useful.

The Zard soil mapping unit occurs in the lowest terrace. The area is under irrigation and the land has a very high potential under irrigated cultivation (irI). It is well suited to all types of crops, vegetables, and orchards. There is no problem in construction, design, and maintenance of irrigation system.

Gorpad

The land comprises of soil mapping units Toba loam variant and Injira and Hathiari. The soil mapping unit Toba loam variant occupies convex position in the gently undulating old alluvial fans which are dissected by streams. The Injra mapping unit occupies gently undulating alluvial fans which are at lower terrace than old alluvial fans. The alluvial fans are also dissected by streams. The land has gravely surface with some stones. Presently, it is being used as rangeland.

Toba loam variant is gravely loam overlying gravel bed within 30 to 80 cm depth. It contains lime concretion zone after 20 cm depth. The lime content is about 20 to 30%. The Toba soils

are somewhat excessively drained, have moderately rapid permeability, and low water holding capacity. The organic matter content is 0.1 to 0.3%. The Injra soil mapping unit is similar to above soil mapping unit except that it does not contain lime concretion zone. The land has poor grazing potential (VIIc).

The soil mapping unit Hathiari is deep silt loam and very fine sandy loam. The soil has no physical or chemical constraints. Due to traditional cultivation without fertilizer, nutrient deficiency occurs in the area. The soil is well drained and has moderate permeability and moderate water holding capacity. The land has a high potential under irrigated cultivation (irI). It is well suited to all types of crops, vegetables and orchards. There is no problem in design, construction and maintenance of irrigation system. Presently, it is under dry-farming for wheat only.

Laghmgir

The area comprises of soil mapping unit Zard and Shamozai. The area is generally nearly level and is under irrigation.

The soil mapping unit Zard comprises of deep, deeply developed silt loam and very fine sandy loam. The soil mapping unit Shamozai occurs close to gullied area or piedmont alluvial fan apron and therefore may contain gravel bed at 90 to 100 cm depth. The soil being developed from limestone contains fine silt and clay. It contains 0.2 to 0.5% organic matter and is therefore susceptible to surface crusting. Nutrient deficiency generally exists because of low input of chemical fertilizer and low organic matter. The area is deficient in plant available N and P.

The land has a very high potential under irrigation (irI). It is well suited to all types of crops, vegetables and orchards. There is no problem in construction, design, and maintenance of irrigation system.

D.6.2 Proposed Dam Sites

Brewery

The area comprises of young alluvial fans and piedmont plains. The alluvial fans are formed of gravelly and stony mountain out-washes deposited by torrential streams. At places, land is elevated than the adjacent piedmont plains. The soil mapping unit in the alluvial fan is Chiltan. The alluvial fan is slightly to severely dissected by present streams and by human induced activities such as construction of road. Because of gravelly nature of the Chiltan soil, severe

erosion, and uneven surface, it is not suitable for crop cultivation. Palatable forage plants in the area have depleted due to high grazing pressure.

The piedmont plain comprises of the Zard soil mapping unit. Because of low organic matter and fine silt particles the soil is highly susceptible to soil crusting close to the *lora*.

Dominant part of the Brewery area has a high potential under irrigated cultivation. The soils have crop suitability rating Class-I, *well suited,* for all types of crops, vegetables, and orchard. The irrigation suitability of the soil is good.

To enhance soil organic matter green manuring, addition of FYM, and plowing of crop residues are useful. High yield could be obtained on sustainable basis with modern management and balanced doze of fertilizer.

Ghutai Shela

The area comprises of young alluvial fans and piedmont plains. It has been disturbed due to human activities which include expansion of constructed area and harvesting of orchard close to air force residential area. The alluvial fans comprise of three soil mapping units namely Chiltan, Shamozai and Shamozai (mottled) variant. The Chiltan soil mapping unit in the alluvial fan has no potential for arable cultivation due to gravelly nature, undulating topography and moderate depth to gravel bed. It has a poor grazing potential.

The piedmont plain in Ghutai Shela comprises of Shamozai and Shamozai mottled variants soil mapping units. Shamozai soil mapping unit contains some area where loamy sands occur after 110 cm. Shamozai mottled variant occurs at comparatively higher elevation. Presently, it is well drained. The formation of yellowish brown and gray mottled throughout the profile indicates past restricted drainage. In addition to macro-nutrient deficiency, the soil may be deficient in iron and manganese as indicated by the field observation. Some parts of the unit contain sandy loam at about 60 cm depth which prohibit their suitability for deep rooted crops.

Major part of the area has a high potential, while some part has moderately to high potential under irrigated cultivation. The former area is well suited while the later moderately well suited according to crop suitability classification. The irrigation suitability of the area is moderate to high because of human influence and differential elevation of land.

Wali Dad

The area comprises of young alluvial fans and piedmont plains. The alluvial fans are formed of gravelly and stony mountain out-washes deposited by the torrential streams. The alluvial fans have coalesced to form an apron of 2 to 4 km width. Close to mountain the surface is stony and gravelly. In the alluvial fan, gravelly loam having gravel bed occurs at a depth of 40 to 70

cm. Surface is gravelly with some stones. The infiltration rate of the soil is very high and water holding capacity very low (Chiltan soil mapping unit). The area being dissected has gently undulating topography. The Chiltan has no potential for cultivation of crops but has poor potential as grazing land.

The piedmont plain in the Wali Dad area contain Zard, Shamozai, Sariab, Quetta, and Sariab soil mapping units. Major part of the area has surface crusting problem due to low organic matter and fine silt particles. Because of traditional soil management nutrient deficiency is evident. Small areas close to *lora* have rill erosion and patchy salinity on the surface.

The major soils in the piedmont plain have a very high potential (irI) under irrigation. The crop suitability for all types of crops, vegetables and orchards is Cass-1, *well suited*. Considering the features important in design and management the irrigation suitability is also good.

To build up organic matter content of the surface soil green manuring, addition of farm yard manure, and plowing of crop residues are recommended. Balanced dose based only on soil analysis will enhance the yield.

Dara

The cultivated area is gently sloping to nearly level and comprises of soil mapping units Lajwar, Sariab, Quetta and Shamozai. The soil mapping unit *Lajwar* occurs in slightly depressional area having locally somewhat restricted drainage. The soil is very deep, gray (2.5 Y hue) silty clay loam. Near village Sarghazai, it over lies gravel bed with 70 to 100 cm depth. The soil has slight workability and seed bed preparation problem. It has high to moderately high water holding capacity and is well to moderately well drained.

The soil mapping unit *Sariab* occurs close to the apron of the fans in level to gently sloping piedmont plains. The soil is deep, moderately deep developed, has few scattered gravels in the profile and is medium textured. The soil permeability is moderately rapid and water holding capacity is moderate to high. The Shamozai and Quetta soil mapping units have no physical or chemical soil problems.

The central part of the land has a very high to high potential for irrigated crops, vegetables and orchards. According to crop suitability classification the area is well to moderately well suited. There is also no land and soil problem in major part of the area for design, construction, and maintenance of irrigation system.

Murgi Kotal

The area comprises of young alluvial fans, piedmont plains, and basins/playas. Soil parent material is mainly from limestone but close to *lora* limestone is intermixed or overlies the red

clays, silt, sandstone's and conglomerates. The area comprises of soil mapping units: Chiltan, Shamozai, Lajwar, and Azim.

The soil mapping unit Chiltan occupies young alluvial fan which gradually merge with the piedmont plain. The alluvial fan is slightly dissected and has gravelly loam soil extending to 40 to 70 cm depth lying over gravel beds.

The piedmont plain mainly contains Shamozai and Lajwar soil mapping units. The Shamozai soil mapping unit occupies areas close to piedmont basin/playas, therefore, it usually overlies clayey material within 40 to 60 cm depth. This may result in restricted rooting depth and perched water table condition. Lajwar soil mapping unit occupies slightly depressional areas in the piedmont plains. The sub-soil is, therefore, grayish in color.

The piedmont basin/playas is dominated by the Azim soil mapping unit. The soil is very hard, dense, very slow permeability and collects runoff resulting in pounding during rainy season. The external drainage is a problem.

The land in the young alluvial fan has poor grazing potential and is not fit for arable cultivation because of gravel and stones in the surface, high infiltration rate, and low water holding capacity. The land in the piedmont plain has good potential for irrigated crops. It has a well suited to moderately well suited crop suitability ratings. The irrigation suitability is good. The land in the piedmont basin playas has high potential under irrigation and poor potential under dry-farming. It is moderately suited for crops and marginally suited for orchard according to crop suitability classification. The irrigation suitability is marginal to moderate.

Kach

The beneficiary area contains the soil mapping units Shabaq and Chiltan. The Shabaq soil mapping unit occurs at higher terrace and occupies nearly level to sloping parts in the undulating to gently undulating landscape. The Chiltan soil mapping unit occupies lower terrace and covering nearly level to gently sloping parts.

The Shabaq soil mapping unit mainly comprises of moderately deep, gravelly clay loam overlying gravel beds. Some parts have gravel bed within 50 cm depth while some other parts have loamy sand within 50 to 70 cm depth. The soils are somewhat excessively to excessively drained. These soils have moderately rapid permeability and low to very low water holding capacity. About 30% lime exists in the B horizon at about 20 to 40 cm depth in the form of lime soft lime-specks. The surface contain many gravels and few to common stones.

The Chiltan soil mapping unit occupies lower terrace. The soil is moderately deep, gravelly loam having gravel bed underneath. The soil does not contain lime-speck. At places gravel bed

occurs within 50 cm depth. The soil has almost the same limitations as the soil mapping unit Shabaq.

Because of the gravelly nature of the soil, landscape position, severe erosion, and uneven surface terrain, an economical irrigation is problematic. It is therefore, not recommended for irrigated or dry-farmed arable cultivation. Presently, the soil has poor grazing potential (VIIc). The grazing potential could be increased by planned rotational grazing, construction of dykes for water, development of watering points, use of cheap rock phosphate, and re-seeding. According to crop suitability classification and considering criteria for irrigation, the area falls in class "not suited".

Jigda

The area comprises of soil mapping unit Pinakai and Pinakai gray variant. The area is dissected by torrential streams. The gravel bed occurs within 40 to 100 cm depth at some places close to streams or near the apron of the alluvial fan. The area is under irrigation for cultivation of all types of crops, vegetables, and orchards. At few places salts are visible on the surface.

Pinakai soil is deep, well drained, has moderate permeability and high water holding capacity. The soil has no physico-chemical problems. However, because of intensive cultivation, nutrient deficiency occurs in the area. The ECe may be close to 3 to 4 mS/cm at surface where salts are visible. The land has a very high potential for irrigated orchards. Pinakai gray variant is similar in all respect to Pinakai except that its color is in 2.5Y hue.

The land with gravel bed within 50 to 100 cm depth has high potential (irIIs) under irrigated crop cultivation. These are well suited to all types of crops and vegetables but moderately well suited for orchards. At few places gravel beds occur within 30 to 50 cm depth or have over wash of gravels (about 20 cm). The area which have overwash are not suitable for cultivation of cereal crops and vegetables.

Sanzali

The area comprises of gently undulating landforms which have been dissected by torrential streams. It contains loamy sand at the surface which is subject to wind erosion. Gully and rill erosion is also present.

The Sanazali area comprises of the soil mapping unit Pishine which usually has loamy sand at the surface and sandy loam/fine sandy loam upto 60 to 80 cm depth. It overlies either gravel bed or stratified coarse and moderately coarse texture material. The soil is somewhat excessively to excessively drained, has moderately rapid to rapid permeability and moderately

low to low water holding capacity. The land has poor/marginal potential under irrigated cultivation. It is poorly suited for crops, vegetables, and orchards except for melons.

Presently, it is being used for cultivation of wheat under dry-farming or as grazing land. Because of landscape position, and poor potential, it is not recommended for irrigated cultivation. In order to check wind erosion, it should be developed as rangeland.

Arambi

The area occurs in small patches along the stream and at the foot of mountain in level to very gently undulating piedmont plain. It is located around Zarded, Adosh, Silad, Babe, Killi Kamran and Killi Fardous. The main soil mapping units are Pinakai and Lajwar.

The soil mapping unit Pinakai consists of very deep, deeply developed, medium textured soils. Small area is moderately deep and has gravel bed within 70 to 100 cm depth. The area around village Silad is mainly of Lajwar soil mapping unit. The soil is grayish and may contain distinct yellowish brown mottles. Its present drainage is well but in past had some restricted drainage.

Major land area has very high potential for irrigated cultivation (irI). It is well suited to all crops, vegetables and orchard. Irrigation suitability is good, except, that it occurs in small patches on both sides of the stream which may require special design and proper care in maintenance.

Sakhol

The area comprises of the soil mapping units Pringabad and Shabaq. It occupies mainly lower terrace and is under irrigation.

Pringabad soil mapping unit consists of deep, very fine sandy loam soils. The soil has the lowest organic matter content ranging from 0.04 to 0.06% and is subject to great hazard of wind erosion. Part of the area is being stabilized by soil conservation department. The soil is well to some what excessively drained, has moderate to moderately rapid permeability and moderately low water holding capacity. The land has high potential (irI) under irrigation. It is well suited to all types of crops, vegetables, and orchards.

The area occupied by the Shabaq soil mapping is of minor extent and occurs near Killi Rolkhani on the leveled alluvial fan. The upper 26 cm of soil unit is loam without many gravels which makes it suitable for cultivation of crops, vegetables, and orchards. The lower soils is gravelly loam having common lime speck and moderate permeability and low water holding capacity (< 3 cm/ 75 cm). The soil has high potential (irIIs) under irrigated cultivation. Water requirement will be high. Therefore frequent but light irrigation is recommended.

Mangi

The land comprises of soil mapping units Kaftari and Patkai. The soil mapping unit Patkai occupies gently sloping to sloping areas in the young alluvial fans while Kaftari soil mapping unit occupies nearly level to gently sloping piedmont plains at the end of apron of fans. The soil mapping unit Kaftari is cultivated and terraced.

Patkai soil mapping unit comprises of gravely loam, having shallow depth to gravel bed. It has gravely and stony surface. The soil is excessively drained and has high intake rate and very low water holding capacity. The land is not suitable for arable cultivation or plantation of orchards. It has a poor grazing potential (VIIc).

The soil mapping unit Kaftari is moderately deep over gravel bed or coarse texture material within 80 to 100 cm depth or moderately deep developed silt loam and very fine sandy loams. The soil has no physical or chemical constraints except shallow depth which may be a problem for orchards. The ECe is expected to be 3 to 4 ms/cm in major part. It has low OM content, soil has salinity and high SAR patch. Nutrient deficiency occurs in the area because of continuos cultivation without fertilizer input. Kaftari is deficient in N, P, Zn, and Fe. The soil is well to somewhat excessively drained. Its permeability is moderate to moderately rapid and water holding capacity moderately high to high. The land has a high potential under irrigated agriculture. It is well suited to all types of crops and vegetables but moderately suited to orchards in some parts. There is no problem in the design, construction and maintenance of irrigation system in this part.

Kad Kocha

The land comprises of soil mapping unit Shamozai and Zard. Both soil mapping units occupy nearly level piedmont plain. The land usually contain gravel layer or a coarse textured material within 100 to 150 cm depth. Presently the area is under cultivation for cereal crops, vegetables, and orchards.

The soil mapping unit Zard comprises of, deeply developed silt loams and very fine sandy loams overlying loamy sand or gravel layer within 140 to 150 cm depth. The soil is well drained, has moderate permeability, and moderate to high water holding capacity 10 to 14 cm / 75 cm. The soil mapping unit Shamozai comprises of, moderately deep developed silt loams and very fine sandy loams overlying gravel layers or a coarse texture material within 100 and 120 cm depth. The soil is well drained, has moderate to moderately rapid permeability, and moderately high water holding capacity. Both the soil mapping units are susceptible to surface crusting because of low organic matter (0.2 to 0.4%).

The land has a very high potential under irrigated cultivation (irI). It is well suited to all types of crops, vegetables and orchards. There is no problem in construction, design, and maintenance of irrigation system.

Iskalkoo

The area comprises of a small valley. At the entrance it has been dissected by stream and the area is moderately well to imperfectly drained. In the central part of the valley it has gravel beds within a depth of 100 to 120 cm. The area comprises of the soil mapping unit Sariab and Shamozai.

Shamozai soil mapping unit overlies silty clay or silty clay loam which have gray and yellowish brown distinct mottles. The area has somewhat restricted drainage has moderately slow permeability and moderate water holding capacity. Shamozai in Iskalku area is deficient in N, P, and Fe. Land has high potential under irrigated cultivation. It is well suited to all types of crops and vegetables but moderately suited for orchards.

Sariab soil mapping unit has gravel bed within 100 to 120 cm depth. The soils are well to somewhat excessively drained, have moderate to moderately rapid permeability and moderately high water holding capacity. The land has very high potential for irrigated cultivation. It is well suited for all type of crops and vegetables, however, it may have some problem for plantation of orchards due to shallow profile depth especially near the alluvial fan.

D.7 SOIL PROFILE DESCRIPTION OF THE SELECTED SITES

Name of Dam	Wali Dad
Pit No./Bore No	Pit: Wld-2 Bore: Wld-2
Name of soil series	Sariab
Location	30 06' 54.7" N; 66 56' 42.1" E
Name of Village	Shamozai, west of killi Shamozai in garden close to main electric line pole.
Land use / vegetation	Irrigated apricot and apple orchard
Topography	Nearly level
Physiography	Close to alluvial fan apron
Moisture	Moist
Parent material	Piedmont plain
Profile drainage	Well drained
Permeability	Moderate
Water holding capacity	High
Erosion	Nill
Moisture	Moist
USDA Classification	Typic Eutrochrepts

Horizon	Depth	Description
Ap	0-12	Dark grayish brown to brown (10YR 4/2.5) moist and pale brown (10YR 6/3) dry; very fine sandy loam / loam; massive; very slightly sticky, very slightly plastic, very friable moist, slightly hard dry; few fine and common very fine pores; few gravely, few stones also present; strongly calcareous; few common very fine roots; clear smooth boundary; pH 8.4.
Bw1	12-44	Brown (10YR 4/3) moist and pale brown (10YR 6/3) dry; loam(-); very weak coarse sub-angular blocky; very slightly sticky, very slightly plastic, very friable moist, slightly hard dry; common fine and very fine tubular pores; few fine and medium scattered gravel's and few medium stone also present; strongly calcareous; few medium and coarse and common fine and very fine roots; clear smooth boundary; pH 8.2.
Bw2	44-96	Brown (10YR 4/3) moist and pale brown (10YR 6/3) dry; loam; very weak coarse sub-angular blocky; very slightly sticky, very slightly plastic, very friable moist, slightly hard dry; few medium, common fine and very fine tubular pores at places and few fine and common fine tubular pores otherwise, few charcoal pieces; very few medium gravel's; strongly calcareous; few medium, common very fine roots at places, and few fine and very fine roots through the profile; gradual smooth boundary; pH 8.0.
BC	96-112	Brown (10YR 4/3) moist and pale brown (10YR 6/3) dry; loam(-); massive breaking to very weak coarse and medium sub-angular blocky; very slightly sticky, very slightly plastic, very friable moist, very slightly hard dry; few fine tubular pore; very few medium scattered gravel's present; strongly calcareous; common medium, few coarse roots and common fine roots; abrupt smooth boundary; pH 8.0
ABb	112-122	Brown to dark yellowish brown (10YR 4/3.5) moist and light yellowish brown (10YR 6/4) dry; very fine sandy loam(-); massive breaking into single granular; slightly sticky, slightly plastic, friable moist, slightly hard dry; common very fine tubular pores; light yellowish pottery piece strongly calcareous; few medium and few roots; abrupt smooth boundary; pH 8.0.
Bwb	122-142	Dark yellowish brown (10YR 4/4) moist and light yellowish brown (10YR 6/3) dry; silt loam; weak fine and medium sub-angular blocky; slightly sticky, slightly plastic, friable moist, slightly hard dry; few fine, common medium, many very fine tubular pores; strongly calcareous; few coarse and fine roots; abrupt smooth boundary; pH 8.0.

