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Discussion Paper No. 606

Water/Pasture Assessment of Registan Desert
(Kandahar and Helmand Provinces)

by
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October 2005

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The desolate desert in Afghanistan's Kandahar and Helmand Provinces was previously populated by thousands of pastoralists until a devastating drought decimated animal herds and forced them to live as IDPs (Internally Displaced Persons) on land bordering the desert. Through funding from UNAMA (United Nations Assistance Mission in Afghanistan), this report assesses conditions in the Registan Desert and border regions to devise solutions to the problems facing Registan Kuchi nomads. A work plan is provided for putting all scientific and practical efforts into immediate action for range rehabilitation programs and agro-pastoralism development in contiguous desert/semidesert areas such as Panjwayi, Maiwand, Takteh Pol and Garmsir (Kandahar and Helmand provinces).

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Kuchi Nomads in the West of Heart, 2003

Kuchi Nomads in Registan

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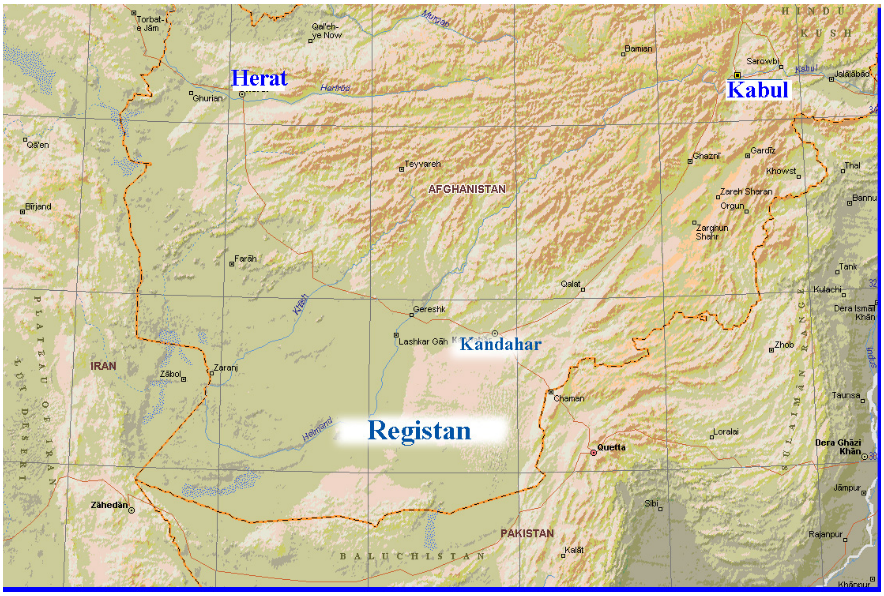
Kuchi Ladies, 2003



Registan Area

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INTRODUCTION

Through funding from UNAMA (United Nations Assistance Mission in Afghanistan) and Central Asia Development Group (CADG) in 2004 was conducted detailed survey of water resources and rangeland productivity of the Registan Desert (Kandahar and Helmand Provinces), which has suffered from drought for the past five years. As a result of this drought, vast territories of the Registan Desert previously populated by thousands of Kuchi nomads were entirely ruined due to lack of water resources and the death of livestock. Registan Kuchi nomads now reside in IDP (Internally Displaced Person) camps or smaller settlements in the Kandahar and Helmand Provinces. The main goal of the present study is to determine the current state of vegetation, rangeland resources, its carrying grazing capacity, and water sources in the Registan desert.

Analysis of the area was designed to compare environmental trends by contrasting frequency distribution of grazing intensity, grass and woody cover, floristic and botanical identification, and age population structure. Pasture assessment work was based on Kuchi migration patterns that were abandoned or disrupted. Existing wells and previous grazing areas through Registan were used to determine the focus (key resources sites) points for the rebuilding of nomadic pastoralism or agro-pastoralism development.

During the initial research stage, the majority of information on current and prior conditions within Registan Desert came from Kuchi interviews within the four main IDP camps in Kandahar Province. Kuchi nomads were interviewed over numerous visits to collect valuable data on previous grazing capacity, migration routes, pastoral traditions, well distribution and their current conditions, tribal relations and income generation. Focus groups were held in the camps over several months with the later involvement of visiting consultants. Research information based on these interviews was often unreliable as the Kuchi currently living in the four IDP camps (Marghar, Talukan, Moshan and Qala-e-Shamir) were routinely dishonest in their answers. Attempts to ascertain information on previous grazing capacity, well usage, and income generation through interviews were very difficult.

This study was carried out in close collaboration with Kuchi leaders, Afghan government ministries, UN agencies, and other NGOs.

Keywords:

Afghanistan, Kuchi, IDP, Kandahar, Helmand, Agriculture, Desertification, Farming system, Irrigation system, Water quality

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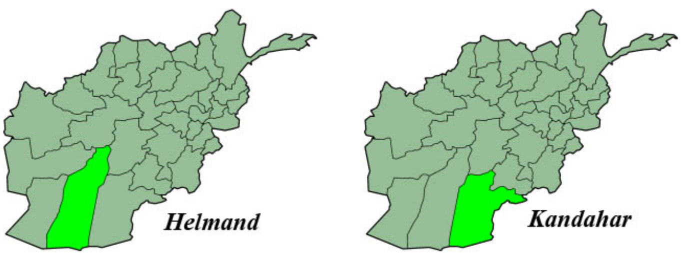
MAIN OBJECTIVES

- to study the physical-geographical features of the Registan sandy desert
- to provide a geo-botanical description of different types of pastures in the Registan desert
- to determine the botanical diversity of flora of the Registan desert; make a collection of herbarium
- to estimate the current state of pastures, its grazing resources and grazing capacity
- to analyze some parameters of water quality (drinking, underground, surface etc.) from the territory of sandy desert and adjacent irrigated lands
- to evaluate the situation of irrigation networks and technologies currently used for crop farming in both Kandahar and Helmand Provinces for possible expansion
- to test the operations/techniques of direct seeding of some non-native desert fodder plants both in field experimental plots and development operations of a transplant nursery
- to examine opportunities for the cultivation of drought tolerant plants in the region
- to establish experimental demonstration plots for seeding/testing of drought tolerant plants from desert/semidesert areas of Central Asia
- to set up an work plan for range rehabilitation and agro-pastoral development



Southwestern Provinces of Afghanistan

I. STUDY AREA

Phytogeographical characteristics and phytogenetic resources of Registan Desert

Phytogeographically, the greater part of Afghanistan belongs to the West and Central Asiatic region and the southern lowland belongs to the African-Indian Desert region.

The southwestern plateau of Afghanistan, known as Registan Desert (with a total area of about 24,000 km^2) and Dasht-e-Margo (Desert of Death: 11,500 km^2 located north of the Helmand River Basin) from ancient times was home to thousands of different nomadic tribes. However, recent several years of drought decimated up to 90% of livestock herds and forced Registan's pastoralists to give up their traditional way of life. Most of the Registan (Balkh and Pashtun) Kuchi moved out of their traditional lands and now live in IDP camps. There should be no attempt to return nomadic people of southern Afghanistan to their point of origin without an extensive assessment of water sources, pastures, and vegetation of the Registan Desert. Rehabilitation of the area will also require a re-thinking of restocking efforts and management of livestock production to ensure successful rebuilding of their livelihood conditions. The Registan desert has received little study but supports an impressive range of desert biotopes from sand dunes to gravel plains and semi-desert scrub.

II. STUDY METHODS

- Comparative analysis on environmental trends in the desert of Registan (Helmand and Kandahar Provinces, southwestern Afghanistan) by contrasting grazing intensity, grass and woody cover, floristic and botanical identification, and age population structure.
- Kuchi interviews within the four main IDP camps in Kandahar Province to collect data on previous grazing capacity, migration routes, pastoral traditions, well distribution and their current conditions, tribal relations, and income generation. Some Kuchi ideas, recollections, and visions are summarized and presented in the Appendix 1.
- Years of international donor assistance has produced a dependency that encourages Kuchi IDP to give false information to NGO researchers. Later interviews were conducted in Registan Kuchi settlements in the Garmsir district of Helmand Province.
- Analysis of parameters of water quality (drinking, underground, surface etc.) from the territory of sandy desert and adjacent irrigated lands
- Test of operations/techniques of direct seeding of some non-native desert fodder plants both in field experimental plots and development operations of a transplant nursery

III. STUDY SITES

The pastoralists used southwestern regions of the Registan Desert for centuries. All selected areas were assessed to be generally similar in terms of soils, landscapes, and vegetative biomass capacity. Sites were initially mapped using GPS coordinates and GIS technologies to delineate the well location and current status (water table level, width/length, salinity, EC, DO, ions contents, pH, etc.). A database of wells clusters within Registan Desert is under construction. Quantification of range ecology variables in each site was based on an ocular survey method developed by Russian methodology that employed up to 5 – 10 sample point intercepts of 5m x 10m (Gaevskaya et al, 1975). Each site was described in terms of percent of canopy cover (percentage occupied by plants) for the herbaceous and woody layers, density of plants (no/ha), floristic and botanical species diversity, etc. Random sampling of plants was used to estimate the vegetation biomass and rangeland productivity.