Name of Dam	Brewery
Pit No. & Bore No	Pit: Bry-2 Bore: B-13
Name of soil series	Zad
Location	30 08' 19.0" N; 66 57' 18.0" E
Name of village	Dildar Killi, in a garden about 50 on the left hand side of the killi.
Physiography	About 50 meter from the apron of the alluvial fan
Parent material	Piedmont alluvium from limestone
Topography	Gently slopping to slopping
Land use / vegetation	Apple orchard
Profile drainage	Well drained
Permeability	Moderate
Water holding capacity	High
Erosion	Nill
Moisture	Moist throughout
USDA Classification	Typic Eutrochrepts

Horizon	Depth	Description
Ap	0-10	Brown (10YR 4/3) moist and pale brown (10YR 6/3) moist; very fine sandy loam tending to silt loam; massive; very slightly sticky, very slightly plastic, very friable moist; soft dry; few fine, common very fine tubular pores; strongly calcareous; common medium and fine and many very fine roots in pockets; clear smooth boundary;; pH 8.2.
Bw1	10-21	Dark yellowish brown to yellowish brown (10YR 4.5/4) moist and light yellowish brown (10YR 6/4) dry; silt loam; weak coarse sub-angular blocky; very slightly sticky, very slightly plastic, very friable moist; slightly hard dry; few Fine and medium, common very fine pores; few irrigation coating along the pores or in some pees; strongly calcareous; few fine and common very fine roots; clear smooth boundary;; pH 8.0.
Bw2	21-79	Yellowish brown (10YR 5/4) moist and very pale brown (10YR 7/4) dry; silt loam tending to very fine sandy loam; weak coarse sub-angular blocky structure; very slightly sticky, very slightly plastic very friable moist, soft dry; few fine and medium, common very fine tubular pores; strongly calcareous; few medium and coarse, common fine and very fine roots in pockets; abrupt smooth boundary; pH 8.0.
BC	79-107	Brown (10YR 5/3) moist and pale brown (10YR 6/3) dry; very fine sandy loam, massive breaking to very weak angular blocky; slightly sticky, almost non plastic, very friable moist; soft dry; very fine tubular pores; strongly calcareous; few medium and fine roots; one or two gravel's may be present; abrupt smooth boundary; pH 8.0.
Bwb	107-132	Yellowish brown (10YR 4/4) moist and light yellowish brown (10YR 6/4) dry; silt loam; weak coarse sub-angular blocky; slightly sticky, slightly plastic, friable moist; slightly hard dry; few fine and medium, common very fine tubular pores; one or two gravel's might be present; strongly calcareous; few very fine roots; clear smooth boundary;; pH 8.0.
C	132-145(+)	Brown to dark yellowish brown (10YR 4/3.5) moist and pale brown (10YR 6/3) dry; silt loam; massive; slightly sticky, slightly plastic, friable moist, slightly to hard dry; few fine tubular pores; strongly calcareous; few very fine roots; pH 8.0.

Name of Dam	Marium
Pit No. & Bore No	Pit: Mrm-1 Bore: Mrm-1
Name of soil series	Man-made (material transported from outside)
Location	30 16' 11.8" N; 67, 09' 20.2" E
Name of village	In the Karak valley
Physiography	Gently slopping terraced area in the alluvial fan
Parent material	Limestone and conglomerate
Topography	Terracing
Land use / vegetation	Apple orchid
Profile drainage	Well drained
Permeability	Moderate to moderately slow
Water holding capacity	High
Erosion	Nill
Moisture	Moist
USDA Classification	

Horizon	Depth	Description
Ap	0-12	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; silt loam; massive breaking to fine granular; very slightly sticky, very slightly plastic, very friable moist; slightly hard dry; many coarse, few fine and medium tubular pores; strongly calcareous; few medium, common fine and very fine roots; clear smooth boundary; pH 8.4.
BA	12-38	Brown (10YR 5/3) dry and pale brown (10YR 6/3) dry; silt loam(+) /silty clay loam(-);weak fine and medium angular blocky; slightly sticky, plastic, friable moist, slightly hard dry; few coarse, common fine, and many very fine tubular pores; strongly calcareous; few coarse and medium, common fine and very fine roots; clear smooth boundary; pH 8.2.
Bw1	38-79	Dark yellowish brown (10YR 4/4) dry and light yellowish brown (10YR 6/4) dry; silt loam (+)/ silty clay loam(-); weak fine and medium sub-angular blocky; slightly sticky, plastic, friable moist, slightly hard dry; few medium, and common fine and very fine tubular, few medium and fine interstitial pores; strongly calcareous; few coarse and medium, common fine and very fine roots; gradual wavy boundary; pH 8.0.
Bw2	79-130+	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; silt loam; weak to moderate coarse angular and sub-angular blocky; very slightly sticky, very slightly plastic, friable moist, slightly hard dry; few fine, many very fine and very fine tubular and few medium and fine interstitial pores; strongly calcareous; few medium, common fine and very fine roots; one or two gravel's present; pH 8.2.

Name of Dam	Kach
Pit No. & Bore No	Pit: Kch-1 Bore: K-43
Name of soil series	Shabak
Location	30 15' 04.4" N; 66 03' 14.4" E
Name of village	About 15feet on the left side of the road from Quetta to Shabak.
Physiography	Close to the apron of the fan.
Parent material	Piedmont alluvium from limestone
Topography	Gently undulating.
Land use / vegetation	Uncultivated mainly wild bushes
Profile drainage	Some what excessive to excessive
Permeability	Moderately rapid
Water holding capacity	Low
Erosion	Sheet and rill erosion visible, gully erosion also present in the area.
Moisture	Upper 60 cm dry then slightly moist
USDA Classification	Xerollic Camborthids

Horizon	Depth	Description
A	0-9	Brown/dark brown (7.5YR 4/4) moist and light brown (7.5YR 6/4) dry; gravely loam; massive with some what platy structure; slightly sticky, slightly plastic; very friable moist and hard dry, , few tubular and vesicular pores; strongly calcareous, few fine roots; abrupt smooth boundary, pH 8.2.
BA	9-25	Brown (7.5YR 5/4) moist and pink (7.5YR 7/4) dry; loam (+)/(clay loam -); weak coarse angular and sub-angular blocky; sticky, plastic, friable moist, hard dry, common fine and many very fine pores; few medium fine and medium lime specks, strongly calcareous; few fine roots; clear smooth boundary; pH 8.0.
Bwk	25-56	Brown (7.5YR 4/4) moist and light brown (7.5YR 6/4) dry; gravely loam(+)/gravely clay loam (-); weak fine and medium sub-angular blocky structure; sticky, plastic, friable moist, hard dry; common fine and medium and many very fine tubular pores; few distinct yellowish brown mottles, many medium lime specs; strongly calcareous; few fine and medium roots scattered in the horizon; gradual wavy boundary; pH 8.0.
BCk	56-80	Brown (7.5YR 4/4) moist and light brown (7.5YR 6/4) dry; gravely clay loam; weak medium and fine sub-angular blocky structure; sticky, plastic, friable moist, hard dry; common fine and tubular pores; strongly calcareous; few fine and medium roots scattered in the horizon; gradual wavy boundary; pH 8.0;
C	80-150	Brown (7.5YR 5/4) moist and pink brown (7.5YR 7/4) dry; sandy loam with about 90% gravel in the horizon; many very fine and medium but few coarse stones present in the horizon, pores not visible; few fine scattered roots; pH 8.0.

Name of Dam	Ghutai Shela
Pit no & Bore no	Pit: Gsl-3 Bore: B-31
Name of soil series	Shamozai
Location	30 08' 19.0" N?; 66 57' 18.0" E?
Name of village	On the Quetta Smangli road close to the Air port check post, on the South-east at about 500 meters from the checkpost.
Physiography	Terraced field
Parent material	Piedmont alluvium from limestone
Topography	Gently slopping to slopping piedmont plain
Land use / vegetation	Close to the wheat crop field
Profile drainage	Well drained
Permeability	Moderate
Water holding capacity	Moderate
Erosion	Slight sheet erosion
Moisture	Dry
USDA Classification	Typic Eutrochrept

Horizon	Depth	Description
Ap	0-9	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; very fine sandy loam; massive; very slightly sticky, very slightly plastic, very friable moist; soft dry; no pores; strongly calcareous; few fine and medium roots; clear smooth boundary; pH 8.2.
Bw1	9-42	Dark yellowish brown to yellowish brown (10YR 4.5/4) dry and light yellowish brown (10YR 6/4) dry; loam; weak coarse sub-angular blocky; slightly sticky, very slightly plastic, very friable moist; soft dry; few fine and medium, common very fine tubular pores; strongly calcareous; few medium and fine, common very fine roots; gradual smooth boundary; pH 8.2.
Bw2	42-94	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; loam; weak coarse sub-angular blocky; slightly sticky, slightly plastic; very friable moist, soft dry; few fine and medium tubular pores; strongly calcareous; few medium lime specks; few fine gypsum crystals; few medium and fine, common very fine roots; gradual smooth boundary; pH 8.2.
C	94-130+	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; sandy loam tending to loam; massive; very slightly sticky, very slightly plastic, very friable moist, soft dry; strongly calcareous; few decayed and few very fine roots; pH 8.2.

Name of Dam	Khora Manda
Pit No. & Bore No	Pit: Kmd-4 Bore: Kmd-6
Name of soil series	Ghaza non saline non sodic variant
Location	30 13' 18.6" N; 66, 49' 26.8" E
Name of village	At the end of the link road from Haji Barkat to stream
Physiography	Close to the stream in the lower terrace
Parent material	Shale and lime stone
Topography	Terraced slopping area
Land use / vegetation	Plowed field
Profile drainage	Well drained
Permeability	Moderate
Water holding capacity	High
Erosion	Nill
Moisture	Up to 60 cm dry lower slightly moist
USDA Classification	Typic Eutrochrepts

Horizon	Depth	Description
Ap	0-17	*Brown to yellowish brown (10YR 5/3.5) moist and pale brown (10YR 6/3) dry; silt* loam; massive, slightly sticky, slightly plastic, friable moist; hard dry; few fine common very fine tubular, common very fine vesicular pores; strongly calcareous; few fine and very fine roots; clear smooth boundary; pH 8.4.
BA	17-31	Yellowish brown to dark yellowish brown (10YR 4.5/4) moist and light yellowish brown (10YR 6/4) dry; silt loam(+); weak coarse and medium sub-angular blocky; slightly sticky, slightly plastic, friable moist, hard dry; common fine, many very fine tubular pores;; strongly calcareous; few very fine roots; clear smooth boundary; pH 8.4.
Bw	31-59	Dark yellowish brown (10YR 4/4) moist and light yellowish brown (10YR 6/4) dry; silty clay loam; weak medium and fine sub-angular blocky; sticky, plastic, friable moist, hard dry; few medium, common fine, many very fine, tubular, few fin interstitial pores; strongly calcareous; common very fine roots; clear smooth boundary; pH 8.4.
Bwy	59-73	Yellowish brown to dark yellowish brown (10YR 4.5/4) moist and light yellowish brown (10YR 6/4) dry; silty clay loam; weak, medium and fine sub-angular blocky; sticky, plastic, friable moist, hard dry; few fine, many very fine tubular pores; strongly calcareous; common fine white salt specks probably of gypsum; rarely very fine roots; clear smooth boundary; pH 8.4.
Bcy	73-103	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; silt loam(+)/silty clay loam (-); weak coarse angular and sub-angular blocky; slightly sticky, slightly plastic, very friable moist, slightly hard dry; few medium and fine, many very fine tubular pores; many very fine salt specks, probably of gypsum; *strongly calcareous; almost no roots; clear smooth boundary; pH 8.4.*
BC	103-121	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; silt loam; weak coarse angular and sub-angular blocky; slightly sticky, slightly plastic, *friable moist, slightly hard dry; few fine and common very fine tubular pores;* strongly calcareous; almost no roots; abrupt smooth boundary; pH 8.2.
CB	121-150+	Yellowish brown (10YR 5/4) moist and very pale brown (10YR 7/4) dry; silt loam; massive and homogenize; slightly sticky, slightly plastic, friable moist, slightly hard dry; common fine and many very fine tubular pores; strongly calcareous; few very fine roots; pH 8.2.

Name of Dam	Murghi Kotal
Pit No. & Bore No	Pit: Mgk-1 Bore: B-33
Name of soil series	Azam
Location	30 19' 44.8" N; 66 55' 09.8" E
Name of village	On the right hand side of the Killi Shamulzai Kark road, after 100 m from Killi Shamulzai.
Physiography	Edge of the playa
Parent material	*Piedmont alluvium from limestone*
Topography	Playa
Land use / vegetation	Fellow rain-fed wheat field
Profile drainage	Moderately well drained
Permeability	Very slow
Water holding capacity	Moderate
Erosion	Sheet and rill erosion
Moisture	Profile dry throughout
USDA Classification	Xerollic Camborthid (un-irrigated)

Horizon	Depth	Description
Ap	0-7	Yellowish brown (10YR 5/4) moist and pale brown (10YR 6/3) dry; silt loam; massive , slightly sticky, slightly plastic, very friable moist; slightly hard dry; common fine, and very fine tubular, few fine vesicular pores; strongly calcareous; common fine and very fine roots; clear smooth boundary; pH 8.2.
BA	7-34	Brown (10YR 4/3) dry and pale brown (10YR 6/3) dry; silt loam(+); weak coarse sub angular blocky; sticky, plastic, friable moist; few medium, few fine and very fine tubular, common fine interstitial and vesicular pores; strongly calcareous; few fine and very fine roots, and one coarse root; clear smooth boundary; pH 8.2.
Bw1	34-66	Dark yellowish brown (10YR 4/4) moist and light yellowish brown (10YR 6/4) dry; silty clay; weak coarse columnar breaking to weak fine and medium sub-angular blocky; very sticky, very plastic, firm moist, very hard dry; common very fine tubular pores; strongly calcareous; common very fine roots; clear smooth boundary; pH 8.2.
Bw2	66-85	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; silty clay; weak medium and fine sub-angular blocky; very sticky, very plastic, firm moist, very hard dry; few fine and common very fine tubular pores; strongly calcareous; common lime specks; few fine roots; clear smooth boundary; pH 8.0.
BC	85-121	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; silty clay; very weak angular blocky; very sticky, plastic, firm moist; very hard dry; common very fine tubular pores; strongly calcareous; no roots; gradual smooth boundary; pH 8.0.
C	121-130+	Brown (10YR 5/3) moist and pale brown (10YR 6/3) dry; silty clay; massive breaking to very weak angular blocky; very sticky, plastic, firm moist; very hard dry; common very fine tubular pores; strongly calcareous; no roots; pH 8.0.

Name of Dam	Murghi Kotal
Pit No. & Bore No	Pit: Mgk-3 Bore: B-38
Name of soil series	Lajwar
Location	30 20' 11.9" N; 66 56' 15.4" E
Name of village	Killi Kateer, on the northern side of the Garden owned by Malik Abdullah.
Physiography	Nearly level playa
Parent material	Piedmont alluvium from shale and sandstone
Topography	Margin of playa
Land use / vegetation	Salt bushes
Profile drainage	Presently well, previously seems to be moderately to imperfectly drained
Permeability	Moderately slow
Water holding capacity	High
Erosion	Sheet erosion active
Moisture	Moist
USDA Classification	?

Horizon	Depth	Description
Ap	0-12	Brown (10YR 5/3) moist and pale brown (10YR 6/3) dry; silt loam; massive, slightly sticky, slightly plastic, very friable moist; slightly hard dry; common fine, and very fine tubular pores; strongly calcareous; few fine and common very fine roots; clear smooth boundary; pH 8.2.
BA	12-33	Yellowish brown (10YR 5/4) dry and light yellowish brown (10YR 6/4) dry; silt loam; weak coarse sub angular blocky; slightly sticky, slightly plastic, very friable moist, slightly hard dry; few fine, common very fine tubular pores; strongly calcareous; few fine, common very fine roots; clear smooth boundary; pH 8.2.
Bw1	33-84	Grayish brown (2.5Y 5/2) moist and light brownish brown (2.5YR 6/2) dry; silt loam (+)/ silty clay loam (-); weak coarse, medium, and fine sub-angular blocky, sticky, plastic, friable moist, slightly hard dry; common fine, few coarse and very fine tubular pores; strongly calcareous; few medium and fine roots; gradual smooth boundary; pH 8.4.
Bw2	84-122	Dark grayish brown (2.5Y 4/2) moist and light brownish gray (2.5YR 6/2) dry; common fine and medium distinct yellowish brown (10YR 5/6) mottles; silty clay loam; weak, coarse, medium sub-angular blocky; sticky, plastic, friable moist, hard dry; few fine and many very fine tubular pores; strongly calcareous; no roots; clear smooth boundary; pH 8.4.
BC	122-145+	Dark grayish brown (2.5Y 4/2) moist and light yellowish brown (2.5YR 6/2) dry; common medium fine distinct yellowish brown mottles; silty clay loam; very weak coarse angular blocky; many very fine and few fine tubular pores; strongly calcareous; no pores; pH 8.4.

Name of Dam	Bostan
Pit No. & Bore No	Pit: Bsn-2 and Bore: Bsn-2
Name of soil series	Zard
Location	30 25' 31.2" N; 67 00' 25.4" E
Name of village	On the linked metaled road to Bostan, north-west corner of the village in Mr. A. Jabbar's orchid
Physiography	Some what terraced field
Parent material	Alluvium from limestone
Topography	Terracing
Land use / vegetation	Apple orchard irrigated
Profile drainage	Well drained
Permeability	Moderate
Water holding capacity	High
Erosion	Nill
Moisture	Through moist
USDA Classification	Typic Eutrochrepts

Horizon	Depth	Description
Ap	0-13	Brown (10YR 4/3) moist and pale brown (10YR 6/3) dry; silt loam/very fine sandy loam; massive, very slightly sticky, very slightly plastic, very friable moist; soft dry; few medium and fine, and many very fine, few fine and medium, many very fine tubular, and common fine vesicular pores; strongly calcareous; common medium and coarse, many fine and very fine roots; clear smooth boundary; pH 8.2.
BA	13-36	Yellowish brown (10YR 5/4) dry and light yellowish brown (7.5YR 6/4) dry; silt loam; weak coarse sub-angular blocky; very slightly sticky, very slightly plastic, very friable moist, slightly hard dry; few medium common fine, and many very fine tubular pores; strongly calcareous; common fine and very fine roots; clear smooth boundary; pH 8.2.
Bw	35-79	Dark yellowish brown (10YR 4/4) moist and yellowish brown (10YR 5/4) dry; silt loam(+); weak medium and fine sub-angular blocky, slightly sticky, slightly plastic, very friable moist, slightly hard dry; common medium and fine and many very fine tubular pores; strongly calcareous; common fine and very fine roots; clear smooth boundary; pH 8.2.
Bw2	79-129	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; silt loam(+) / silty clay loam(-); weak, medium and fine sub-angular blocky; sticky, plastic, very friable moist, slightly hard dry, few medium, common fine, and many very fine tubular pores, strongly calcareous; few medium, common fine and very fine roots; clear smooth boundary; pH 8.2.
BC	129-150	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; silt loam(+) / silty clay loam(-) ; very weak coarse sub-angular and angular blocky; sticky, plastic, very friable moist, slightly hard dry; common medium and fine, many very fine tubular pores; strongly calcareous; few medium and common fine and very fine roots; pH 8.2.