A. Current Characteristics of Soils of Registan Desert

Vast areas of the surveyed territories in Kandahar and Helmand Provinces are covered by immature soils, derived from unconsolidated materials, such as gravel, rocks, or sand. We find here almost all variety that was described previously by Zohary (1973) in the sense of geomorphology and desert types: hammadas, serirs, regs, ergs, nebkhas, takyrs and playas- each in a variety of forms. Very shallow depressions and clay flat plains of this region are developed by intensive deflation or by neo-techtonic movement and represent barren deserts incapable of supporting any plant life. Halomorphic soils may occur on various substrates such as loams, loess, and sand, but often they are limited to alluvial lowlands and basins of Helmand, Farah, Arghandab, and Tanaka dryrivers banks with very fine-textured parent materials. The cemented compounds are mostly calcium carbonate or calcium sulfate, but also salts of sodium- chloride as in the case of Takteh Pol (fig. 1, 2).

Figure 1. Halomorphic soils with a fine-texture on the dry banks of Tanaka River

Figure 2. Cemented compounds of mineral salts on the surface of soil in the Takteh Pol

Sandy deserts soils have a low humus content (0.2-0.4%), high water infiltration rate, insignificant mobile substrate, condensation ability, and a low salinity. Nevertheless, the gradually sedimentation of clay particles from adjoining marginal irrigated lands decrease the deflation of sands as well as improve water (moisture) holding capacity of soil, promoting the large accumulation of humus and nutritional elements into the soil. Therefore marginal grounds are considered best for any sandy desert reclamation program.

Moreover, the sandy substrate of the Registan Desert differs from other substrate by a more favorable water regime that provides a long period of growth for the vegetation because of easily available stored water in the soil profile, especially in the winter/early spring period. Conversely, a number of negative aspects affect the plant cover on sandy soils such as sand mobility. This limits plant establishment, especially at the early stage of ontogenesis, producing poor soil structure and low organic matter. It is easily loosened under trampling by grazing livestock. It is also subject to high temperature as this is the case during the dry, hot summer/early autumn. This particularity of sandy soil in desert environment of Registan induces the formation of a special ecological group of plants. The psammophytes that may include all kinds of plant forms.

Soil loss, however, is the primary cause of range degradation. This is because in most areas of the Registan Desert, especially in Garmsir areas (southeast of Lashkar Gah), the rate of soil erosion is faster than the rate of soil formation. Little data is available on soil characteristics of the Registan Desert: rate of soil loss and the effect of this on rangeland degradation, plant communities and its botanical diversity. Nevertheless sandy, nutrient-poor soils produce vegetation which is relatively stable in its productivity- both palatable and unpalatable, but resistant to herbivore grazing pressure. Range types on this soil may be relatively less exposed to degradation.

Soils full of ephemeroid-Artemisia herbae-alba steppes on the large territories both in Kandahar and Helmand Provinces exhibit the opposite characteristics-instability of mass production (under fluctuating rainfall), high feed palatability, and high animal stock densities. It is important to remind that both of these soils types are prone to compaction.

In layman terms, the most important characteristics are the presence of mobile sand dunes, separated by hammadas (small stone covered soils with varying slopes) that protect relatively stable sandy and loess soils. The hammadas are relatively free of vegetation and are important as being conducive to water runoff for potential water collection when there are rainfall events of sufficient intensity. The sandy and loess type soils are those that support the more important (for livestock) desert-type vegetation that has been collected, identified and classified for this report.

According to the opinion of Ghani Ayubi (unpublished data) soils of Helmand Province give good indicators of soil quality in the region. They have been developed under warm, very dry conditions and most of the mineral material released during the weathering process of parent material have not been removed from the soil and have accumulated in soil profiles. Soils of Helmand Province mainly belong to the following great soil groups: a) Calciorthids, b) Camborthids, c) Torriorthids, d) Gypsorthids, e) Torripsamments. The most important characteristics and properties of Helmand soils in relation to agriculture and crop growth can be briefly described as follows:

They are generally low in organic matter and nitrogen.

They are mainly alkaline in reaching with pH usually 8.0-8.5 (average 8.2)

They are mainly calcareous and usually contain high quantities of calcium carbonate (lime).

Soil fertility is usually good, expect in the case of nitrogen, available phosphorus and some micronutrients.

Soil of Helmand Province widely varies in texture. They vary from coarse-textured to fine-textured soils. The most common textural classes in different areas are as follows:

Nad-Ali – Sandy loams, sandy clay loams, silt loams, silty clay loams, clay loams.