Name of Dam	Dara
Pit No. & Bore No	Pit: Dra-4 Bore: B-7
Name of soil series	Quetta/Quetta
Location	30 17' 10.5" N; 66 58' 45.6" E
Name of village	
Physiography	Slightly depressional position.
Parent material	Limestone
Topography	Depression
Land use / vegetation	Fodder field
Profile drainage	Well drained
Permeability	Slow
Water holding capacity	High
Erosion	Nill
Moisture	Moist
USDA Classification	Typic Eutrochrept

Horizon	Depth	Description
Ap	0-12	Brown (10YR 4/3) moist and pale brown (10YR 6/3) dry; silt loam; massive, slightly sticky, slightly plastic, very friable moist; soft dry; few coarse, common fine and very fine tubular pores; strongly calcareous; common medium, and many very fine roots; clear smooth boundary; pH 8.4.
Bw	12-50	Brown to dark yellowish brown (10YR 4/3.5) moist and pale brown (7.5YR 6/3) dry; silty clay loam; weak coarse sub angular blocky; slightly sticky, slightly plastic, very friable moist, hard dry; common fine and very fine tubular pores; strongly calcareous; few fine and medium roots are present close to A-horizon, otherwise fine and very fine roots; gradual smooth boundary; pH 8.2.
Bw2	50-79	Brown (10YR 4.5/3) moist and pale brown (10YR 6/3) dry; silty clay loam; weak coarse sub-angular blocky, sticky, plastic, very friable moist, hard dry; few medium and fine, many very fine tubular pores; strongly calcareous; few medium and fine, common very fine roots; clear smooth boundary; pH 8.0.
IIBwb	79-132	Dark yellowish brown (10YR 4/4) moist and light yellowish brown (10YR 6/4) dry; silty clay loam; weak, medium sub-angular blocky; sticky, plastic, very friable moist, hard dry; few medium and fine, many very fine tubular pores; strongly calcareous; few fine roots; gradual smooth boundary; pH 8.0.
IIC	132-140+	Yellowish brown (10YR 5/4) moist and very pale brown (10YR 7/4) dry; loam; massive, slightly sticky, slightly plastic, very friable moist, slightly hard dry; few fine and common very fine tubular pores; strongly calcareous; few very fine roots; pH 8.0.

Name of Dam	Arambi
Pit No. & Bore No	Pit: Amb-2 Bore: Amb-2
Name of soil series	Pinakai
Location	30 48' 44.8" N; 66 50' 18.4" E
Name of village	In a village of Adosh in a garden of Haji Sunder khan
Physiography	Nearly level area in a slopping piedmont plain
Parent material	Shale and sand stone
Topography	Terracing
Land use / vegetation	Apple orchard
Profile drainage	Well drained
Permeability	Moderate
Water holding capacity	High
Erosion	Nill
Moisture	Moist
USDA Classification	Typic Eutrochrepts

Horizon	Depth	Description
Ap	0-14	Brown (10YR 5/3) moist and pale brown (10YR 6/3) dry; very fine sandy loam; massive, very slightly sticky, very slightly plastic, very friable moist; soft dry; few medium, common fine and very fine tubular, common fine vesicular pores; strongly calcareous; one or two medium and coarse gravel's may be present; common medium, many fine and very fine roots; clear smooth boundary; pH 8.0.
Bw1	14-58	Dark yellowish brown (10YR 4/4) dry and light yellowish brown (10YR 6/4) dry; silt loam tending to very fine sandy loam; weak, medium and fine structure; very slightly sticky, very slightly plastic, friable moist, slightly hard dry; few medium, common fine and many very fine tubular pores; strongly calcareous; one or two coarse gravel's may be present; few medium, common fine and many very fine roots; gradual smooth boundary; pH 8.0.
Bw2	58-149	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; silt loam tending to very fine sandy loam; weak medium and fine sub-angular blocky, very slightly sticky, very slightly plastic, friable moist, slightly hard dry; few medium and fine, common very tubular pores; strongly calcareous; many fine and very fine roots; gradual smooth boundary; pH 8.0.
C	149-154(+)	Yellowish brown (10YR 5/4) moist and very pale brown (10YR 7/4) dry; very fine sandy loam; massive breaking to very weak angular blocky; very slightly sticky, very slightly plastic, very friable moist, slightly hard dry; few fine and very fine tubular pores, strongly calcareous; few fine and very fine roots; pH 8.0.

Name of Dam	Tirkha
Pit No. & Bore No	Pit: Trk-1 Bore: Trk-1
Name of soil series	Barshore
Location	30 29' 09.8" N; 66, 56' 30.3" E
Name of village	Nasozai, in the north west of the village at about 15 meter away from the houses
Physiography	Almost central part of the piedmont plain
Parent material	Sandstone and shale
Topography	Nearly level with 0-1% slope
Land use / vegetation	Rainfed wheat
Profile drainage	Well drained
Permeability	Moderate to moderately rapid
Water holding capacity	Moderate; Erosion: Nill
Moisture	Dry throughout
USDA Classification	*?Fluventic Camborthids*

Horizon	Depth	Description
Ap	0-13	Brown to dark yellowish brown (10YR 4/3.5) moist and pale brown (10YR 6/3) dry; very fine sandy loam; massive, very slightly sticky, very slightly plastic, friable moist; slightly hard dry; few fine, common very fine pores; strongly calcareous; many very fine roots; Clear. smooth boundary; pH 8.2.
BA	13-31	Dark yellowish brown (10YR 4/4) dry and light yellowish brown (10YR 6/4) dry; loam; very weak coarse angular and sub-angular blocky; slightly sticky, slightly plastic, friable moist, slightly hard dry; few fine and common very fine tubular pores; strongly calcareous; few fine and common very fine roots; clear smooth boundary; pH 8.2.
Bwk	31-82	Brown (7.5YR 4/4) moist and pale brown (10YR 6/3) dry; loam; weak, coarse sub-angular blocky, slightly sticky, slightly plastic, friable moist, slightly hard dry; common fine and many very fine tubular pores; strongly calcareous; close to BA one charcoal piece present; common fine and very fine roots; abrupt smooth boundary; pH 8.0.
C	82-99	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; loamy sand; single grain, homogenize; non sticky, non plastic, loose moist, soft dry; pores not visible; strongly calcareous; few fine roots; abrupt smooth boundary; pH 8.0.
IIBwb	99-110	Brown (7.5YR 4/4) moist and pale brown (10YR 6/3) dry; loam (+); weak, coarse angular blocky; slightly sticky, slightly plastic, firm moist, slightly hard dry; common fine, many very fine tub. pores; strongly calcareous; few fine and very fine roots; abrupt smooth boundary; pH 8.0.
IIC1	110-122	Brown (10YR 4/3) moist and pale brown (10YR 6/3) dry; coarse sand; single grain; non-sticky, non-plastic, loose moist, loose dry; pores not visible; strongly calcareous; no roots; abrupt smooth boundary; pH 8.0.
IIC2	122-135	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; loamy sand; single grain, homogenize; non sticky, non plastic, loose moist, soft dry; pores not visible; strongly calcareous; few fine roots; abrupt smooth boundary; pH 8.0.
IIIBwb	135-143	Brown (7.5YR 4/4) moist and pale brown (10YR 6/3) dry; loam (+); weak, coarse angular blocky; slightly sticky, slightly plastic, firm moist, slightly hard dry; common fine, many v. f. tub pores; strongly calcareous; few fine and very fine roots; abrupt smooth boundary; pH 8.0.
IIIC	143-152(+)	Brown (10YR 4/3) moist and pale brown (10YR 6/3) dry; coarse sand; single grain; non-sticky, non-plastic, loose moist, loose dry; pores not visible; strongly calcareous; no roots; abrupt smooth boundary; pH 8.0.

Name of Dam	Jigda
Pit No. & Bore No	Pit: Jgd-2 Bore: Jgd-2
Name of soil series	Pinakai
Location	30 41' 25.0" N; 67, 07' 47.9" E
Name of village	Before killi Saidan in a garden of Haji Abdullah
Physiography	Terraced area about 200m from Nala
Parent material	Shale and sandstone
Topography	Terracing
Land use / vegetation	Apple orchard
Profile drainage	Well drained
Permeability	Moderate
Water holding capacity	High
Erosion	Nil
Moisture	Moist
USDA Classification	Fluventic Camborthids

Horizon	Depth	Description
Ap	0-11	Grayish brown to dark grayish brown (10YR 4.5/2) moist and light brownish gray (10YR 6/2) dry; very fine sandy loam; massive, slightly sticky, slightly plastic, very friable moist; soft dry few fine and medium tubular, many fine and very fine vascular pores; strongly calcareous; few fine and very fine roots; cluster of fine roots at places; clear smooth boundary; pH 8.0.
BA	11-37	Weak red (2.5YR 5/2) dry and pale red (2.5YR 7/2) dry; silt loam (+); weak, coarse sub-angular blocky; slightly sticky, plastic, very friable moist, slightly hard dry; few fine, many very fine tubular pores, few charcoal pieces; strongly calcareous; few fine and medium, common very fine roots; clear smooth boundary; pH 8.0.
Bw	37-132	Weak red to dusky red (2.5YR 4.5/4) moist and pale red brown (10YR 6/3) dry; very fine sandy loam tending to silt loam; weak, medium and fine sub angular blocky, slightly sticky, slightly plastic, very friable moist, soft dry; common fine many very fine tubular pores; strongly calcareous; few medium, common fine and very fine roots; clear smooth boundary; pH 8.0.
BC	132-150	Weak red (2.5YR 5/2) moist and pale red (2.5YR 7/2) dry; very fine sandy loam tending to silt loam; weak, coarse sub-angular blocky; slightly sticky, slightly plastic, very friable moist, soft dry; few medium, common fine, many very fine tubular pores; strongly calcareous; few fine, common very fine root; clear smooth boundary; pH 8.0.

Note: Salts are visible at some places in the profile.

Name of Dam	Sanzali
Pit No. & Bore No	Pit: Snz-1 Bore Snz-2
Name of soil series	Pishin
Location	30 33' 03.4" N; 66 58' 45.2" E
Name of village	Close to the abundant airport strip and the Yaro - Pishin road about a kilometer from crossection
Physiography	level area
Parent material	Red clay, silt, sandstone and conglomerates
Topography	Gently slopping piedmont plain
Land use / vegetation	Ex-wheat, Booi, salt bushes, khush khaba wheat
Profile drainage	Excessively drained
Permeability	Moderate rapid to rapid
Water holding capacity	Low
Erosion	Rill erosion and gully erosion
Moisture	Dry
USDA Classification	Typic Eutrochrept - Typic Camborthid

Horizon	Depth	Description
Ap	0-11	Dark Yellowish brown (10YR 4/4) moist and very pale brown (10YR 7/4) dry; loamy sand; massive breaking to single grain, non sticky, non plastic, loose moist; very soft dry; strongly calcareous; few scattered fine and medium gravel's and stones on the surface; few very fine roots; clear smooth boundary; pH 8.2.
BA	11-23	Yellowish brown (10YR 5/5) with inclusion of brown (7.5 YR 5/4) moist and pale brown and (10YR 6/3) and brown (7.5YR 6/4) dry; sandy loam; very weak angular blocky; very slightly sticky, almost no plastic, very friable moist, soft dry; strongly calcareous; one or two gravel's, few fine lime specks; few very fine roots; clear smooth boundary; pH 8.2.
Bw	23-42	Yellowish brown (10YR 5/5) moist and brownish (10YR 6/6) dry; sandy loam(+); very weak angular blocky; very slightly sticky, very slightly plastic, loose moist, soft dry; few fine lime specks; strongly calcareous; few very fine roots; abrupt smooth boundary; pH 8.2.
C1	42-89	Dark yellowish brown (10YR 4/4) moist and very pale brown (10YR 7/4) dry; coarse sand; single grain; non sticky, non plastic, loose moist, loose dry; strongly calcareous; no roots; abrupt smooth boundary; pH 8.2.
C2	89-102	Brown (10YR 5/3) moist and pale brown (10YR 6/3) dry; sand; single grain; non-sticky, non plastic, loose moist, loose dry; strongly calcareous; no roots; abrupt smooth boundary; pH 8.2.
IIBwb	102-116	Brown (7.5YR 5/4) moist and light brown (7.5YR 6/4) dry; loam; homogenize to very weak angular blocky; slightly sticky, slightly plastic, very friable moist, soft dry; few fine and very fine tubular pores; strongly calcareous; no roots; abrupt smooth boundary; pH 8.2.
IIC1	116-119	Yellowish brown (10YR 5/4) moist and very pale brown (10YR 7/4) dry; coarse sand; single grain; non sticky, non plastic, loose moist, loose dry; strongly calcareous; no roots; abrupt smooth boundary; pH 8.2.
IIIBwb	119-143	Brown (7.5YR 5/4) moist and pink (7.5YR 7/4) dry; loam; homogenize; slightly sticky, slightly plastic, very friable moist, soft dry; strongly calcareous; few fine roots; abrupt smooth boundary; pH 8.2.
IIIC1 sticky,	143-150	Yellowish brown (10YR 5/4) moist and very pale brown (10YR 7/4) dry; sand; non non plastic, loose moist, loose dry, no pores; strongly calcareous; no roots; pH 8.0.

Name of Dam	Sakhol
Pit No. & Bore No	Pit: Sak-1 Bore: Sak-1
Name of soil series	Pringabad
Location	29 50' 23.8" N; 66 50' 46.3" E
Name of village	About 50m inside on the right hand side from the board of soil conservation station, Mostung.
Physiography	Level slight depression in level area
Parent material	Lime stone and shale
Topography	gently sloping
Land use / vegetation	Lana hermal
Profile drainage	Well drained
Permeability	Moderate to moderately rapid
Water holding capacity	High to moderate
Erosion	Wind erosion
Moisture	Dry after 60 cm slightly moist
USDA Classification	Xerollic Camborthid (un-irrigated)

Horizon	Depth	Description
Ap	0-12	Brown to yellowish brown (10YR 5/3.5) moist and pale brown (10YR 6/3) dry; loamy very fine; single grain; non sticky, non plastic, loose moist, loose dry; strongly calcareous; few fine, and very fine roots; clear smooth boundary; pH 8.2.
BA	12-30	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4 hue slightly redder) dry; loamy very fine sandy loam; very weak coarse sub-angular blocky to homogenize; very slightly sticky, non plastic, loose moist, soft dry; few fine and very fine tubular pores, strongly calcareous; few fine and common very fine roots; clear smooth boundary; pH 8.2.
Bw1	30-89	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; very fine sandy loam tending to fine sandy loam; weak, coarse and medium sub-angular blocky; very slightly sticky, very slightly plastic, very friable moist, soft dry; few very fine tubular pores; strongly calcareous; common very fine roots; gradual smooth boundary; pH 8.2.
Bw2	89-147+	Yellowish brown to dark yellowish brown (10YR 4.5/4) moist and light yellowish brown (10YR 6/4) dry; very fine sandy loam; weak, coarse and medium sub-angular blocky; very slightly sticky, very slightly plastic, friable moist, soft dry; few fine and many very fine tubular pores; strongly calcareous; few fine and very fine roots; pH 8.2.

Name of Dam	Amch
Pit No. & Bore No	Pit: Amch-4 Bore: Amch-4
Name of soil series	Pringabad
Location	29 48' 08.2" N; 66, 51' 09.5" E
Name of village	
Physiography	High lying gently slopping piedmont plain terraced leveled area
Parent material	Shale and limestone
Topography	Terraced
Land use / vegetation	*Fellow wheat field*
Profile drainage	Well to somewhat excessively drained
Permeability	Moderately rapid
Water holding capacity	Moderately high
Erosion	Wind erosion active
Moisture	Dry
USDA Classification	Xerollic Camborthids (un-irrigated), Typic Eutrochrept (irrigated)

Horizon	Depth	Description
Ap	0-13	Brown to yellowish brown (10YR 5/3.5) moist and pale brown (10YR 6/3) dry; very fine sandy loam; massive with some lamination; very slightly sticky, non-plastic, very friable moist, very slightly hard dry; no pores; strongly calcareous; few fine charcoal pieces visible on the surface; one or two fine gravel also present; few very fine roots; clear smooth boundary; pH 8.1.
BA	13-33	Dark yellowish brown to yellowish brown (10YR 4.5/4) dry and light yellowish brown (10YR 6/4) dry; very fine sandy loam; weak, coarse angular blocky; very slightly sticky, very slightly plastic, very friable moist, slightly hard dry; few fine and common very tubular pores; strongly calcareous; one or two very fine gravel present; few very fine roots; clear smooth boundary; pH 8.2.
Bw1	33-82	Dark yellowish brown (10YR 4/4) dry and light yellowish brown (10YR 6/4) dry; very fine sandy loam; weak coarse angular blocky; very slightly sticky, very slightly plastic, very friable moist, slightly hard dry; few fine and common very fine tubular and fine interstitial pores; strongly calcareous; 3 or 4 fine and medium gravel's present in whole of the horizon; rarely very fine roots; clear smooth boundary; pH 8.2.
Bw2	82-135	Dark yellowish brown (10YR 4/4) moist and light yellowish brown (10YR 6/4) dry; very fine sandy loam; very weak coarse angular blocky; very slightly sticky, very slightly plastic, very friable moist, slightly hard dry; few fine, many very fine tubular and common fine interstitial pores; strongly calcareous; no gravel's; no roots; abrupt smooth boundary; pH 8.2.
BC	135-145+	Yellowish brown (10YR 5/4) moist and very pale brown (10YR 7/4) dry; fine sandy loam; massive, homogenized; very slightly sticky, very slightly plastic, very friable moist, soft dry; common very fine tubular pores; strongly calcareous; no roots; pH 8.2.

Name of Dam	Kad Kocha
Pit No. & Bore No	Pit: Kad-2 Bore: Kad-2
Name of soil series	Zard
Location	29 39' 42.9" N; 66 46' 22.1" E
Name of village	Kad Kocha
Physiography	Terraced level area
Parent material	Lime stone and shale
Topography	Terracing
Land use / vegetation	Ex wheat field
Profile drainage	Well drained
Permeability	Moderate to moderately rapid
Water holding capacity	Moderately high
Erosion	Wind erosion
Moisture	30 cm dry lower moist
USDA Classification	Fluventic Camborthids

Horizon	Depth	Description
Ap	0-15	Dark yellowish brown to yellowish brown (10YR 4.5/4) moist and light yellowish brown (10YR 6/4) dry; very fine sandy loam; massive; very slightly sticky, very slightly plastic, very friable moist, soft dry; few fine, common very fine tubular pores; strongly calcareous; few medium, common fine roots; clear smooth boundary; pH 8.2.
Bw1	15-41	Yellowish brown (10YR 5/5) moist and brownish yellow (10YR 6/6 hue slightly redder) dry; very fine sandy loam (+); weak, coarse and medium sub-angular blocky; very slightly sticky, very slightly plastic, very friable moist, slightly hard dry; common fine, many very fine tubular pores, strongly calcareous; rarely very fine gravel's; one medium, one coarse, common very fine roots; clear smooth boundary; pH 8.2.
Bw2	41-66	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; fine sandy loam; weak, coarse and medium sub-angular blocky; slightly sticky, slightly plastic, friable moist, soft dry; common fine, many very fine tubular pores; strongly calcareous; few medium, common very fine roots; clear smooth boundary; pH 8.2.
BC	66-142	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; very fine sandy loam; very weak angular blocky to homogenized; very slightly sticky, very slightly plastic, very friable moist, slightly hard dry; few fine, common very fine tubular pores; strongly calcareous; few fine roots; abrupt smooth boundary; pH 8.2.
C1	142-150	Gravely layer; abrupt smooth boundary
C2	150-153+	Yellowish brown (10YR 5/6) moist and brownish yellow (10YR 6/6) dry; loamy sand; single grain; non-sticky, non-plastic, loose moist, loose dry; no pores; strongly calcareous; no roots; pH 8.2.

Name of Dam	Laghamgir
Pit No. and Bore No	Pit: Lgr-3 Bore: Lgr-3
Name of soil series	Zard
Location	29 21' 19.2" N; 66 27' 36.9" E
Name of village	About 3 km north of Karchap in Jaladin garden
Physiography	High lying level area
Parent material	Limestone and shale
Topography	Slightly higher flat terraced
Land use / vegetation	Orchid
Profile drainage	Well drained
Permeability	Moderate
Water holding capacity	High
Erosion	Nill
Moisture	Moist
USDA Classification	Fluventic Camborthids

Horizon	Depth	Description
Ap	0-12	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; silt loam; massive; very slightly sticky, very slightly plastic, very friable moist, soft dry; common fine and many very fine tubular, and few fine interstitial; strongly calcareous; few coarse and medium, many fine and very fine roots; clear smooth boundary; pH 8.2.
BA	12-27	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4 hue slightly redder) dry; silt loam; very weak coarse angular blocky; very slightly sticky, very slightly plastic, very friable moist, soft dry; few fine common very fine tubular pores; strongly calcareous; few coarse and medium, common fine, and many very fine roots; clear smooth boundary; pH 8.2.
Bw1	27-43	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; silt loam(+); weak coarse and medium sub-angular blocky; very slightly sticky, slightly plastic, very friable moist, slightly hard dry; common fine and many very fine tubular pores; strongly calcareous; common fine and very fine roots; gradual smooth boundary; pH 8.2.
Bw2	43-90	Yellowish brown (10YR 5/5) moist and light yellowish brown (10YR 6/4) dry; silt loam(+);weak coarse and medium sub-angular blocky; slightly sticky, slightly plastic, friable moist, slightly hard dry; few medium, common fine, and many very fine tubular pores; strongly calcareous; few medium and coarse and many fine and very fine roots; clear smooth boundary; pH 8.2.
BC	90-140+	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 7/4) dry; very fine sandy loam; very weak coarse angular blocky; very slightly sticky, very slightly plastic, very friable moist, soft dry; few fine and common very fine tubular pores; strongly calcareous; few fine and common very fine roots; pH 8.2.

Name of Dam	Iskalku
Pit No. and Bore No	Pit: Isk-2 Bore: Isk-2
Name of soil series	Shamozai
Location	29 02' 27.1" N; 66 39' 52.8" E
Name of village	About 100 m in the north east of primary school Pandraniabad, Iskalku valley.
Physiography	Terraced level area close to alluvial fan.
Parent material	Limestone and shale
Topography	Gently slopping piedmont plain from lime stone and shale
Land use / vegetation	Mangli, Jir
Profile drainage	Well to moderately well drained
Permeability	Moderate to moderately slow
Water holding capacity	High
Erosion	Slight sheet and rill erosion
Moisture	Dry upto 40cm dry and lower part moist
USDA Classification	Typic Eutrochrept

Horizon	Depth	Description
Ap	0-10	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; very fine sandy loam; massive; very slightly sticky, very slightly plastic, very friable moist, soft dry; few fine and medium, common very fine vesicular pores; strongly calcareous; few fine and common very fine roots; clear smooth boundary; pH 8.4.
Bw	10-41	Dark yellowish brown to yellowish brown (10YR 5.5/4) moist and light yellowish brown (10YR 6/4) dry; silt loam; weak coarse sub-angular blocky; slightly sticky, slightly plastic, very friable moist, slightly hard dry; few fine and common very fine tubular pores; strongly calcareous; few fine charcoal pieces; few medium and fine, and common very fine roots; clear smooth boundary; pH 8.4.
IIBwb	41-86	Brown (10YR 4/3) moist and pale brown (10YR 6/3) dry; silty clay loam(-); weak coarse and medium sub-angular blocky; sticky, plastic, friable moist, hard dry; few medium, common fine, many very fine tubular pores; strongly calcareous; few fine and common very fine roots; gradual smooth boundary; pH 8.2.
IIBw2b	86-122	Brown (10YR 5/3) moist and pale brown (10YR 6/3) dry; silty clay loam; weak coarse and medium angular blocky; sticky, plastic, friable moist, hard dry; common fine and very fine tubular pores; strongly calcareous; few very fine roots; clear smooth boundary; pH 8.2.
BC	122-130(+)	Yellowish brown to brown (10YR 5/3.5) moist and pale brown (10YR 6/3) dry; silty clay loam; very coarse angular blocky; sticky, plastic, friable moist, hard dry; common fine and very fine tubular pores; strongly calcareous; no roots; pH 8.2.

Name of Dam	Gorpad
Pit No. & Bore No	Pit: Gpd-1 Bore: Gpd-2
Name of soil series	Hathiari
Location	28 56' 25.1" N; 66 28' 34.7" E
Name of village	On Kalat-Khuzdar road at a distance of 13 km from Kalat, kacha road leading to a small deserted village. The pit was close to the village in a cultivated field left hand side of the road
Physiography	Level central part of gently slopping to gently undulating piedmont plain
Parent material	Limestone, shale and volcanic rocks
Topography	Flat
Land use / vegetation	Wheat
Profile drainage	Well drained
Permeability	Moderate
Water holding capacity	High
Erosion	Sheet erosion, enclosed by the bunds, in uncultivated area partly rill erosion
Moisture	Upper 50 cm dry and then slightly moist
USDA Classification	Typic Eutrochrepts

Horizon	Depth	Description
Ap	0-16	Yellowish brown (10YR 5/4) moist and pale brown (10YR 6/3) dry; very fine sandy loam; massive; very slightly sticky, very slightly plastic, very friable moist, soft dry; few fine tubular, common fine vesicular and interstitial pores; strongly calcareous; few medium, common fine and very fine roots; clear smooth boundary; pH 8.4.
Bw1	16-33	Dark yellowish brown to brown (10YR 4/2 to 7.5YR 4/4) moist and light brown (7.5YR 6/4) dry; silt loam; weak coarse and medium sub-angular blocky; slightly sticky, slightly plastic, friable moist, slightly hard dry; common fine and many very fine tubular pores; strongly calcareous; few medium and common fine and common very fine roots; clear smooth boundary; pH 8.2.
Bw2	33-56	Yellowish brown to brown (10YR 5/4 to 7.5YR 4/4) moist and light brown (7.5YR 6/4) dry; few fine distinct yellowish brown (10YR 5/6) mottles; silt loam(+); weak coarse and medium sub-angular blocky; slightly sticky, slightly plastic, friable moist, soft dry; common fine and many very fine tubular pores; strongly calcareous; few fine and common very fine roots; gradual smooth boundary; pH 8.2.
Bw3	56-91	Dark yellowish brown (10YR 4/4) moist and light yellowish brown (10YR 6/4) dry; silt loam(+); weak coarse and medium sub-angular blocky; slightly sticky, slightly plastic, friable moist, soft dry; few fine and common very tubular pores; strongly calcareous; few artifacts at 90 cm; few fine roots; abrupt smooth boundary; pH 8.2.
Bw1b	91-119	Dark yellowish brown (10YR 4/4) moist and pale brown (10YR 6/3) dry; silty clay loam(-); weak medium sub-angular blocky; sticky, plastic, friable moist, slightly hard dry; common and many very fine pores; strongly calcareous; few fine roots; abrupt smooth boundary; pH 8.2.
Bw2b	119-131	Yellowish brown to dark yellowish brown (7.5YR 4.5/4) moist and brown (10YR 6/3) dry; silty clay loam(-)/silt loam(+); weak medium sub-angular blocky; slightly sticky, slightly plastic, friable moist, slightly hard dry; few fine and very fine tubular pores; strongly calcareous; no roots; pH 8.2.

Name of Dam	Mangi
Pit No. and Bore No	Pit: Mgi-4 Bore: Mgi-4
Name of soil series	Kaftari
Location	29 34' 43.0" N; 66 22' 58.2" E
Name of village	
Physiography	Level area of gently slopping piedmont plain close to the stream
Parent material	Sand stone and shale
Topography	Nearly level
Land use / vegetation	Booi
Profile drainage	Well drained to some what excessively drained
Permeability	Moderate to moderately rapid
Water holding capacity	Moderately high
Erosion	Slight rill and sheet erosion
Moisture	Moist
USDA Classification	Typic Eutrochrept

Horizon	Depth	Description
Ap	0-14	Dark yellowish brown (10YR 4/4) moist and pale brown (10YR 6/3) dry; silt loam; massive; very slightly sticky, very slightly plastic, friable moist, slightly hard dry; few fine, common very fine tubular, common very fine vesicular pores; strongly calcareous; few fine, and very fine roots; clear smooth boundary; pH 8.4.
Bw1	14-41	Dark yellowish brown? (10YR 4/4) moist and light yellowish brown (10YR 6/4) dry; silt loam; weak medium and coarse sub-angular blocky; very slightly sticky, very slightly plastic, friable moist, slightly hard dry; common fine and many very fine tubular pores, strongly calcareous; few fine and common very fine roots; clear smooth boundary; pH 8.4.
Bw2	41-77	Yellowish brown (10YR 5/4) moist and light yellowish brown (10YR 6/4) dry; very fine sandy loam; weak, coarse and medium sub-angular blocky; very slightly sticky, very slightly plastic, friable moist, soft dry; common fine and many very fine tubular pores; strongly calcareous; few medium, and fine, common very fine roots; clear smooth boundary; pH 8.2.
BC	77-98	Yellowish brown (10YR 5/4) moist and very pale brown (10YR 7/4) dry; very fine sandy loam; very weak angular blocky; very slightly sticky, very slightly plastic, very friable moist, soft dry; few fine, and common very fine tubular pores; strongly calcareous; few fine roots; abrupt smooth boundary; pH 8.0.
C	98-130+	Yellowish brown (10YR 5.5/4 slightly lighter) moist and very pale brown (10YR 7/4) dry; loamy sand; single grain; non sticky, non plastic, loose moist, loose dry; no pores, strongly calcareous; no roots; pH 8.0.

TABLE D.1 LIST OF THE TEST PITS

Dam Name	Pit# / Bore#	Soil Series	G. P. S. Location		Name of village
Wali Dad	Wld-1 / B-1	Zard	30 06' 55.7" N	66 57' 07.5" E	Shamozai
Wali Dad	Wld-2 / B-2	Sariab	30 06' 54.7" N	66 56' 42.1" E	Shamozai
Wali Dad	Wld-3 / B-3	Mrgnl Quetta	30 06' 47.1" N	66 56' 39.8" E	Shadenzai
Brewary	Bry-1 / B-16	Zard	30 08' 42.4" N	66 57' 02.4" E	Sardar karez
Brewery	Bry-2 / B-13	Zard	30 08' 19.0" N	66 57' 18.0" E	Dildar Killi
Brewery	Bry-3 / B-24	Zard	30 10' 21.2" N	66 57' 30.9" E	Killi Kirani.
Brewery	Bry-4 / B-16?	Zard	30 08' 42.4" N	66 57' 02.4" E	Sardar Killi, north side
Marium	Mrm-1/ Mrm-1	Sariab old vrnt	30 16' 11.8" N	67 09' 20.2" E	In the Karak valley
Marium	Mrm-2 /Mrm-2	Sariab old vrnt	30 16' 19.1" N	67 09' 32.0" E	In the Karak valley
Marium	Mrm-3/ Mrm-3	Man-made soil	30 16' 22.2" N	67 10' 42.5" E	In Killi Karak, Karak valley
Marium	Mrm-4/ Mrm-4	Taler	30 14' 53.5" N	67 11' 29.9" E	Central part of valley in Gujrat
Kach	Kch-1 / K-43	Shabak	30 15' 04.4" N	66 03' 14.4" E	Shabak
Kach	Kch-2 / K-44	Shabak med	30 15' 24.1" N	67 03' 29.4" E	Shabak
Kach	Kch-3 / K-45	Shabak	30 16' 14.3" N	67 02' 56.9" E	Sar khala
Kach	Kch-4 /K-46	Shabak	30 17' 08.4" N	67 02' 21.4" E	Mala Khalabad
Kach	Kch-5 /K-47	Chilton red vnt	30 16' 30.8" N	67 02' 42.2" E	Shabak
Kach	Kch-6 K-48	Shabak eroded	30 08' 19.0" N	66 57' 18.0" E	Shabak Killi.
Ghutai Shela	Gsl-1 / B-25	Shamozai, eroded	30 13' 15.7" N	66 57' 26.7" E	Khrota Abad
Ghutai Shela	Gsl-2 /B-27	Shamozai	30 13' 26.3" N	66 57' 23.9" E	Kharot Abad
Ghutai Shela	Gsl-3 /B-31	Shamozai	30 08' 19.0" N	66 57' 18.0" E	Smangli road, checkpost
Ghutai Shela	Gsl-4 /B-29	Shamozai mottd	30 13' 36.8" N	66 57' 04.7" E	Smangly road, checkpost
Ghutai Shela	Gsl-5 /B-30	Shamozai loam	30 13' 28.1" N	66 57' 05.1" E	Smangly road, checkpost
Khora Manda	Kmd-1/Kmd-3	Shamozai	30 12' 47.4" N	66 49' 25.6" E	Killi Siddique in orchard
Khora Manda	Kmd-2/Kmd-4	Zard	30 12' 49.4" N	66 49' 10.4" E	Killi Siddique toward stream
Khora Manda	Kmd-3/Kmd-5	Shamozai/Quetta	30 13' 04.3" N	66 49' 38.8" E	Killi Barkat toward stream
Khora Manda	Kmd-4/Kmd-6	Ghaza no-sal/sod	30 13' 18.6" N	66 49' 26.8" E	Haji Barkat toward stream
Khora Manda	Kmd-5/Kmd-7	Zard	30 12' 24.3" N	66 49' 10.6" E	West of Killi Ali Muhammad
Khora Manda	Kmd-6/Kmd-8	Zard	30 12' 29.5" N	66 49' 03.1" E	Killi Ali Muhammad toward stream
Murghi Kotal	Mgk-1/ B-33	Azam	30 19' 44.8" N	66 55' 09.8" E	Killi Shamulzai
Murghi Kotal	Mgk-2/ B-34	Shamozai /Azam	30 19' 44.6" N	66 54' 39.7" E	Samali - Kark road on the left
Murghi Kotal	Mgk-3/ B-38	Lajwar	30 20' 11.9" N	66 56' 15.4" E	Killi Kateer, on the northern side
Murghi Kotal	Mgk-4/ B-39	Azam	30 19' 07.3" N	66 55' 04.0" E	Core of village Mulazai
Bostan	Bsn-1 / Bsn-1	Shamozai/Quetta	30 25' 50.6" N	67 00' 34.2" E	NW of Bostan railway station
Bostan	Bsn-2 / Bsn-2	Zard	30 25' 31.2" N	67 00' 25.4" E	Bostan
Bostan	Bsn-3 / Bsn-3	Zard	30 24' 37.2" N	67 59' 34.9" E	Killi Qasim 1
Bostan	Bsn-4 / Bsn-4	Zard loam variant	30 24' 26.0" N	66 59' 41.7" E	Killi Qasim 1
Bostan	Bsn-5 / Bsn-5	Shamozai/Shamz	30 25' 43.2" N	67 02' 00.3" E	Bostan
Bostan	Bsn-6 / Bsn-6	Shamozai	30 25' 57.9" N	67 01' 58.4" E	Bostan loora
Bostan	Bsn-7 / Bsn-7	Zard	30 23' 42.4" N	67 03' 36.3" E	Killi Khanan
Dara	Dra-1 /	Lajwar	30 16' 59.0" N	67 00' 21.1" E	Killi Sarghzai
Dara	Dra-2 /	Sariab shallow	30 17' 13.5" N	67 00' 11.0" E	Sarghazi
Dara	Dra-3 /	Sariab	30 17' 07.2" N	66 59' 35.1" E	Sarghazi Killi Chashma
Dara	Dra-4 /	Quetta/Quetta	30 17' 10.5" N	66 58' 45.6" E	
Dara	Dra-5/	Lajwar	30 16' 56.3" N	66 58' 09.1" E	
Dara	Dra-6/	Shamozai	30 16' 40.6" N	60 58' 12.3" E	Killi Chashma Achozai
Arambi	Amb-2 /Amb-2	Pinakai	30 48' 44.8" N	66 50' 18.4" E	Killi Adosh
Arambi	Amb-3 /Amb-3	Barshore /Pinakai	30 48' 31.1" N	66 48' 58.4" E	In Silad village
Arambi	Amb-4 /Amb-4	Pinakai	30 48' 46.7" N	66 48' 49.7" E	Babe
Arambi	Amb-5 /Amb-5	Pinakai old variant	30 47' 10.9" N	66 47' 06.1" E	Killi Kamran
Arambi	Amb-6 /Amb-6	Pinakai	30 47' 05.4" N		South of Killi Firdous
Tirkha	Trk-1 /Trk-1	Barshore	30 29' 09.8" N	66 56' 30.3" E	NW Nasozai
Tirkha	Trk-2 /Trk-2	Pishin	30 32' 39.0" N	66 56' 11.3" E	SW of Yaro Chimni
Tirkha	Trk-3 / Trk-3	Barshore	30 28' 28.4" N	66 56' 28.1" E	Hydarzai
Tirkha	Trk-4 / Trk-4		30 28' 32.4" N	66 57' 01.5" E	Killi Mandan
Tirkha	Trk-5 / Trk-5	Barshore mod. fn	30 30' 36.2" N	66 57' 29.3" E	NW Yaro Pishin
Tirkha	Trk-6 / Trk-6	Barshore	30 31' 20.9" N	66 57' 55.0" E	Nasozai Killi