Marja – Sandy clay loams, clay loams, and sandy loams.

Nawa – loams, silt loams, sandy loams, silty clay loams, and loamy sand.

Darweshan – loams, silt loams, sandy loams, silty clay loams, and loamy sand.

Garmsir – Sandy loams, loams, loamy sands, silt loams, and clay loams.

Kajaki – Silty clay loams, clay loams, silty clay.

Seraj – Silt loams, silty clay loams.

Soils of Helmand Province are generally under-laid by an impermeable compact layer of conglomerate and/or other cemented material with the associated problem of poor drainage and high water table.

Most soils (central and lower Helmand) have salinity and/or alkalinity problems with varying degrees.

Soil erosion, particularly by wind, is a serious problem in central and southwest Helmand. Soil erosion by water is serious in north Helmand with relatively steep slopes.

They are generally under-laid by an impermeable compact layer of conglomerate and/or other cemented material with the associated problem of poor drainage and high water table. Most soils (central and lower Helmand) have salinity and/or alkalinity problems with varying degrees. Soil erosion, particularly by wind, is a serious problem in central and southwest Helmand. Soil erosion by water is serious in north Helmand with relatively steep slopes.

Results of soil samples analyses from various districts are in Table 1-2 (Appendix 2).

B. Current Climatic Data of Registan Desert

The southwest region of Afghanistan, including Registan Desert, is characterized by extremely continental arid climate with some subtropical elements. Only a short period of the year exhibits less than thirty days with minimum temperature below 0 °C. It is usually in January that the mean monthly minimum of temperature rises above 0 °C (1.5-7.8 °C) and where the mean monthly maximum temperature (21 °C) is high enough to enable plant growth. On the other hand, from May to September more than 80 days per year are reported with an average temperature exceeding 45 °C and absolute maximum around 52 °C.

As seen from table 3, 4, 5 & 6 (Appendix 3) the main monthly relative humidity at Helmand districts varies from 16 .0 to 86.0 (in February). The relative humidity appears to have a positive relationship with rainfall. The high mean of relative humidity was registered between December and April, i.e. the period during which the differences between maximum and minimum relative humidity was low. This allows an environment favorable to plant growth in the desert.

The rainfall data was summarized and compared for three regions. As is shown from figure 3 and tables 5 & 6 the precipitation varies greatly within years and regions. The chart depicts the monomodal distribution of the precipitation that varies from 78-100 mm in Lashkar Gah (lower Helmand region), 100-190mm in Kajaki (upper Helmand region) and 90-185 mm in Kandahar Province respectively.

The rainfall data indicates that the studied areas of Registan desert receive some light precipitations in December and continuation until May. The main annual rainfall is very low in summer season and with a peak rating month being in January.

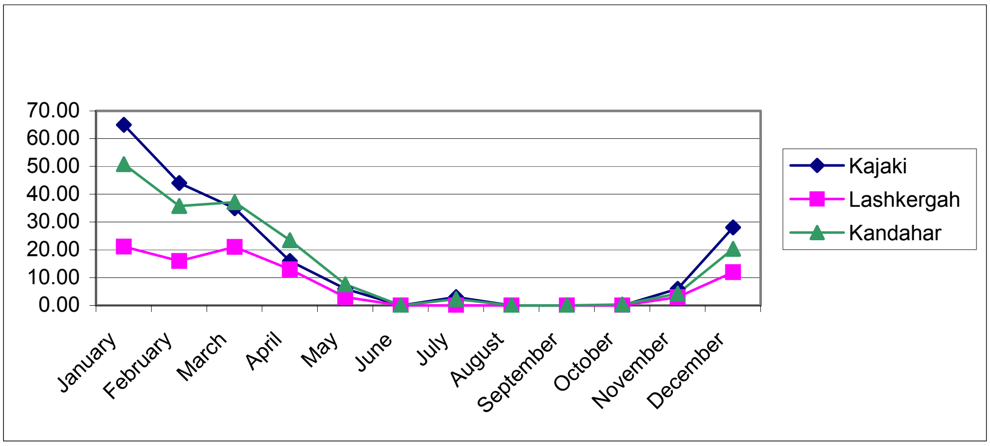


Figure 3. Dynamics of precipitation (rainfall) in different regions of southwestern Afghanistan

The thermal graph (figure 3, 4) is based on the assumption that the dry period is roughly defined (Le Houerou 1995) and clearly shows that monthly precipitation in mm is smaller than 2T (mean monthly temperature in °C). From this graph, it can be seen that the dry season starts in late April –mid of May and extends throughout the summer until late autumn precipitation. The summer until late autumn continues to be extreme dry and hot. Thus, the relative humidity is low with annual means 50-76% or even lowers (30-45%).

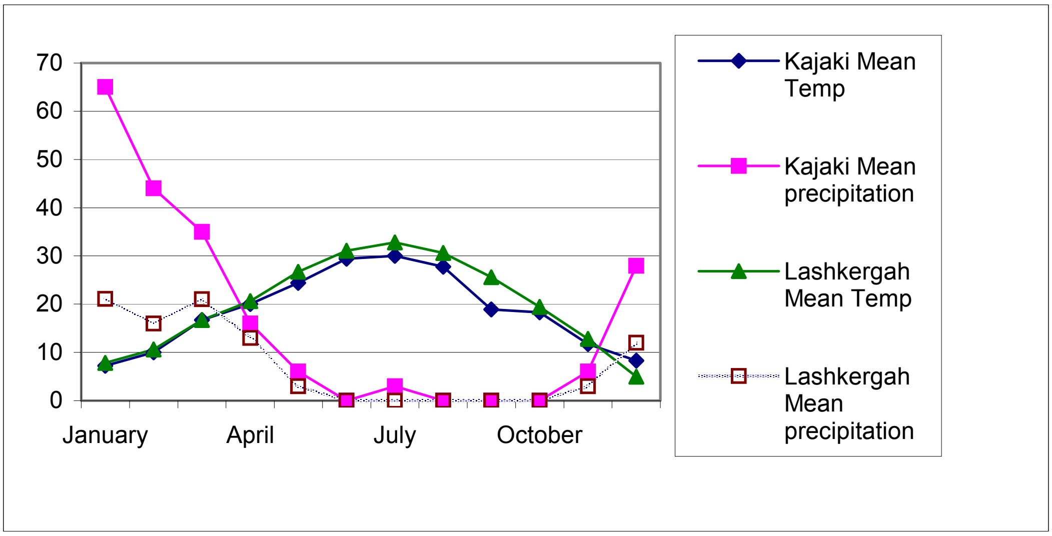


Figure 4. Changes of Rainfall in Relation to Temperature (Southwestern Afghanistan).

The potential evapotranspiration (PET) calculated based on Hangreaves method ranged from 73.0 (January) to 459.0 mm/month (July) with an annual of 2,927.0 mm. The moisture availability index values indicate that the water supply exceeds the water need for two months (October & November) and during the rest of the ten months, the supply is less than the PET value. Thus, the precipitation a PET estimates clearly shows that the natural moisture is completely insufficient for the active plant growth on the pastures, especially in Garmsir areas.

In conclusion, the climate of most Registan desert areas may be classified as being at the limit of the arid and hyperarid environments with precipitations during the cold periods and near-total summer drought. This has a clear impact on cover vegetation, which is essentially winter-early spring active with the development of perennial grasses and biannual –hemicryptophytes (with buds on or slightly above the soil surface represented by bunch or tussock grasses, e.g. Stipagrostis, Festuca spp., Stipa parviflora, Carex physodes., C. pseudofoetida, Scirpus vulpinicolor, Poa bulbosa. etc.) and therophytes also called 'ephemerals', as they live for only a short time during spring, e.g. Malcolmia africana, var. intermedia, Bromus spp., Eremopyrum spp., Plantago spp., Mathiola spp., Merendera persica, Heliotropium eichwaldi, Citrullus colocynthus, Astragalus spp., Halarchon vesiculosus, etc.). Most interesting what is the early development of perennial woody plants, especially species of genus Calligonum, Astragalus etc. that in the second week of April are in the fruit maturation stage-almost finishing its cycle of vegetation. The dominant agricultural system here is strictly nomadic and transhumant pastoralism. If the vegetation is destroyed in this hyperarid environment, there is little likelihood of regeneration.