Dam Name	Pit# / Bore#	Soil Series	G. P. S. Location		Name of village
Jigda	Jgd-1 / Jgd-1	Pinakai	30 41' 42.1" N	67 07' 33.7" E	Tori Shah to Kamal Zai road
Jigda	Jgd-2 / Jgd-2	Pinakai	30 41' 25.0" N	67 07' 47.9" E	Killi Saidan in a garden
Jigda	Jgd-3 / Jgd-3	Pinakai shall/gray	30 41' 55.5" N	67 07' 37.7" E	NW of Killi Kamal Zai
Jigda	Jgd-4 / Jgd-4	Pinakai shall/gray	30 42' 25.8" N	67 08' 08.2" E	Killi Malik Yar
Jigda	Jgd-5 / Jgd-5	Pinakai gray	30 42' 21.1" N	67 08' 44.5" E	Daman area
Jigda	Jgd-6 / Jgd-6	Pinakai shallow	30 42' 45.6" N	67 08' 50.3" E	Qureshabad village
Sanzali	Snz-1 / Snz-2	Pishin	30 33' 03.4" N	66 58' 45.2" E	Yaro - Pishin road airport
Sanzali	Snz-2 / Snz-3	Pishin	30 33' 03.4" N	66 58' 45.2" E	
Sanzali	Snz-3 / Snz-4	Pishin	30 33' 51.2" N	67 00' 36.1" E	
Sanzali	Snz-4 / Snz-5	Pishin	30 33' 51.6" N	66 59' 59.8" E	
Sanzali	Snz-5 / Snz-6	Pishin	30 32' 21.1" N	66 58' 01.1" E	Killi Abdul Razaq
Sanzali	Snz-6 / Snz-7	Pishin coarse	30 32' 01.0" N	66 58' 35.0" E	Killi Abdull Razaq
Sakhol	Sak-1 / Sak-1	Pringabad	29 50' 23.8" N	66 50' 46.3" E	Soil Conservation, Mastung.
Sakhol	Sak-2 / Sak-2	Pringabad	29 49' 17.0" N	66 50' 40.5" E	Mastung, Kalat bypass
Sakhol	Sak-3 / Sak-3	Maslakh	29 49' 18.9" N	66 49' 44.2" E	South Rolkhani Killi
Sakhol	Sak-4 / Sak-4	Pringabad	29 49' 58.9" N	66 49' 12.6" E	South of Piti Bagh, Mastung
Amach	Amch-1/Amch-1	Pringabad, fine	29 49' 06.5" N	66 51' 55.0" E	Shamsabad/Dadazai graveyard
Amach	Amch-2/Amch-2	Pringabad, coarse	29 49' 00.3" N	66 51' 22.9" E	North of Killi Akhana graveyard
Amach	Amch-3/Amch-3	Pringabad	29 48' 43.9" N	66 51' 26.7" E	Kazi Killi
Amach	Amch-4/Amch-4	Pringabad	29 48' 08.2" N	66 51' 09.5" E	
Amach	Amch-5/Amch-5	Zard	29 48' 53.7" N	66 48' 54.3" E	Near to government farm
Kad Kocha	Kad-1 / Kad-1	Shamozai/Shamz	29 40' 08.1" N	66 46' 38.8" E	Near Kad Kocha stop
Kad Kocha	Kad-2 / Kad-2	Zard	29 39' 42.9" N	66 46' 22.1" E	Kad Kocha
Kad Kocha	Kad-3 / Kad-3	Shamozai	29 39' 42.9" N	66 46' 22.1" E	Opposite of Killi Tul
Kad Kocha	Kad-4 / Kad-4	Zard	29 39' 59.0" N	66 45' 55.5" E	Kad Kocha
Laghamgir	Lgr-1 / Lgr-1	Shamozai	29 20' 57.4" N	66 27' 21.7" E	Close Kachap graveyard
Laghamgir	Lgr-2 / Lgr-2	Zard	29 20' 41.5" N	66 27' 47.6" E	East of Kachap
Laghamgir	Lgr-3 / Lgr-3	Zard	29 21' 19.2" N	66 27' 36.9" E	North of Kachap in Jaladin garden
Laghamgir	Lgr-4 / Lgr-4	Shamozai	29 21' 09.2" N	66 28' 16.0" E	4 km south of Karchap
Laghamgir	Lgr-5 / Lgr-5	Zard	29 31' 07.4" N	66 28' 25.2" E	Killi Din Muhammad
Laghamgir	Lgr-6 / Lgr-6	Shamozai	29 21' 47.4" N	66 28' 51.2" E	East of Killi Mir Karim Bux
Iskalku	Isk-1 / Isk-1	Shamozai/buried	29 02' 26.9" N	66 39' 35.0" E	Iskalku valley
Iskalku	Isk-2 / Isk-2	Shamozai/buried	29 02' 27.1" N	66 39' 52.8" E	Iskalku valley
Iskalku	Isk-3 / Isk-3	Sariab	29 02' 16.7" N	66 40' 16.9" E	Iskalku valley
Iskalku	Isk-4 / Isk-4	Chilton	29 01' 57.3" N	66 40' 37.0" E	Killi Banianzai in Iskalku valley
Gorpad	Gpd-1/Gpd-2	Hathiara	28 56' 25.1" N	66 28' 34.7" E	On Kalat-Khuzdar road
Gorpad	Gpd-2/Gpd-3	Toba loam variant	28 56' 21.5" N	66 29' 16.7" E	On Kalat-Khuzdar road
Gorpad	Gpd-3/Gpd-4	Toba loam, eroded	28 54' 30.2" N	66 28' 28.2" E	Nurridin link road
Gorpad	Gpd-4/Gpd-5	Injera	28 55' 48.7" N	66 29' 88.9" E	At about 15km from Kalat
Gorpad	Gpd-5/Gpd-6	Hathiara	28 56' 11.2" N	66 28' 37.7" E	Nurrudin Shah
Mangi	Mgi-1/ Mgi-1	Kaftari	29 31' 00.9" N	66 22' 01.7" E	West of Tamaz Khan (Mul)
Mangi	Mgi-2/ Mgi-2	Kaftari	29 31' 54.2" N	66 23' 11.2" E	North of Tamaz Khan (Mul)
Mangi	Mgi-3/ Mgi-3	Kaftari	29 33' 04.5" N	66 22' 43.4" E	West of Killi new Kaftari
Mangi	Mgi-4/ Mgi-4	Kaftari	29 34' 43.0" N	66 22' 58.2" E	NW of Killi new Kaftari

Table D.2.1 Results of Soil Analysis : Soil Texture (1)

No.	Dam site	Pit No	Soil series	Depth	Sand	Silt	Clay	Textural Class
				cm		%		
1	Wali Dad	Wld-1	Zard	0-9	37.24	53.76	9.00	Silt loam
1	Wali Dad	Wld-1	Zard	9-25	34.26	53.45	12.30	Silt loam
1	Wali Dad	Wld-1	Zard	25-61	33.45	54.25	12.30	Silt loam
1	Wali Dad	Wld-2	Sariab	0-12	54.52	33.75	11.73	Sandy loam
1	Wali Dad	Wld-2	Sariab	12-44	32.31	48.22	19.47	loam
1	Wali Dad	Wld-2	Sariab	44-96	32.23	49.04	18.75	loam
2	Brewery	Bry-1	Zard	0-16	54.54	27.20	18.26	Sandy loam
2	Brewery	Bry-1	Zard	16-32	54.54	26.44	19.02	Sandy loam
2	Brewery	Bry-1	Zard	32-80	56.16	24.05	19.80	Sandy loam
2	Brewery	Bry-2	Zard	0-10	54.83	26.91	18.26	Sandy loam
2	Brewery	Bry-2	Zard	10-21	27.16	52.84	20.00	Silt loam
2	Brewery	Bry-2	Zard	21-79	27.97	54.53	17.50	Silt loam
2	Brewery	Bry-3	Zard	0-10	31.18	51.56	17.26	Silt loam
2	Brewery	Bry-3	Zard	10-21	26.44	54.54	19.02	Silt loam
2	Brewery	Bry-3	Zard	21-96	22.30	56.16	21.55	Silt loam
3	Ghutai Shella	Gsl-1	Shamozai	0-10	58.76	31.24	10.00	Sandy loam
3	Ghutai Shella	Gsl-1	Shamozai	10-30	72.17	17.09	10.74	Sandy loam
3	Ghutai Shella	Gsl-1	Shamozai	30-56	69.21	21.82	8.97	Sandy loam
3	Ghutai Shella	Gsl-2	Shamozai	0-8	72.17	11.82	16.01	Sandy loam
3	Ghutai Shella	Gsl-2	Shamozai	8-26	62.76	24.74	12.50	Sandy loam
3	Ghutai Shella	Gsl-2	Shamozai	26-90	28.01	63.76	8.23	Silt loam
3	Ghutai Shella	Gsl-3	Shamozai	0-9	58.60	33.17	8.23	Sandy loam
3	Ghutai Shella	Gsl-3	Shamozai	9-42	42.63	48.40	8.97	loam
3	Ghutai Shella	Gsl-3	Shamozai	42-94	42.88	48.89	8.23	loam
3	Ghutai Shella	Gsl-4	Shamozai	0-9	61.97	29.06	8.97	Sandy loam
3	Ghutai Shella	Gsl-4	Shamozai	9-40	48.91	42.12	8.97	loam
3	Ghutai Shella	Gsl-4	Shamozai	40-61	42.91	44.37	8.72	loam
4	Murghi Kotal	Mgk-1	Azim	0-7	21.96	55.38	22.65	Silt loam
4	Murghi Kotal	Mgk-1	Azim	7-34	20.63	52.72	26.65	Silt loam(+)
4	Murghi Kotal	Mgk-1	Azim	34-66	11.37	47.56	41.07	Silty clay
4	Murghi Kotal	Mgk-2	Shamozai / Azim	0-8	60.52	33.01	6.47	Sandy loam
4	Murghi Kotal	Mgk-2	Shamozai / Azim	8-26	32.31	52.46	15.23	Silt Loam
4	Murghi Kotal	Mgk-2	Shamozai / Azim	26-42	17.06	63.44	19.00	Silt Loam
4	Murghi Kotal	Mgk-3	Lajwar	0-12	34.37	56.63	9.00	Silt Loam
4	Murghi Kotal	Mgk-3	Lajwar	12-33	19.02	53.46	27.52	Silty clay loam(-)
4	Murghi Kotal	Mgk-3	Lajwar	33-84	13.31	52.86	34.83	Silty clay loam
4	Murghi Kotal	Mgk-4	Azim	0-11	25.03	61.97	13.00	Silt loam
4	Murghi Kotal	Mgk-4	Azim	11-31	19.89	52.38	27.74	Silty Clay loam(-)
4	Murghi Kotal	Mgk-4	Azim	31-79	11.44	42.60	45.96	Silty clay
5	Dara	Dra-4	Quetta	0-12	17.55	58.29	24.16	Silt loam
5	Dara	Dra-4	Quetta	12-50	19.05	47.67	33.28	Silty Clay loam
5	Dara	Dra-4	Quetta	50-79	16.33	48.67	35.00	Silty Clay loam
6	Kach	Kch-2	Shamozai	0-9	47.83	42.91	9.26	loam
6	Kach	Kch-2	Shamozai	9-25	49.59	41.15	9.26	loam
6	Kach	Kch-2	Shamozai	25-56	42.57	28.95	28.48	Clay loam
6	Kach	Kch-3	Shabaq	0-9	73.04	16.22	10.76	Sandy loam
6	Kach	Kch-3	Shabaq	9-24	32.13	30.17	37.70	Clay Loam
6	Kach	Kch-3	Shabaq	24-58	43.75	30.62	25.63	loam
7	Bostan	Bsn-1	Shamozai	0-15	23.61	52.33	24.07	Silt loam
7	Bostan	Bsn-1	Shamozai	15-35	16.16	60.33	23.51	Silt loam
7	Bostan	Bsn-1	Shamozai	35-66	13.55	59.97	26.48	Silt loam
7	Bostan	Bsn-2	Zard	0-15	20.76	52.76	26.48	Silt loam
7	Bostan	Bsn-2	Zard	15-38	22.26	54.16	23.58	Silt loam
7	Bostan	Bsn-2	Zard	38-68	22.97	55.27	21.76	Silt loam

Table D.2.2 Results of Soil Analysis : Soil Texture (2)

No.	Dam site	Pit No	Soil series	Depth	Sand	Silt	Clay	Textural Class
				cm		%		
8	Tirkha	Trk-1	Barshore	0-20	59.50	29.03	11.47	Sandy loam
8	Tirkha	Trk-1	Barshore	20-50	47.29	41.26	11.45	loam
8	Tirkha	Trk-1	Barshore	50-80	44.21	43.61	12.18	loam
8	Tirkha	Trk-2	Pishine	0-13	72.69	18.39	8.92	Sandy loam
8	Tirkha	Trk-2	Pishine	13-28	56.18	31.90	11.92	loam (-)
8	Tirkha	Trk-2	Pishine	28-71	53.07	36.82	10.11	loam (-1)
9	Sanalzai	Snz-1	Pishine	0-11	82.14	12.09	5.77	Loamy sand
9	Sanalzai	Snz-1	Pishine	11-23	73.19	16.81	10.00	Sandy loam
9	Sanalzai	Snz-1	Pishine	23-42	74.13	17.37	8.50	Sandy loam
10	Arambi	Amb-2	Pinakai	0-14	61.61	19.89	18.50	Sandy loam
10	Arambi	Amb-2	Pinakai	14-58	21.74	52.76	25.50	Silt loam
10	Arambi	Amb-2	Pinakai	58-149	33.92	52.19	13.89	Silt loam
10	Arambi	Amb-3	Lajwar	0-14	38.45	52.55	9.00	Silt loam
10	Arambi	Amb-3	Lajwar	14-38	33.13	54.58	12.30	Silt loam
10	Arambi	Amb-3	Lajwar	38-107	32.46	51.07	16.47	Silt loam
11	Jigda	Jgd-1	Pinakai	0-11	64.35	29.17	6.47	Sandy loam
11	Jigda	Jgd-1	Pinakai	11-22	63.12	28.53	8.24	Sandy loam
11	Jigda	Jgd-1	Pinakai	22-76	54.45	32.47	13.18	Sandy loam
11	Jigda	Jgd-2	Pinakai	0-11	28.44	59.26	12.30	Silt loam
11	Jigda	Jgd-2	Pinakai	11-37	24.30	61.20	14.50	Silt loam
11	Jigda	Jgd-2	Pinakai	37-132	23.80	60.50	15.70	Silt loam
12	Khor Manda	Kmd-1	Shamozai	0-13	55.76	33.91	10.33	Sandy loam
12	Khor Manda	Kmd-1	Shamozai	13-24	34.64	55.72	9.64	Silt loam
12	Khor Manda	Kmd-1	Shamozai	24-77	31.38	49.20	16.42	Sandy loam
12	Khor Manda	Kmd-4	Ghaza non-S&S	0-17	30.89	51.56	17.55	Silt loam
12	Khor Manda	Kmd-4	Ghaza non-S&S	17-31	21.61	52.91	25.47	Silt loam
12	Khor Manda	Kmd-4	Ghaza non-S&S	31-59	28.27	51.16	20.58	Silt loam
13	*Marrium*	*Mrm-1*	*Man-made*	*0-12*	*26.63*	*51.61*	*21.76*	*Silt loam*
13	Marrium	Mrm-1	Man-made	12-38	15.63	46.01	38.36	Silty Clay loam
13	Marrium	Mrm-1	Man-made	38-79	20.54	52.96	26.55	Silt loam
14	Sakhul	Sak-1	Pringabad	0-12	77.02	17.25	5.73	Loamy v.f. sand
14	Sakhul	Sak-1	Pringabad	12-30	70.76	20.72	8.52	Sandy loam
14	Sakhul	Sak-1	Pringabad	30-89	68.99	21.64	9.37	Sandy loam
15	Amch	Amc-4	Pringabad	0-13	73.72	19.61	6.47	Sandy loam
15	Amch	Amc-4	Pringabad	13-33	72.50	20.28	7.22	Sandy loam
15	Amch	Amc-4	Pringabad	33-82	69.19	22.06	8.75	sandy loam
16	Kad Khucha	Kad-2	Zard	0-15	62.22	29.55	8.23	Sandy loam
16	Kad Khucha	Kad-2	Zard	15-44	69.59	21.88	8.53	Sandy loam
16	Kad Khucha	Kad-2	Zard	44-81	69.06	25.94	5.00	Sandy laom
16	Kad Khucha	Kad-3	Shamozai	0-10	68.90	22.90	8.21	Sandy loam
16	Kad Khucha	Kad-3	Shamozai	10-23	64.05	64.05	10.70	Silt loam
16	Kad Khucha	Kad-3	Shamozai	23-69	58.35	30.26	11.40	Sandy loam
17	Laghumgir	Lgr-3	Zard	0-9	30.18	53.32	16.50	Silt loam
17	Laghumgir	Lgr-3	Zard	9-27	30.48	53.14	17.28	Silt loam
17	Laghumgir	Lgr-3	Zard	27-43	23.18	51.56	25.26	Silt loam
18	Iskalku	Isk-1	Shamozai / burried	0-9	55.25	26.49	18.26	Sandy loam
18	Iskalku	Isk-1	Shamozai / burried	9-31	53.60	25.63	19.50	Sandy loam
18	Iskalku	Isk-1	Shamozai / burried	31-47	22.61	56.62	20.77	Silt loam
18	Iskalku	Isk-2	Shamozai	0-10	58.01	22.49	17.50	Sandy loam
18	Iskalku	Isk-2	Shamozai	10-41	28.10	52.66	19.24	Silt loam
18	Iskalku	Isk-2	Shamozai	41-86	19.87	53.36	26.77	Silt loam
20	Mangi	Mgi-4	Kaftari	0-14	16.90	59.50	23.60	Silt loam
20	Mangi	Mgi-4	Kaftari	14-41	13.67	64.78	21.55	Silt loam
20	Mangi	Mgi-4	Kaftari	41-77	54.21	26.12	19.67	Sandy loam

Table D.2.3 Results of Soil Analysis : pH, EC and cations (1)

No.	Dam site	Pit No	Soil series	Depth	pH	ECe	CaCO3	K	Na	Ca	Mg	SAR
				cm		mS/cm	--%--	---------- meq/liter ----------				
1	Wali Dad	Wld-1	Zard	0-9	7.83	1.71	25.46	0.23	13.04	2.40	6.09	6.33
1	Wali Dad	Wld-1	Zard	9-25	7.98	0.61	28.09		3.61	1.50	2.21	2.65
1	Wali Dad	Wld-1	Zard	25-61	8.11	1.02	31.48	0.33	7.82	3.30	8.07	3.28
1	Wali Dad	Wld-2	Sariab	0-12	7.91	1.20	31.02	0.44	7.39	2.45	6.58	3.48
1	Wali Dad	Wld-2	Sariab	12-44	8.01	0.47	31.17	0.23	2.34	1.75	1.48	1.84
1	Wali Dad	Wld-2	Sariab	44-96	8.06	0.50	30.71	0.28	2.47	1.75	1.71	1.88
2	Brewary	Bry-1	Zard	0-16	8.22	0.52	21.45	0.26	0.61	3.00	1.95	0.39
2	Brewary	Bry-1	Zard	16-32	8.10	0.33	19.91	0.08	0.78	1.85	1.67	0.59
2	Brewary	Bry-1	Zard	32-80	8.22	0.26	25.31	0.05	0.70	1.35	1.70	0.56
2	Brewary	Bry-2	Zard	0-10	7.91	0.78	20.37	0.38	3.09	2.50	2.69	1.92
2	Brewary	Bry-2	Zard	10-21	7.89	1.50	20.37	0.79	5.56	3.05	4.65	2.83
2	Brewary	Bry-2	Zard	21-79	8.04	0.55	21.76	0.23	2.60	1.90	1.80	1.92
2	Brewary	Bry-3	Zard	0-10	7.87	0.37	20.99	1.00	18.69	4.35	8.23	7.45
2	Brewary	Bry-3	Zard	10-21	7.96	0.26	20.52	0.10	0.70	1.65	1.20	0.58
2	Brewary	Bry-3	Zard	21-96	7.89	0.71	25.62	0.03	1.61	3.50	2.74	0.91
3	Ghutai Shella	Gsl-1	Shamozai	0-10	7.63	2.56	17.28	1.13	0.74	26.60	9.88	0.17
3	Ghutai Shella	Gsl-1	Shamozai	10-30	7.58	2.76	16.98	1.25	1.52	27.55	11.36	0.35
3	Ghutai Shella	Gsl-1	Shamozai	30-56	7.76	1.46	18.52	0.74	3.91	5.35	7.74	1.52
3	Ghutai Shella	Gsl-2	Shamozai	0-8	7.82	0.59	18.52	0.54	1.00	2.20	3.03	0.62
3	Ghutai Shella	Gsl-2	Shamozai	8-26	7.68	0.44	18.98	0.18	3.91	1.20	0.98	3.74
3	Ghutai Shella	Gsl-2	Shamozai	26-90	7.85	0.61	20.99	0.15	5.30	1.00	0.89	5.46
3	Ghutai Shella	Gsl-3	Shamozai	0-9	7.65	2.50	18.98	1.00	0.91	33.00	6.67	0.21
3	Ghutai Shella	Gsl-3	Shamozai	9-42	7.39	3.01	18.36	1.02	4.17	26.75	15.97	0.90
3	Ghutai Shella	Gsl-3	Shamozai	42-94	7.08	5.05	19.60	1.00	45.65	20.35	18.44	10.36
3	Ghutai Shella	Gsl-4	Shamozai, mottled	0-9	7.52	5.75	19.60	0.62	53.91	13.40	24.03	12.46
3	Ghutai Shella	Gsl-4	Shamozai, mottled	9-40		2.84	21.60	0.23	29.13	4.30	11.28	10.44
3	Ghutai Shella	Gsl-4	Shamozai, mottled	40-61	7.79	2.76	17.59	0.23	28.26	4.10	10.70	10.38
4	Murghi Kotal	Mgk-1	Azim	0-7	8.13	0.73	28.09	0.69	3.47	2.00	1.67	2.56
4	Murghi Kotal	Mgk-1	Azim	7-34	8.19	2.62	29.01	0.31		3.20	0.51	
4	Murghi Kotal	Mgk-1	Azim	34-66	7.93	6.43	27.93	0.54	95.60	5.10	8.97	36.06
4	Murghi Kotal	Mgk-2	Shamozai	0-8	7.45	5.06	25.93	2.64	40.86	21.55	14.49	9.62
4	Murghi Kotal	Mgk-2	Shamozai	8-26	7.94	1.41	27.31	2.02	5.43	3.40	3.95	2.83
4	Murghi Kotal	Mgk-2	Shamozai	26-42	7.64	8.40	30.40	2.46	4.17	3.50	5.10	2.01
4	Murghi Kotal	Mgk-3	Lajwar	0-12	8.17	0.45	21.14	0.41	3.47	0.80	1.00	3.67
4	Murghi Kotal	Mgk-3	Lajwar	12-33	8.22	0.44	27.31	0.46	3.65	0.75	0.98	3.92
4	Murghi Kotal	Mgk-3	Lajwar	33-84	8.17	1.98	24.07	0.79	24.34	0.85	4.36	15.08
4	Murghi Kotal	Mgk-4	Azim	11-31	8.03	0.28	28.55	0.23	1.30	1.05	1.24	1.21
4	Murghi Kotal	Mgk-4	Azim	31-79	7.88	0.73	29.94	0.15	5.04	1.40	1.42	4.24
5	Dara	Dra-4	Quetta / Quetta	0-12	7.90	1.30	25.46	0.82	16.08	2.55	4.61	8.50
5	Dara	Dra-4	Quetta / Quetta	12-50	7.90	0.91	24.54	0.10		1.95	1.47	
5	Dara	Dra-4	Quetta / Quetta	50-79	7.78	0.81	22.69	0.13	4.78	2.15	3.29	2.90
6	Kach	Kch-2	Shabaq, medium	0-9	7.84	0.22	30.09	0.18	0.47	1.75	0.81	0.48
6	Kach	Kch-2	Shabaq, medium	9-24	8.19	0.43	32.72	0.13	0.35	1.90	3.21	0.32
6	Kach	Kch-2	Shabaq, medium	24-68	8.04	0.26	36.73	0.08	0.74	1.85	1.08	0.63
6	Kach	Kch-3	Shabaq	0-8	8.07	0.15	25.46	0.28	0.48	1.35	0.66	0.42
6	Kach	Kch-3	Shabaq	8-23	8.05	0.17	33.80	0.26	0.48	1.65	0.68	0.30
6	Kach	Kch-3	Shabaq	23-56	8.18	0.21	44.91	0.10	1.04	1.85	0.88	0.86
7	Bostan	Bsn-1	Shamozai / Quetta	0-15	8.05	1.34	28.40	0.49	7.82	3.35	7.57	3.35
7	Bostan	Bsn-1	Shamozai / Quetta	15-38	8.06	1.00	30.40	0.28	4.69	2.75	2.43	2.92
7	Bostan	Bsn-1	Shamozai / Quetta	38-68	7.98	0.94	32.10	0.10	6.95	2.70	5.10	3.52
7	Bostan	Bsn-2	Zard	0-13	7.73	3.38	26.85	0.51	30.43	7.35	13.66	9.34
7	Bostan	Bsn-2	Zard	13-36	7.89	1.28	26.54	0.15	5.87	2.65	7.24	2.64
7	Bostan	Bsn-2	Zard	36-79	7.75	1.38	30.56	0.13	10.86	3.20	7.08	4.79

Table D.2.4 Results of Soil Analysis : pH, EC and cations (2)

No.	Dam site	Pit No	Soil series	Depth	pH	ECe	CaCO3	K	Na	Ca	Mg	SAR
				cm		mS/cm	--%--	---------- meq/liter ----------				
8	Tirkha	Trk-1	Barshore	0-13	8.37	0.54	19.75	0.49	4.56	1.40	1.40	3.85
8	Tirkha	Trk-1	Barshore	13-31	7.97	4.35	21.30	0.31	34.34	9.60	22.14	8.62
8	Tirkha	Trk-1	Barshore	31-82	8.03	5.31	20.99	0.28	36.08	10.20	34.49	7.63
8	Tirkha	Trk-2	Barshore	0-13	8.15	0.52	18.36	0.64	2.30	2.00	1.76	1.68
8	Tirkha	Trk-2	Barshore	13-28	8.39	0.26	19.75	0.15	2.35	0.80	1.09	2.41
8	Tirkha	Trk-2	Barshore	28-71	8.52	1.10	20.37	0.10	9.95	0.20	0.69	14.91
9	Sanazli	Snz-1	Pishine	0-11	7.86	0.21	21.30	0.26	0.39	1.75	0.67	0.36
9	Sanzali	Snz-1	Pishine	11-23	8.17	0.14	22.07	0.23	0.52	1.20	0.59	0.55
9	Sanzali	Snz-1	Pishine	23-42	7.70	0.28	24.69	0.18	1.09	1.65	1.04	0.94
10	Arambi	Amb-2	Pinakai	0-14	7.88	0.86	17.28	0.82	1.86	3.05	5.68	0.89
10	Arambi	Amb-2	Pinakai	14-58	8.10	0.34	13.89	0.10	1.17	1.60	1.47	0.95
10	Arambi	Amb-2	Pinakai	58-149	8.09	0.36	14.20	0.05	1.74	1.70	1.30	1.42
10	Arambi	Amb-3	Lajwar	0-14	8.15	0.63	13.89	0.21	2.13	2.45	2.43	1.36
10	Arambi	Amb-3	Lajwar	14-38	8.14	0.68	15.90	0.21	2.95	2.15	2.21	2.00
10	Arambi	Amb-3	Lajwar	38-107	8.09	0.48	13.89	0.18	2.30	1.80	1.65	1.75
11	Jigda	Jgd-1	Pinakai	0-11	7.83	4.11	12.19	0.67		3.55	3.46	
11	Jigda	Jgd-1	Pinakai	11-22	8.21	0.59	12.50	0.28	4.30	1.00	1.24	4.06
11	Jigda	Jgd-1	Pinakai	22-76	8.26	1.54	13.43	0.26	22.17	1.05	3.95	14.02
11	Jigda	Jgd-2	Pinakai	0-11	8.26	3.36	13.58	1.65	29.56	3.70	11.19	10.83
11	Jigda	Jgd-2	Pinakai	11-37	8.05	0.98	12.96	0.63	5.65	1.65	2.17	4.08
11	Jigda	Jgd-2	Pinakai	37-132	8.10	0.88	13.12	0.44	5.30	1.40	1.68	4.28
12	Khora Manda	Kmd-1	Shamozai	0-13	8.36	0.44	18.98	0.18	3.52	1.55	0.00	4.00
12	Khora Manda	Kmd-1	Shamozai	13-24	8.21	0.55	28.40	0.10	4.65	1.10	0.00	6.27
12	Khora Manda	Kmd-1	Shamozai	24-77	8.00	1.34	29.63	0.44	27.82	6.30	10.37	9.63
12	Khora Manda	Kmd-4	Ghaza non-S&S	0-17	7.69	2.04	33.02				0.12	
12	Khora Manda	Kmd-4	Ghaza non-S&S	17-31	7.99	1.10	26.70	0.18	10.43	1.50	1.84	8.08
12	Khora Manda	Kmd-4	Ghaza non-S&S	31-59	7.82	2.06	30.71	0.44	19.13	2.85	8.15	8.16
13	Marium	Mrm-1	Man-made	0-12	7.85	0.61	33.64	0.03	1.95	3.00	1.52	1.30
13	Marium	Mrm-1	Man-made	12-38	7.91	0.47	35.19	0.03	1.69	2.40	1.29	1.25
13	Marium	Mrm-1	Man-made	38-79	7.89	0.36	29.01	0.23	1.52	1.80	1.28	1.23
14	Sakhol	Sak-1	Pringabad	0-12	7.99	0.21	18.52	0.23	0.35	1.45	0.89	0.32
14	Sakhol	Sak-1	Pringabad	12-30	8.17	0.19	18.98	0.51	0.43	3.00	1.50	0.29
14	Sakhol	Sak-1	Pringabad	30-89	8.13	0.19	21.91	0.18	0.74	1.45	0.85	0.69
15	Amach	Amc-4	Pringabad	0-13	8.10	0.26	18.98	0.33	0.43	1.80	1.25	0.35
15	Amach	Amc-4	Pringabad	13-33	8.17	0.18	19.91	0.26	0.83	1.20	1.00	0.79
15	Amach	Amc-4	Pringabad	33-82	7.68	0.29	17.28	0.31	2.04	1.25	0.88	1.98
16	Kad Khocha	Kad-2	Zard	0-15	7.80	0.92	25.15	0.56	3.91	2.95	2.58	2.35
16	Kad Khocha	Kad-2	Zard	15-44	8.08	0.49	30.40	0.20	2.43	1.85	1.60	1.85
16	Kad Khocha	Kad-2	Zard	44-81	7.91	0.33	29.01	0.15	2.34	1.25	0.76	2.34
16	Kad Khocha	Kad-3	Shamozai	0-10	7.84	0.56	21.76	0.44	1.26	2.75	2.20	0.80
16	Kad Khocha	Kad-3	Shamozai	10-23	8.01	0.31	21.30	0.28	1.48	1.60	1.14	1.26
16	Kad Khocha	Kad-3	Shamozai	23-69	8.08	0.34	20.68	0.13	2.13	1.70	0.78	1.91
17	Laghmgir	Lgr-3	Zard	0-12	8.06	1.92	22.69	0.92	25.21	1.30	6.67	12.63
17	Laghmgir	Lgr-3	Zard	12-27	8.23	1.10	23.15	0.28	11.73	1.25	5.19	6.54
17	Laghmgir	Lgr-3	Zard	27-43	8.06	1.22	24.38	0.10	11.73	1.20	6.42	6.01
18	Iskalkoo	Isk-1	Shamozai / burried	0-9	7.64	0.71	28.86	1.54	20.40	2.40	2.13	11.35
18	Iskalkoo	Isk-1	Shamozai / burried	9-31	7.48	3.47	32.41	1.54	28.69	4.95	20.49	8.05
18	Iskalkoo	Isk-1	Shamozai / burried	31-47	7.74	4.32	34.26	0.87	39.13	4.60	24.77	10.21
18	Iskalkoo	Isk-2	Shamozai	0-10	8.05	0.53	21.30	0.31	1.30	2.05	2.47	0.87
18	Iskalkoo	Isk-2	Shamozai	10-41	8.22	0.37	21.91	0.46	2.21	1.10	1.19	2.07
18	Iskalkoo	Isk-2	Shamozai	41-66	7.92	0.58	21.76	0.28	2.87	1.45	2.42	2.06
20	Mangi	Mgi-4	Kaftari	0-14	7.56	4.37	20.52	0.54	50.00	5.85	12.35	16.57
20	Mangi	Mgi-4	Kaftari	14-41	8.30	1.13	18.21	0.13	15.22	1.10	0.78	15.69
20	Mangi	Mgi-4	Kaftari	41-77	7.88	3.19	17.90	0.56	43.91	4.45	5.43	19.76

Table D.2.5 Results of Soil Analysis : Soil fertility (1)

No.	Dam site	Pit No	Soil series	Depth	OM	N	AB-P	CEC	Zn	Cu	Fe	Mn
				cm	----%----		ppm	meq	----------mg / liter------			
1	Wali Dad	Wld-1	Zard	0-9	0.124	0.099	5.07	8.26	4.55	11.90	9.90	1.00
1	Wali Dad	Wld-1	Zard	9-25	0.121	0.043	0.96	6.91	0.80	1.90	5.60	0.10
1	Wali Dad	Wld-1	Zard	25-61	0.065	0.028	11.79	6.24	0.78	0.83	2.67	0.40
1	Wali Dad	Wld-2	Sariab	0-12	0.089	0.079	4.94	7.05	2.85	3.35	7.00	0.00
1	Wali Dad	Wld-2	Sariab	12-44	0.078	0.031	0.14	5.62	0.63	2.00	7.30	1.20
1	Wali Dad	Wld-2	Sariab	44-96	0.105	0.033	6.45	5.31	0.81	1.99	7.15	1.20
2	Brewery	Bry-1	Zard	0-16	0.319	0.014	0.14	6.37	3.70	1.68	6.20	1.40
2	Brewery	Bry-1	Zard	16-32	0.515	0.060	0.82	11.12	2.95	1.84	6.20	1.60
2	Brewery	Bry-1	Zard	32-80	0.396	0.052	0.14	9.83	0.43	0.61	1.75	0.70
2	Brewery	Bry-2	Zard	0-10	0.351	0.000	2.19	18.98	0.61	1.29	2.41	1.00
2	Brewery	Bry-2	Zard	10-21	0.684	0.000	1.37	13.80	0.51	1.22	2.17	0.80
2	Brewery	Bry-2	Zard	21-79	0.259	0.000	0.27	8.67	0.65	1.21	1.06	0.10
2	Brewery	Bry-3	Zard	0-10	0.335	0.098	0.82	9.53	0.63	0.99	5.55	5.50
2	Brewery	Bry-3	Zard	10-21	0.316	0.093	0.82	9.93	0.49	1.36	1.94	2.00
2	Brewery	Bry-3	Zard	21-96	0.492	0.017	0.14	8.53	2.80	1.09	1.70	1.10
3	Ghutai Shella	Gsl-1	Shamozai	0-10	0.153	0.005	0.27	7.38	0.34	0.35	1.26	0.80
3	Ghutai Shella	Gsl-1	Shamozai	10-30	0.159	0.001	0.27	7.54	0.45	0.21	0.31	0.00
3	Ghutai Shella	Gsl-1	Shamozai	30-56	0.217	0.018	0.82	7.83	0.51	0.52	0.46	0.10
3	Ghutai Shella	Gsl-2	Shamozai	0-8	0.605	0.067	0.55	9.28	3.90	0.73	1.91	3.50
3	Ghutai Shella	Gsl-2	Shamozai	8-26	0.334	0.009	0.14	0.45	0.94	0.39	0.72	0.70
3	Ghutai Shella	Gsl-2	Shamozai	26-90	0.245	0.026	0.14	0.22	0.65	0.30	0.66	0.70
3	Ghutai Shella	Gsl-3	Shamozai	0-9	0.361	0.006	0.27	0.45	0.66	0.30	0.34	2.00
3	Ghutai Shella	Gsl-3	Shamozai	9-42	0.293	0.010	0.14	0.45	0.56	0.20	0.33	0.30
3	Ghutai Shella	Gsl-3	Shamozai	42-94	0.264	0.020	0.14	7.35	0.53	0.25	0.33	0.50
3	Ghutai Shella	Gsl-4	Shamozai, mottled	0-9	0.548	0.009	0.41	8.91	2.30	0.40	1.63	0.00
3	Ghutai Shella	Gsl-4	Shamozai, mottled	9-40	0.271	0.003	0.27	8.47	0.95	0.35	0.32	0.10
3	Ghutai Shella	Gsl-4	Shamozai, mottled	40-61	0.191	0.009	0.14	6.68	0.60	0.47	0.30	0.10
4	Murghi Kotal	Mgk-1	Azim	0-7	0.561	0.060	1.92	14.46	2.30	0.89	4.75	2.50
4	Murghi Kotal	Mgk-1	Azim	7-34	0.563	0.022	0.55	13.21	2.60	1.30	4.05	2.30
4	Murghi Kotal	Mgk-1	Azim	34-66	0.322	0.007	0.27	11.61	1.95	0.93	5.30	0.80
4	Murghi Kotal	Mgk-2	Shamozai	0-8	0.181	0.052	3.43	8.70		0.89	1.07	0.00
4	Murghi Kotal	Mgk-2	Shamozai	8-26	0.215	0.023	4.53	12.56	3.60	1.97	18.60	0.40
4	Murghi Kotal	Mgk-2	Shamozai	26-42	0.083	0.014	1.37	9.42	0.00	1.52	21.00	0.70
4	Murghi Kotal	Mgk-3	Lajwar	0-12	0.166	0.059	1.23	8.72				
4	Murghi Kotal	Mgk-3	Lajwar	12-33	0.102	0.038	0.41	8.48	4.80	1.42	0.34	
4	Murghi Kotal	Mgk-3	Lajwar	33-84	0.091	0.030	0.41	13.29	3.40	1.71	9.30	0.20
4	Murghi Kotal	Mgk-4	Azim	0-11	0.322	0.013	1.92	9.89	0.64	2.15	5.15	1.50
4	Murghi Kotal	Mgk-4	Azim	11-31	0.289	0.011	0.82	8.65	0.93	1.98	2.11	1.30
4	Murghi Kotal	Mgk-4	Azim	31-79	0.432	0.009	0.27	11.21	0.71	1.65	2.34	0.90
5	Dara	Dra-4	Quetta / Quetta	0-12	0.688	0.011	3.57	8.61	0.52	1.53	8.85	1.40
5	Dara	Dra-4	Quetta / Quetta	12-50	0.437	0.002	0.27	6.77	0.46	1.71	6.85	1.00
5	Dara	Dra-4	Quetta / Quetta	50-79	0.492	0.001	0.27	9.49	0.43	1.09	6.80	0.80
6	Kach	Kch-2	Shabaq, medium	0-9	0.243	0.006	1.78	5.90	0.61	1.27	5.95	1.80
6	Kach	Kch-2	Shabaq, medium	9-24	0.185	0.034		8.35				
6	Kach	Kch-2	Shabaq, medium	24-58	0.167	0.031	0.82	7.40	0.61	0.68	1.40	0.00
6	Kach	Kch-3	Shabaq	0-8	0.272	0.029	2.74	5.98	0.75	1.14	6.40	1.10
6	Kach	Kch-3	Shabaq	8-23	0.250	0.047	1.23	8.62	0.23	1.35	1.83	0.20
6	Kach	Kch-3	Shabaq	23-56	0.105	0.030	1.10	3.86	0.33	1.54	1.44	0.20
7	Bostan	Bsn-1	Shamozai / Quetta	0-15	0.133	0.020	0.82	9.03	3.65	1.78	1.43	0.60
7	Bostan	Bsn-1	Shamozai / Quetta	15-38	0.329	0.013	0.82	16.47	2.55	0.99	0.86	0.30
7	Bostan	Bsn-1	Shamozai / Quetta	38-68	0.287	0.032	1.10	8.11	2.05	0.58	0.93	0.20
7	Bostan	Bsn-2	Zard	0-15	0.689	0.073	1.10	12.72	3.10	0.73	0.88	1.60
7	Bostan	Bsn-2	Zard	15-38	0.525	0.049	0.82	8.75	2.35	1.10	1.15	0.50
7	Bostan	Bsn-2	Zard	38-68	0.234	0.005	0.82	7.64	3.00	0.69	0.66	0.50
8	Tirkha	Trk-1	Barshore	0-13	0.556	0.059	1.10	9.63	2.30	1.14	4.60	2.30
8	Tirkha	Trk-1	Barshore	13-31	0.265	0.017	2.19	13.60	2.40	0.42	1.00	0.50
8	Tirkha	Trk-1	Barshore	31-82	0.211	0.016	1.92	10.93	2.15	0.33	1.11	0.00