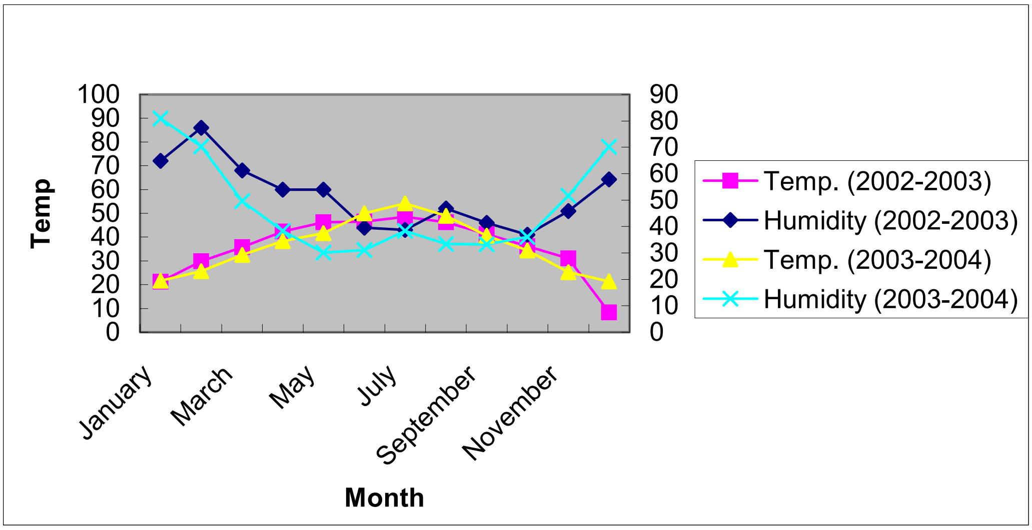


Figure 5. Comparative Data of Temperature & Relative Humidity at CADG Lashkar Gah

It is also notable from figures 4,5 the lowland and desert regions in the Kandahar Province as determined by records for last two years receives much more precipitation and is less arid than the Helmand region of Registan- which is characterized by poor pasture vegetation.

C. Water Quality Data

As part of this study, water sources in Registan were assessed in terms of their ability to function and the level of needed repairs. After five years without maintenance, the most water sources have fallen into disrepair and will require extensive rehabilitation.

The issue of available water resources in Registan is by far the most critical issue for any sustained solution for the Kuchi resettlement. Unfortunately, there is not much known about the water availability in the desert areas of Registan. But from the limited information available, and in light of the fact that basically all hand-dug wells are used to supply water, one might conclude that under the desert of Registan there are very large water resources. Of course, without a serious hydrology survey and well tests it is not possible to reach clear answers regarding critical issues such as potential discharge from deep mechanical wells, the rate of flow of the underground water, the source of the water and the quality. Due to transportation conditions, this type of work will need increased infrastructure in the area. Since very little water was ever pumped in the Registan Desert, there is a fair possibility that large quantities of water might be available for people, livestock and even agriculture. Such water, however, will need to be pumped by modern wells from depth of at least 100 meters as is done in other desert areas around the world.

The southwestern region of Afghanistan, including the Registan desert, is drained by the Furah Rud, Khash Rud, Helmand, Arghandab, and others small rivers which discharge into the swampy inland lakes at the Afghan-Iranian border. In the provinces there are 3 basic water sources: surface water available from rivers; water from diversion canals; and ground water. The water is accessible by tube wells; bore hole wells and horizontally inclined wells known as *karezs.*

Long-term intensive irrigation of lands, lack of engineering control on watering process and bad operation of collector-drainage network has lead to the deterioration of soil conditions. Besides, water losses in the territories investigated by us were on the increase. The efficiency (the proportion of water diverted from rivers or other sources that actually reaches the fields) averages around 60 % for all regions.

The predominance in this region (mainly in Helmand Valley) of earth irrigation channels with a high rate of silt and filtration (seepage into the ground), rather than lined or piped channels, accelerates the degradation of lands significantly.

Detailed water quality from various sources (surface water, open canal, drinking water and collector-drainage water) and for different areas is given in tables 9-11 (Appendix 3). It was found that the pH of the water is neutral to slightly alkaline. The water is safe for use with proper drainage for agriculture crop production and minor to medium plugging problems are expected in the irrigation system. Mineral substances such as carbonates, bicarbonates, calcium and magnesium in high amount will lead to precipitation problems in irrigation system distribution networks and can clog irrigation emitters.

The data on water quality parameters of irrigation water from different wells in suggests that the EC and SAR values are low. The water sources in the surveyed districts represent C2 Salinity and S1 Sodocity Class. Such salinity is suitable for traditional crops, except for very low salt tolerant species. In wells the water quality ranged from low (C3 salinity and S1 Sodocity Class) to high (C3 salinity and S4 Sodocity Class). Problems may be encountered in use of some wells for irrigation, but much of them may be suitable.

Surface water from Helmand River and canal originated from this river is relatively good for farming system development in the region. Poor management of collector-drainage networks and limited drainage infrastructures, as well as the lack of well-timed cleaning (from thickets of Phragmites and different plants) or de-silting work could be one of the main reasons for a rapid decrease of sown irrigated lands in Southwestern Afghanistan in the near future.

The reclamation of desert areas heavily depend on water pumping systems that are either inoperative or poorly performing in the region. Assessment of surface, drinking, and underground water quality in both surveyed provinces (Table 11) clearly shows that the waters of Lashkar Gah are characterized by medium to high salinity that could be used only on soils of moderate to good permeability. Regular leaching and special management are required. Plants with moderate to good salt-tolerance should be used for the reclamation of such desert lands. The excessive saline surface water of Arghandab River (passing as a drainage-collector canal through Registan desert areas) could not be used for the irrigation. However, the saline dry riverbanks (figures 6, 7) represent the best environment for successful development of Tamarix species.

These native Tamarix plant communities, in return, should be used for the preparation of cuttings for any forestation program or for the rehabilitation of salt-affected lands in southwestern Afghanistan.

Only two types of water sources exist in Registan-- hand-dug wells and Nawar rain catchments. The majority of wells in Registan are extremely old, possibly built hundreds of years ago. Well depth varies but many reach 150 meters. With the exception of three UNOPS-funded wells constructed in 1998-1999, the most recent well was constructed thirteen years ago. The construction of a well by traditional Kuchi methods takes at least six months under normal circumstances. The well opening is usually 1-1.5 meters wide- much smaller than hand-dug wells in other parts of the world.

Figure 6, 7. A view of Arghandab River Bank with a developed Tamarix plant community

Well sides were reinforced with wood boards from “barak” trees that previously grew in great numbers in the Registan Desert. The wood in the boards is much harder than that of the Tamarix trees that also grew in Registan. The amount of wood used in shoring up the wells varies greatly from well to well. Reinforcement is usually only needed in the sandy upper sections. Lower sections of the well usually go through more solid soil that does not require wood. Other wells on solid ground require no wood reinforcement. The only exceptions to this method are three wells in the Taghazi section of Registan that are reinforced with brick. The bricks are much more stable and completely seal the well walls from sand. Moreover, while wood rots over time, bricks are more stable. Indeed, the brick wells appeared to be very stable and to show no signs of instability or technical problems. These wells were functioning and required very little, if any, maintenance.

Nawars are large depressions that store rainwater. They are easy to construct but are entirely dependent on seasonal rainfall. Hundreds of Nawars exist in Registan and size varies greatly. Those tribes without access to wells usually leave Registan after the water in Nawars has been exhausted. Ownership of Nawars is also widely accepted in pastoralist communities. It is probable that the Nawars were conveniently utilized by grazing animals until depleted, and only then was water labor-intensively drawn for them from wells. The Nawars are a seasonal water resource and depend totally on the yearly rainfall. In other words, they are an unreliable water resource that may provide much water in some years (possibly even enough for some basic irrigation of agricultural activity around Nawars), but in other years they may be completely dry. Complete dependence on Nawars is therefore very risky. Nawars can be a major source of water in rainy years, possibly even providing enough water for some local agricultural activities to supply enough pasture for sheep and camels.

A major drawback for the Nawars is the large surface area and water evaporation. The potential rate of evaporation in the Registan Desert can be up to 3,000 mm/day. This huge potential evaporation means that the Nawars will dry out quite fast even following a rainy winter, and cannot be treated as long-term reservoirs. Some ideas for improvements to Nawars efficiency will be discussed in this report, but even in the best case, the Nawars can provide significant water only in a rainy year. Thus the Nawars are an unreliable water resource. The presence of productive wells is essential to sustain life in Registan.

The water level ranges from 20 to 120 m below land surface throughout the region, and obviously the ~20 m wells are faster and easier to recover. Nevertheless, it is impossible to estimate the yield of these wells. In other words, a 120 m well could provide more water than a 20 m well, depending on the local aquifer properties. Groundwater quality also varies slightly from well to well, regardless of depth.

Moreover, in some areas within Registan the aquifer may be high transmissible and have high storage while other areas may be underlain by very poor aquifers. It seems that comprehensive hydrological research is impossible due to the lack of wells, pumping equipment, roads and professional hydrologists. Nevertheless, some very basic tests and analyses could be very useful in the future. These include:

(1) Isotopic composition of groundwater in the existing wells, including carbon 14, carbon 13, tritium and oxygen 18. A detailed description of the meaning of these data is beyond the scope of this report; however, generally speaking, they can provide information regarding the recharge area of the local groundwater as well as the rate of replenishment. For example, data analyses could help us to understand whether the groundwater is a “dead source”, i.e., an old reservoir with no annual replenishment of water. Knowledge of the isotopic composition of groundwater could also help us decide whether the groundwater comes from one aquifer or from several independent aquifers with different recharge mechanisms and sources. A rough estimation is that a complete set of isotopic analyses costs $1,200 - 1,800 for one well. These analyses will have to be carried out in a laboratory in Europe, Canada or the US and the samples must be taken according to a specific procedure and in pre-prepared bottles.