Table D.2.6 Results of Soil Analysis : Soil fertility (2)

No.	Dam site	Pit No	Soil series	Depth	OM	N	AB-P	CEC	Zn	Cu	Fe	Mn
				cm	----%	----	ppm	meq	----------	mg / liter	------	
8	Tirkha	Trk-2	Barshore	0-13	0.267	0.031	2.33	12.11	2.65	0.00	0.00	0.50
8	Tirkha	Trk-2	Barshore	13-28	0.157	0.012	1.10	9.94	2.05	0.41	1.47	0.30
8	Tirkha	Trk-2	Barshore	28-71	0.020	0.029	1.10	10.26	2.95	0.37	1.01	0.80
9	Sanzali	Snz-1	Pishine	0-11	0.288	0.002	1.37	6.34	0.92	0.55	1.04	0.70
9	Sanzali	Snz-1	Pishine	11-23	0.185	0.003	0.27	5.95	0.86	0.61	0.50	0.20
9	Sanzali	Snz-1	Pishine	23-42	0.338	0.004	0.27	5.90	0.34	0.25	0.57	0.00
10	Arambi	Amb-2	Pinakai	0-14	0.238	0.013	1.23	12.87	3.95	0.76	0.94	0.60
10	Arambi	Amb-2	Pinakai	14-58	0.377	0.013	0.27	19.04	2.35	0.91	0.70	0.10
10	Arambi	Amb-2	Pinakai	58-149	0.224	0.000	0.14	16.06	2.45	1.10	0.78	0.10
10	Arambi	Amb-3	Lajwar	0-14	0.291	0.030	0.27	7.82	2.10	2.85	9.65	0.00
10	Arambi	Amb-3	Lajwar	14-38	0.159	0.029	0.27	8.46	3.10	1.89	7.75	1.90
10	Arambi	Amb-3	Lajwar	38-107	0.162	0.027	0.41	6.55	0.40	1.73	3.45	1.90
11	Jigda	Jgd-1	Pinakai	0-11	0.156	0.036	1.78	2.93	0.25	0.93	7.35	2.50
11	Jigda	Jgd-1	Pinakai	11-22	0.155	0.028	1.92	4.25	0.28	1.04	7.70	1.40
11	Jigda	Jgd-1	Pinakai	22-76	0.106	0.022	1.23	4.98	0.26	1.62	10.90	1.40
11	Jigda	Jgd-2	Pinakai	0-11	0.250	0.016	6.58	4.51	0.62	2.24	26.00	0.50
11	Jigda	Jgd-2	Pinakai	11-37	0.200	0.033	5.76	6.48	0.46	2.36	13.60	1.30
11	Jigda	Jgd-2	Pinakai	37-132	0.130	0.039	2.47	7.17	0.55	1.88	2.08	1.10
12	Khora Manda	Kmd-1	Shamozai	0-13	0.259	0.072	0.82	12.33	2.20	0.43	4.40	1.70
12	Khora Manda	Kmd-1	Shamozai	13-24	0.314	0.036	1.10	13.25	2.40	0.42	1.71	0.70
12	Khora Manda	Kmd-1	Shamozai	24-77	0.190	0.009	0.55	11.26	1.80	0.28	0.97	0.50
12	Khora Manda	Kmd-4	Ghaza non-S&S	0-17	0.205	0.027	1.10	9.64	2.45	0.84	6.80	1.70
12	Khora Manda	Kmd-4	Ghaza non-S&S	17-31	0.312	0.034	0.82	10.10	2.25	0.94	0.48	0.30
12	Khora Manda	Kmd-4	Ghaza non-S&S	31-59	0.203	0.026	0.55	8.57	1.80	0.48	0.49	0.00
13	Marium	Mrm-1	Man-made	0-12	0.353	0.021	0.27	5.57	3.90	1.48	1.86	0.10
13	Marium	Mrm-1	Man-made	12-38	0.655	0.019	0.14	2.30	4.50	1.38	1.25	0.20
13	Marium	Mrm-1	Man-made	38-79	0.359	0.050	0.27	6.09	2.70	1.12	0.63	0.10
14	Sakhol	Sak-1	Pringabad	0-12	0.082	0.034	1.23	4.39	2.25	8.05	6.85	2.30
14	Sakhol	Sak-1	Pringabad	12-30	0.094	0.009	1.51	4.32	0.16	0.70	6.25	1.20
14	Sakhol	Sak-1	Pringabad	30-89	0.066	0.013	1.23	4.16	0.16	0.82	6.50	0.90
15	Amach	Amc-4	Pringabad	0-13	0.213	0.063	4.66	7.31	0.48	1.64		0.00
15	Amach	Amc-4	Pringabad	13-33	0.137	0.039	2.72	5.16	0.43	1.42	5.70	2.10
15	Amach	Amc-4	Pringabad	33-82	0.049	0.012	1.65	5.40	0.22	0.88	5.90	0.80
16	Kad Khocha	Kad-2	Zard	0-15	0.370	0.007	0.82	5.78	0.63	0.57	1.69	2.00
16	Kad Khocha	Kad-2	Zard	15-44	0.241	0.002	0.14	5.45	0.83	0.80	0.39	0.20
16	Kad Khocha	Kad-2	Zard	44-81	0.191	0.000	0.14	4.26	0.72	0.39	0.06	0.10
16	Kad Khocha	Kad-3	Shamozai	0-10	0.303	0.045	2.33	6.02	0.89	0.99	2.26	2.00
16	Kad Khocha	Kad-3	Shamozai	10-23	0.325	0.049	1.51	7.15	1.25	1.80	5.15	1.40
16	Kad Khocha	Kad-3	Shamozai	23-69	0.190	0.034	0.82	6.35	0.62	0.87	2.11	0.60
17	Laghmgir	Lgr-3	Zard	0-12	0.262	0.056	0.82	9.17	2.50	0.82	7.30	2.20
17	Laghmgir	Lgr-3	Zard	12-27	0.412	0.052	0.27	9.59	2.55	0.67	6.70	1.20
17	Laghmgir	Lgr-3	Zard	27-43	0.370	0.005	0.82	8.84	1.95	0.80	5.20	0.90
18	Iskalkoo	Isk-1	Shamozai / burried	0-9	0.359	0.008	2.19	7.73	0.31	0.80	0.60	0.00
18	Iskalkoo	Isk-1	Shamozai / burried	9-31	0.595	0.007	0.27	9.18	0.32	1.25	3.00	0.00
18	Iskalkoo	Isk-1	Shamozai / burried	31-47	0.658	0.000	0.82	5.30	0.41	1.00	6.25	0.30
18	Iskalkoo	Isk-2	Shamozai	0-10	0.318	0.000	1.65	6.51	0.35	0.50	2.04	0.90
18	Iskalkoo	Isk-2	Shamozai	10-41	0.497	0.000	0.69	6.46	0.33	0.43	0.89	0.10
18	Iskalkoo	Isk-2	Shamozai	41-66	0.403	0.000	0.27	7.43	0.33	0.69	0.81	0.50
20	Mangi	Mgi-4	Kaftari	0-14	0.389	0.010	1.10	7.99	0.52	0.95	6.30	1.90
20	Mangi	Mgi-4	Kaftari	14-41	0.186	0.007	0.55	7.00	0.47	0.67	1.41	0.30
20	Mangi	Mgi-4	Kaftari	41-77	0.134	0.006	0.27	5.43	0.35	0.77	0.69	0.20

Table D.2.7 Results of Soil Analysis : Soil misture retension (1)

No.	Dam	Pit No	Soil series	Depth cm	Bulk density g/cm3	Soil moisture retension 0.1 bar Qm	0.3 bar Qm	15 bar Qm	Plant Avalble Qv
1	Wali Dad	Wld-1	Zard	0-9		0.275	0.202	0.090	
1	Wali Dad	Wld-1	Zard	9-25	1.606	0.261	0.194	0.087	0.171
1	Wali Dad	Wld-1	Zard	25-61	1.536	0.232	0.169	0.083	0.132
1	Wali Dad	Wld-2	Sariab	0-12					
1	Wali Dad	Wld-2	Sariab	12-44	1.609	0.240	0.096	0.043	0.086
1	Wali Dad	Wld-2	Sariab	44-96	1.491	0.232	0.103	0.044	0.088
1	Wali Dad	Wld-3	Quetta, marginal	0-11	1.490	0.232	0.205	0.130	0.111
1	Wali Dad	Wld-3	Quetta, marginal	11-23	1.486	0.216	0.169	0.095	0.109
1	Wali Dad	Wld-3	Quetta, marginal	23-91	1.543	0.250	0.205	0.102	0.159
2	Brewarry	Bry-1	Zard	0-16	1.429	0.279	0.204	0.075	0.183
2	Brewarry	Bry-1	Zard	16-32	1.464	0.255	0.204	0.085	0.175
2	Brewarry	Bry-1	Zard	32-80	1.586	0.245	0.197	0.097	0.158
2	Brewarry	Bry-2	Zard	0-10	1.525	0.262	0.164	0.075	0.136
2	Brewarry	Bry-2	Zard	10-21	1.404	0.279	0.168	0.076	0.129
2	Brewarry	Bry-2	Zard	21-79	1.624	0.287	0.194	0.108	0.141
2	Brewarry	Bry-3	Zard	0-10	1.443	0.261	0.178	0.095	0.119
2	Brewarry	Bry-3	Zard	10-21	1.553	0.247	0.179	0.103	0.118
2	Brewarry	Bry-3	Zard	21-96	1.682	0.238	0.180	0.097	0.140
3	Ghutai Shella	Gsl-1	Shamozai	0-10	1.355				
3	Ghutai Shella	Gsl-1	Shamozai	10-30	1.378				
3	Ghutai Shella	Gsl-1	Shamozai	30-56	1.377				
3	Ghutai Shella	Gsl-2	Shamozai	0-8	1.151	0.206	0.163	0.092	0.082
3	Ghutai Shella	Gsl-2	Shamozai	8-26	1.528	0.207	0.163	0.083	0.121
3	Ghutai Shella	Gsl-2	Shamozai	26-90	1.384	0.190	0.157	0.083	0.102
3	Ghutai Shella	Gsl-4	Shamozai, mottled	0-9	1.554	0.268	0.120	0.055	0.100
3	Ghutai Shella	Gsl-4	Shamozai, mottled	9-40	1.554	0.244	0.076	0.038	0.059
3	Ghutai Shella	Gsl-4	Shamozai, mottled	40-61	1.541	0.268	0.111	0.044	0.104
4	Murghi Kotal	Mgk-1	Azim	0-7		0.256	0.205	0.076	
4	Murghi Kotal	Mgk-1	Azim	7-34		0.284	0.271	0.110	
4	Murghi Kotal	Mgk-1	Azim	34-66					
4	Murghi Kotal	Mgk-2	Shamozai	0-8	1.329	0.213	0.195	0.097	0.130
4	Murghi Kotal	Mgk-2	Shamozai	8-26	1.520	0.269	0.247	0.137	0.168
4	Murghi Kotal	Mgk-2	Shamozai	26-42	1.695	0.197	0.169	0.161	0.014
4	Murghi Kotal	Mgk-3	Lajwar	0-12	1.588	0.225	0.183	0.096	0.139
4	Murghi Kotal	Mgk-3	Lajwar	12-33	1.699	0.253	0.213	0.132	0.138
4	Murghi Kotal	Mgk-3	Lajwar	33-84	1.686	0.251	0.202	0.129	0.124
4	Murghi Kotal	Mgk-4	Azim	0-11	1.735	0.247	0.209	0.118	0.159
4	Murghi Kotal	Mgk-4	Azim	11-31	1.521	0.268	0.214	0.107	0.163
4	Murghi Kotal	Mgk-4	Azim	31-79	1.719	0.247	0.211	0.133	0.134
5	Dara	Dra-4	Quetta / Quetta	0-12	1.534	0.232	0.191	0.116	0.115
5	Dara	Dra-4	Quetta / Quetta	12-50	1.853	0.198	0.172	0.097	0.137
5	Dara	Dra-4	Quetta / Quetta	50-79	1.544	0.273	0.249	0.121	0.198
6	Kach	Kch-2	Shabaq, medium	0-9					
6	Kach	Kch-2	Shabaq, medium	9-24	1.745	0.166	0.132	0.088	0.076
6	Kach	Kch-2	Shabaq, medium	24-58					
6	Kach	Kch-3	Shabaq	0-8					
6	Kach	Kch-3	Shabaq	8-23	1.607	0.210	0.186	0.114	0.116
6	Kach	Kch-3	Shabaq	23-56					
7	Bostan	Bsn-1	Shamozai / Quetta	0-15	1.402	0.254	0.175	0.050	0.175
7	Bostan	Bsn-1	Shamozai / Quetta	15-38	1.525	0.245	0.151	0.049	0.155
7	Bostan	Bsn-1	Shamozai / Quetta	38-68	1.467	0.261	0.147	0.045	0.149
7	Bostan	Bsn-2	Zard	0-13	1.563	0.201	0.131	0.050	0.126
7	Bostan	Bsn-2	Zard	13-36	1.549	0.203	0.127	0.051	0.118
7	Bostan	Bsn-2	Zard	36-79	1.454	0.222	0.133	0.061	0.105

Table D.2.8 Results of Soil Analysis : Soil misture retension (2)

No.	Dam	Pit No	Soil series	Depth cm	Bulk density g / cm3	Soil moisture retension 0.1 bar	0.3 bar	15 bar	Plant Avalble Qv
						---------- Qm ----------			
8	Tirkha	Trk-1	Barshore	0-13	1.598	0.226	0.175	0.081	0.150
8	Tirkha	Trk-1	Barshore	13-31	1.576	0.237	0.174	0.078	0.151
8	Tirkha	Trk-1	Barshore	31-82	1.505	0.252	0.170	0.044	0.190
8	Tirkha	Trk-2	Barshore	0-13	1.518	0.262	0.139	0.041	0.149
8	Tirkha	Trk-2	Barshore	13-28	1.631	0.213	0.122	0.049	0.118
8	Tirkha	Trk-2	Barshore	28-71	1.504	0.203	0.111	0.040	0.107
9	Sanazli	Snz-1	Pishine	0-11	1.717	0.196	0.089	0.055	0.059
9	Sanazli	Snz-1	Pishine	11-23	1.895	0.164	0.061	0.034	0.052
9	Sanazli	Snz-1	Pishine	23-42	1.770	0.163	0.066	0.038	0.049
10	Arambi	Amb-2	Pinakai	0-14	1.434	0.299	0.137	0.051	0.123
10	Arambi	Amb-2	Pinakai	14-58	1.351	0.322	0.120	0.043	0.104
10	Arambi	Amb-2	Pinakai	58-149	1.518	0.311	0.304	0.053	0.381
10	Arambi	Amb-3	Lajwar	0-14	1.420	0.341	0.194	0.075	0.169
10	Arambi	Amb-3	Lajwar	14-38	1.552	0.312	0.187	0.082	0.162
10	Arambi	Amb-3	Lajwar	38-107	1.408	0.364	0.182	0.049	0.186
11	Jigda	Jgd-1	Pinakai	0-11	1.545	0.213	0.152	0.053	0.152
11	Jigda	Jgd-1	Pinakai	11-22	1.608	0.215	0.119	0.043	0.123
11	Jigda	Jgd-1	Pinakai	22-76	1.588	0.241	0.218	0.073	0.229
11	Jigda	Jgd-2	Pinakai	0-11	1.607	0.239	0.212	0.080	0.213
11	Jigda	Jgd-2	Pinakai	11-37	1.600	0.231	0.196	0.082	0.183
11	Jigda	Jgd-2	Pinakai	37-132	1.458	0.290	0.175	0.047	0.187
12	Khora manda	Kmd-1	Shamozai	0-13	1.418	0.251	0.110	0.051	0.083
12	Khora manda	Kmd-1	Shamozai	13-24	1.335	0.216	0.110	0.045	0.086
12	Khora manda	Kmd-1	Shamozai	24-77	1.527	0.201	0.141	0.059	0.125
12	Khora manda	Kmd-4	Ghaza non-S&S	0-17	1.683	0.210	0.143	0.073	0.117
12	Khora manda	Kmd-4	Ghaza non-S&S	17-31	1.645	0.200	0.171	0.103	0.112
12	Khora manda	Kmd-4	Ghaza non-S&S	31-59	1.641	0.205	0.166	0.125	0.068
13	Marrium	Mrm-1	Man-made	0-12	1.608	0.261	0.261	0.222	0.063
13	Marrium	Mrm-1	Man-made	12-38	1.590	0.177	0.192	0.167	0.040
13	Marrium	Mrm-1	Man-made	38-79	1.587	0.085	0.105	0.089	0.025
14	Sakhul	Sak-1	Pringabad	0-12	1.412	0.224	0.071	0.038	0.046
14	Sakhul	Sak-1	Pringabad	12-30	1.474	0.189	0.058	0.034	0.035
14	Sakhul	Sak-1	Pringabad	30-89	1.443	0.216	0.058	0.033	0.035
15	Amch	Amc-4	Pringabad	0-13	1.550	0.252	0.111	0.056	0.085
15	Amch	Amc-4	Pringabad	13-33	1.476	0.224	0.111	0.078	0.048
15	Amch	Amc-4	Pringabad	33-82	1.482	0.198	0.085	0.050	0.052
16	Kad khucha	Kad-2	Zard	0-15	1.459	0.226	0.106	0.030	0.111
16	Kad khucha	Kad-2	Zard	15-44	1.415	0.183	0.129	0.048	0.114
16	Kad khucha	Kad-2	Zard	44-81	1.404	0.220	0.138	0.030	0.152
16	Kad khucha	Kad-3	Shamozai	0-10	1.428	0.218	0.173	0.033	0.199
16	Kad khucha	Kad-3	Shamozai	10-23	1.390	0.227	0.187	0.035	0.211
16	Kad khucha	Kad-3	Shamozai	23-69	1.265	0.227	0.169	0.028	0.179
17	Laghumgir	Lgr-3	Zard	0-12	1.434	0.324	0.118	0.047	0.102
17	Laghumgir	Lgr-3	Zard	12-27	1.410	0.319	0.118	0.047	0.101
17	Laghumgir	Lgr-3	Zard	27-43	1.409	0.321	0.146	0.057	0.125
18	Iskalku	Isk-1	Shamozai / burried	0-9	1.383	0.349	0.164	0.069	0.131
18	Iskalku	Isk-1	Shamozai / burried	9-31	1.301	0.364	0.174	0.072	0.133
18	Iskalku	Isk-1	Shamozai / burried	31-47	1.323	0.327	0.158	0.081	0.102
18	Iskalku	Isk-2	Shamozai	0-10	1.425	0.316	0.127	0.047	0.113
18	Iskalku	Isk-2	Shamozai	10-41	1.364	0.333	0.133	0.062	0.097
18	Iskalku	Isk-2	Shamozai	41-66	1.472	0.260	0.159	0.081	0.114
20	Mangi	Mgi-4	Kaftari	0-14	1.521	0.205	0.160	0.078	0.124
20	Mangi	Mgi-4	Kaftari	14-41	1.688	0.202	0.143	0.089	0.090
20	Mangi	Mgi-4	Kaftari	41-77	1.614	0.199	0.108	0.055	0.086

Table D.2.9 Results of Soil Analysis : Infiltration rate

No.	Dam	Soil Series	Pit#	R	Depth	Time	Intake	Infiltrn	K-best	K-max	Phi-best	Phi-max
					cm	min	cm/min	cm/min	cm/h	cm/h	cm^2/h	cm^2/h
1	Wali Dad	Zard	Wld-1	1	0-9	6	0.367	0.095	1.440	2.988	12.240	23.400
1	Wali Dad	Zard	Wld-1	1	9-25	18	0.067	0.017	0.263	0.540	2.196	4.320
1	Wali Dad	Zard	Wld-1	1	25-61	21	0.100	0.026	0.396	0.828	3.312	6.480
1	Wali Dad	Quetta mgl	Wld-3	1	0-11	21	0.267	0.069	1.044	2.196	8.640	16.920
1	Wali Dad	Quetta mgl	Wld-3	1	11-23	24	0.133	0.035	0.540	1.080	4.320	8.640
1	Wali Dad	Quetta mgl	Wld-3	1	23-91	15	0.020	0.005	0.079	0.162	0.648	1.296
2	Brewary	Zard	Bry-1	1	0-8	21	0.600	0.156	2.376	4.860	19.800	37.620
2	Brewary	Zard	Bry-1	1	8-20	24	0.433	0.113	1.710	3.618	14.220	28.260
2	Brewary	Zard	Bry-1	1	20-38	21	0.367	0.095	1.458	2.934	12.060	23.400
2	Brewary	Zard	Bry-3	1	0-15	30	0.383	0.100	1.530	3.132	12.780	24.480
2	Brewary	Zard	Bry-3	1	15-30	21	0.117	0.030	0.455	0.954	3.798	7.560
2	Brewary	Zard	Bry-3	1	30-45	15	0.030	0.008	0.119	0.245	0.990	1.926
3	Gh Shela	Shamozai	Gsl-2	1	0-23	21	1.133	0.294	4.320	9.360	36.000	72.000
3	Gh Shela	Shamozai	Gsl-2	1	23-60	39	1.100	0.286	4.320	9.000	36.000	72.000
3	Gh Shela	Shamozai	Gsl-2	1	60-100	14	1.700	0.442	6.840	14.040	57.600	108.000
3	Gh Shela	Shmzi-mtl	Gsl-5	1	0-20	16	1.300	0.338	5.040	10.620	43.200	82.800
3	Gh Shela	Shmzi-mtl	Gsl-5	1	20-40	32	1.375	0.357	5.580	11.340	46.080	88.200
3	Gh Shela	Shmzi-mtl	Gsl-5	1	40-55	26	1.250	0.325	5.040	10.080	39.600	79.200
4	Murgi Kotal	Lajwar	Mgk-3	1	0-15	21	0.133	0.035	0.527	1.080	4.338	8.640
4	Murgi Kotal	Lajwar	Mgk-3	1	15-30	33	0.100	0.026	0.396	0.828	3.312	6.480
4	Murgi Kotal	Lajwar	Mgk-3	1	30-45	27	0.065	0.017	0.257	0.536	2.160	4.194
4	Murgi Kotal	Azim	Mgk-4	1	0-15	45	0.367	0.095	1.458	2.934	12.060	23.400
4	Murgi Kotal	Azim	Mgk-4	1	15-30	27	0.167	0.043	0.666	1.350	5.400	10.800
4	Murgi Kotal	Azim	Mgk-4	1	30-45	39	0.133	0.035	0.522	1.098	4.356	8.640
5	Dara	Lajwar	Dar-5	1	0-15	6	0.067	0.017	0.263	0.540	2.196	4.320
5	Dara	Lajwar	Dar-5	1	15-30	30	0.080	0.021	0.317	0.648	2.628	5.040
5	Dara	Lajwar	Dar-5	1	30-45	15	0.033	0.009	0.133	0.274	1.116	2.124
7	Bostan	Zard	Bsn-2	1	0-15	33	0.200	0.052	0.792	1.620	6.480	12.960
7	Bostan	Zard	Bsn-2	1	38-68	9	0.217	0.056	0.864	1.764	7.020	13.860
8	Tirkha	Barshore	Trk-1	1	0-20	27	0.283	0.074	1.116	2.322	9.360	18.180
8	Tirkha	Barshore	Trk-1	1	20-50	18	0.517	0.134	2.052	4.158	17.100	32.580
8	Tirkha	Barshore	Trk-1	1	50-80	21	0.400	0.104	1.584	3.348	13.320	25.560
8	Tirkha	Barshore	Trk-6	1	0-15	21	0.500	0.130	1.980	3.960	16.560	32.040
8	Tirkha	Barshore	Trk-6	1	15-30	15	0.767	0.199	3.024	6.120	25.200	50.400
8	Tirkha	Barshore	Trk-6	1	30-45	2	0.500	0.130	1.980	3.960	16.560	32.040
8	Tirkha	Barshore	Trk-6	1	30-45	14	0.900	0.234	3.564	7.200	29.880	57.600
9	Sanzali	Pishin	Snz-5		0-38	4	0.500	0.130	1.980	3.960	16.560	32.040
9	Sanzali	Pishin	Snz-5		38-58	7	0.033	0.009	0.133	0.274	1.116	2.124
10	Arambi	Pinakai	Amb-2	1	0-15	18	0.067	0.017	0.263	0.274	2.196	2.124
10	Arambi	Pinakai	Amb-2	1	15-45	25	0.020	0.005	0.079	3.960	0.648	32.040
11	Jigda	Pinakai	Jgd-2	1	0-15	9	0.033	0.009	0.133	0.274	1.116	2.124
11	Jigda	Pinakai	Jgd-2	1	20-45	20	0.040	0.010	0.158	0.328	1.332	2.556
11	Jigda	Pinakai	Jgd-2	1	45-65	10	0.060	0.016	0.238	0.504	1.980	3.960
12	Kh Manda	Shamozai	Kmd-1		0-13	18	0.667	0.173	2.628	5.400	21.960	43.200
12	Kh Manda	Shamozai	Kmd-1		13-24	12	0.800	0.208	3.168	6.480	26.280	50.400
12	Kh Manda	Shamozai	Kmd-1		24-77	14	1.300	0.338	5.040	10.800	43.200	82.800
12	Kh Manda	Ghaza	Kmd-4		0-17	21	0.067	0.017	0.263	0.540	2.196	4.320
16	Kd Kocha	Zard	Kdk-2	1	0-15	12	0.800	0.208	3.168	6.480	26.280	50.400
16	Kd Kocha	Zard	Kdk-2	1	15-30	14	0.750	0.195	2.988	6.120	24.840	46.800
16	Kd Kocha	Zard	Kdk-2	1	30-50	12	1.250	0.325	5.040	10.080	39.600	79.200
17	Laghmgir	Shamozai	Lgr-1	1	0-23	28	1.100	0.286	4.320	9.000	36.000	72.000
17	Laghmgir	Shamozai	Lgr-1	1	23-60	11	1.500	0.390	6.120	12.240	50.400	97.200
17	Laghmgir	Shamozai	Lgr-1	1	60-100	6	0.700	0.182	2.772	5.760	23.040	43.200
18	Iskalkoo	Sariab	Isk-3	1	0-9	42	0.500	0.130	1.980	3.960	16.560	32.040
18	Iskalkoo	Sariab	Isk-3	1	9-22	18	0.100	0.026	0.396	0.828	3.312	6.480
18	Iskalkoo	Sariab	Isk-3	1	22-104	50	0.010	0.003	0.040	0.083	0.331	0.648

Table D.3 Crop Suitability Factors and the Suitability Rating of the Soils (1)

Soil	Depth	Drainage	Slope and land-form	pH	Texture#	Permeability	WHC* cm/75cm	Crop	Suitability
Azim	very deep	mod. well drained	Level area in piedmont basin and playas	8.0	sil	very slow	10.9	Wheat	1
								Barley	2
								Maize	2
								Melons	3
								Vegetable	2
								Apple	3
								Grape	3
Bashore	deep - mod deep	mod. well drained	nearly level to very gently undulating piedmont	8.0	vf sl	slow	12.3	Wheat	1
								Barley	1
								Maize	1
								Melons	1
								Vegetable	1
								Apple	1
								Grape	1
Hathiari	deep - very deep	well drained	level to nearly level piedmont plain	8.4	vf sl	moderate		Wheat	1
								Barley	1
								Maize	1
								Melons	1
								Vegetable	1
								Apple	1
								Grape	1
Kaftari	deep - very deep	well drained	nearly level to gently sloping in piedmont plain	8.2	vf sl / sil	moderate	7	Wheat	1
								Barley	1
								Maize	1
								Melons	1
								Vegetable	1
								Apple	1
								Grape	1

Table D.3 Crop Suitability Factors and the Suitability Rating of the Soils (2)

Soil	Depth	Drainage	Slope and land-form	pH	Texture#	Permeability	WHC* cm/75cm	Crop	Suitability
Lajwar	deep - very deep	well drained	level to nearly basin	8.2	sicl	moderately slow	9.8	Wheat	1
								Barley	1
								Maize	1
								Melons	2
								Vegetable	1
								Apple	1
								Grape	1
Pinakai	deep - very deep	well drained	level to very gently undulating piedmont plain	8.0	vf sl/sil	moderate	12.8	Wheat	1
								Barley	1
								Maize	1
								Melons	1
								Vegetable	1
								Apple	1
								Grape	1
Pishin	deep	excessively drained	gently & very gently undulating area	8.0	l f sl	rapid	3.8	Wheat	2
								Barley	2
								Maize	2
								Melons	2
								Vegetable	2
								Apple	3
								Grape	3
Pringabad	deep - very deep	well drained	nearly level area in high piedmont terraces	8.2	vf sl	moderately high	2.8	Wheat	1
								Barley	1
								Vegetable	1
								Maize	1
								Melons	1
								Apple	1
								Grape	1

Table D.3 Crop Suitability Factors and the Suitability Rating of the Soils (3)

Soil	Depth	Drainage	Slope and land-form	pH	Texture#	Permeability	WHC* cm/75cm	Crop	Suitability
Quetta	very deep	well drained	level to gently level in area undulating in piedmont	8.0	sil	moderately slow	10.8	Wheat	1
								Barley	1
								Maize	1
								Melons	1
								Vegetable	1
								Apple	1
								Grape	1
Sariab	deep	well drained	level to gently sloping in the piedmont	8.0	sil/vf sl	moderately rapid	6.5	Wheat	2
								Barley	2
								Maize	2
								Melons	2
								Vegetable	2
								Apple	1
								Grape	1
Shamozai	moderately deep	well drained	nearly level close to apron of alluvial fan	8.0	vf sl/sil	moderate	7.8	Wheat	1
								Barley	1
								Maize	1
								Melons	1
								Vegetable	1
								Apple	1
								Grape	1
Zard	v deep -v deep	well drained	nearly level to level in the piedmont plain	7.9	vf sl/sil	moderate	10.5	Wheat	1
								Barley	1
								Maize	1
								Melons	1
								Vegetable	1
								Apple	1
								Grape	1

*, WHC plant available water holding capacity;
#, Texture: sil, silt loam; vf sl, very fine sandy loam; sicl, silty clay loam;

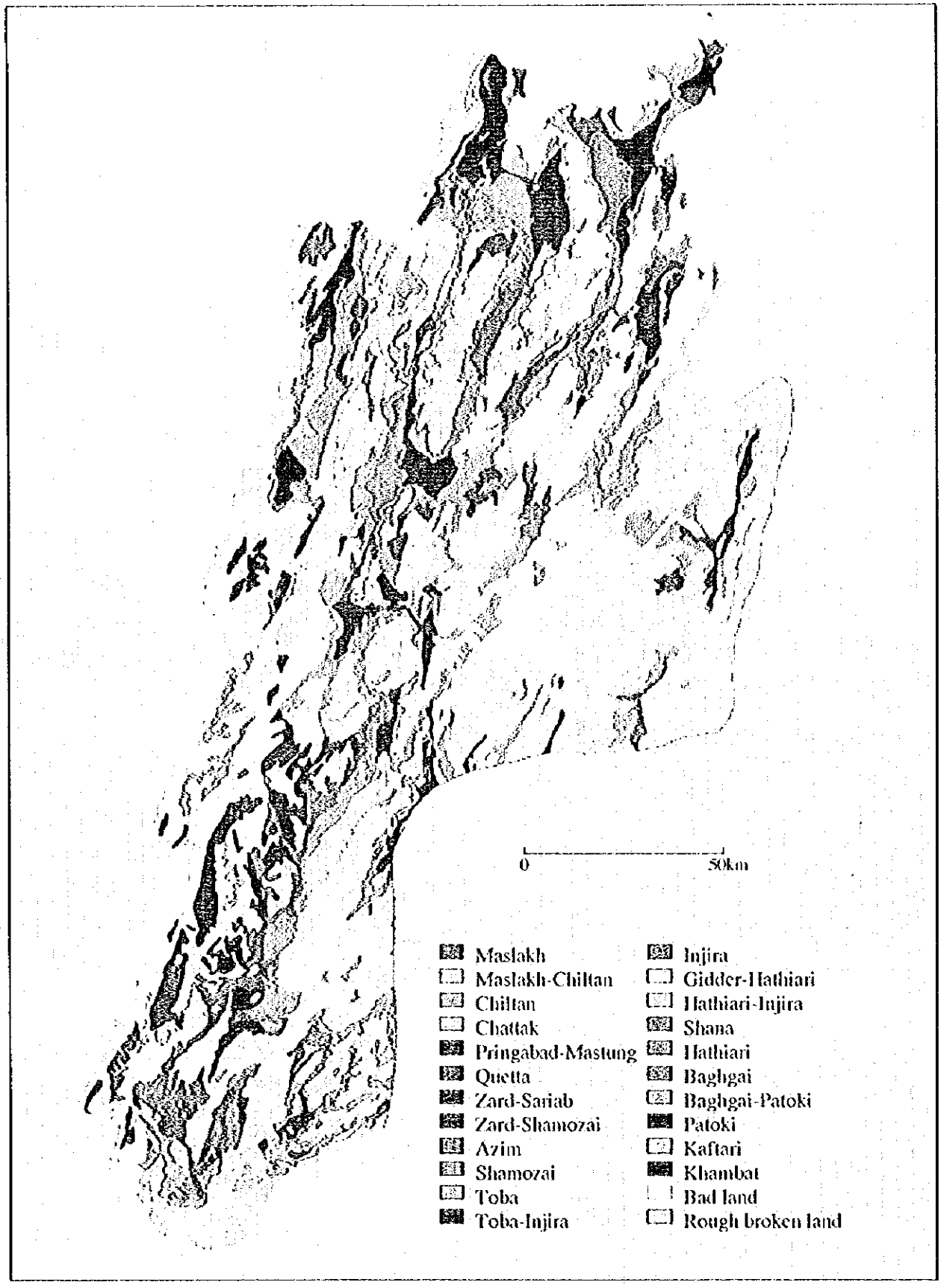

Fig. D-2 Soil Map of the Study Area (Mastung and Kalat Districts)

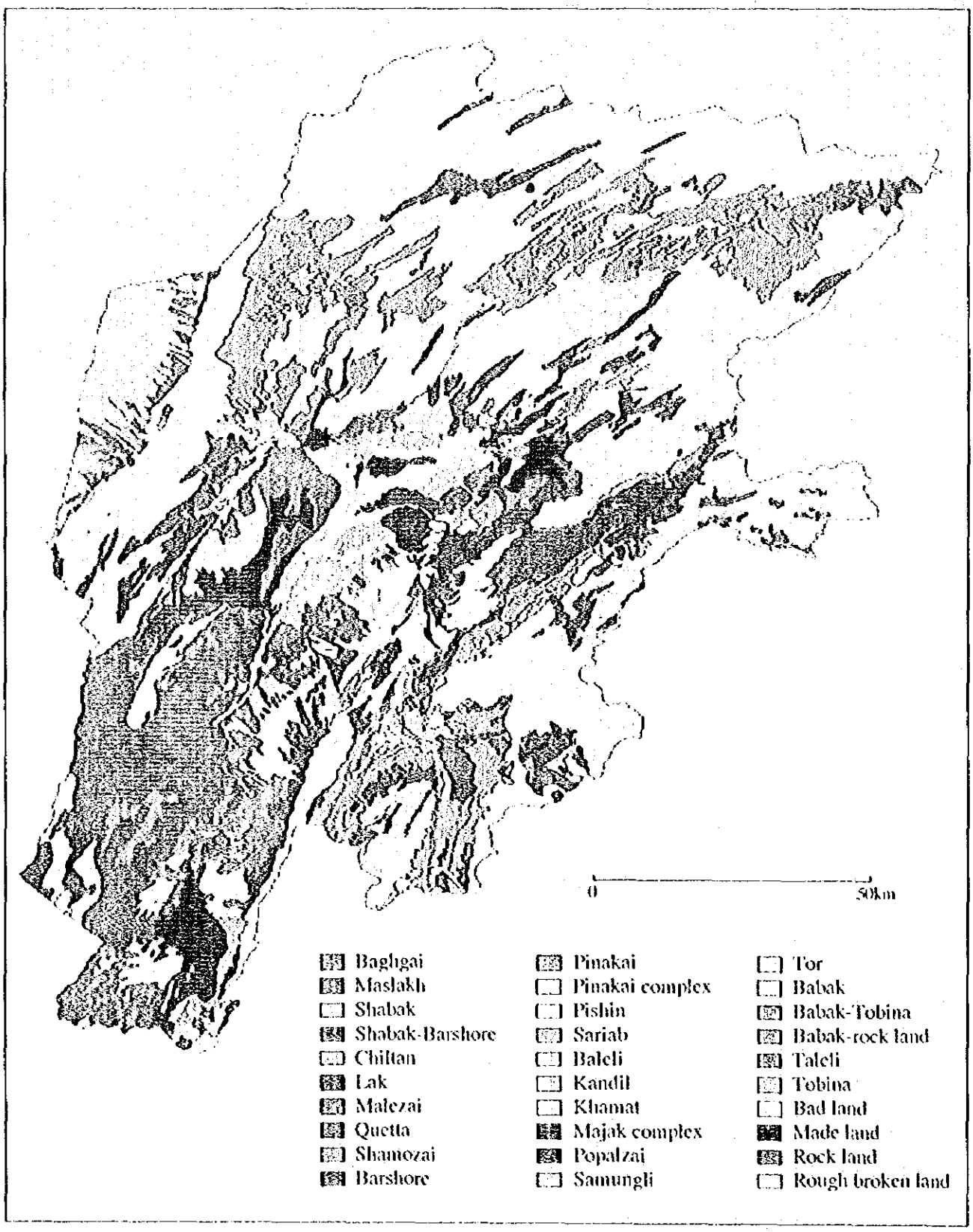

Fig. D-1 Soil Map of the Study Area (Quetta, Pishin and Qila Abdullah Districts)