(2) Slug or pumping tests in the existing wells would provide useful information on the amount of water that each well can provide, as well as its sensitivity to drought. Unfortunately, due to the depth

of some of the wells, heavy diesel pumps would be needed to run these tests. Additionally, pressure transducers would have to be installed during the tests. Considering the problematic accessibility to most wells, this operation is likely to be not only expensive but also technically complicated. If the funding agencies decide to carry out these tests despite the complications and costs, a more comprehensive report and complete instructions should be drawn up.

Beyond the collection of data from any rehabilitation or new drilling work, the need for a broad hydrological data base and for a water authority in Afghanistan is apparent to any professional hydrologist visiting in the area.

IV. PASTURES ASSESSMENT

The drought has destroyed the pasture in many areas where it will take several years with good rainfall and range rehabilitation efforts to recover. The regeneration of grazing land is also hindered by the collection of shrubs for firewood- often employing Kuchi from the IDP camps as labor.

A. Vegetation and Botanic Diversity

One purpose of this study was to get accurate knowledge about the flora of Registan, of which only fragmentary data has been previously published (Boissier 1869, Aitchison 1884, Kitamura 1955, Zohary 1973, Freitag 1971, Siegmar-W. Breckle 1986, etc.). According to the opinion of Siegmar-W. Breckle, plant associations are found on the desert/semidesert areas of Afghanistan today. They are often monotonous and repeat themselves over vast expanses.

Many types of vegetation can be distinguished in the Registan Desert and adjacent territories. The most dominant are:

- Psammophytic vegetation (on sand dunes and sandy fixed areas)
- Vegetation on loess (predominantly covered by typical semidesert vegetation rich in ephemerals)
- Vegetation on scree, gravel, rocks (hammada, serir, and reg)
- Desertic Vegetation, non-saline (hammada)
- Semidesert Regions (dominant by Artemisia plant communities that is common in the foothills)
- Shrubby Semidesert (only in a few areas)

Open Woodlands (semidesert with singular trees)

Vegetation of Oases and River Margins (with additional water supply)

Halophytic Vegetation (patchy distribution in the Helmand River Basin as well as in some places of Arghandab River (as in our case study figure)

Gypsophylous Vegetation (usually in desert and semidesert with semishrubs on the gypeseferous soils).

Identification of potentially suitable fodder plants starts with consideration of their taxonomy, growth form, and habitat. Kuchi nomads in the desert areas helped to determine the fodder plants, which animals graze on the pastures. Based on our fieldwork observations, plant collection as herbarium, and subsequent identification using different published references we were able to describe most common species for the Registan Desert and adjacent semideserts areas. The list of the identified species is given in the Appendix 4.

We have determined that good fodder plants that are willingly grazed or eaten by livestock represent about 40% described in this report. Along its fodder value for livestock many species could be exploited for food, industrial dyes, and medicinal (fig.8). The cash plants from our botanical survey represent about 10%. The utilization of these potential plants, however, has not started yet.

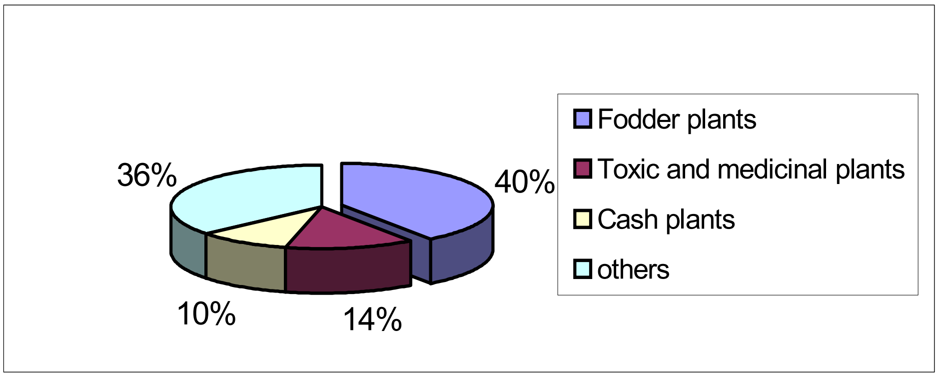


Figure 8. Different groups of Registan plants according to their significance

On figure 9, we try to represent the spectrum of main flowering families of the Flora of Registan Desert and adjacent territories. It was found that the representatives of the Poaceae, Chenopodiaceae, Fabaceae, Polygonaceae, Brasicaceae, Cyperaceae and Brassicaceae supply the largest number of satisfactory fodder plants.

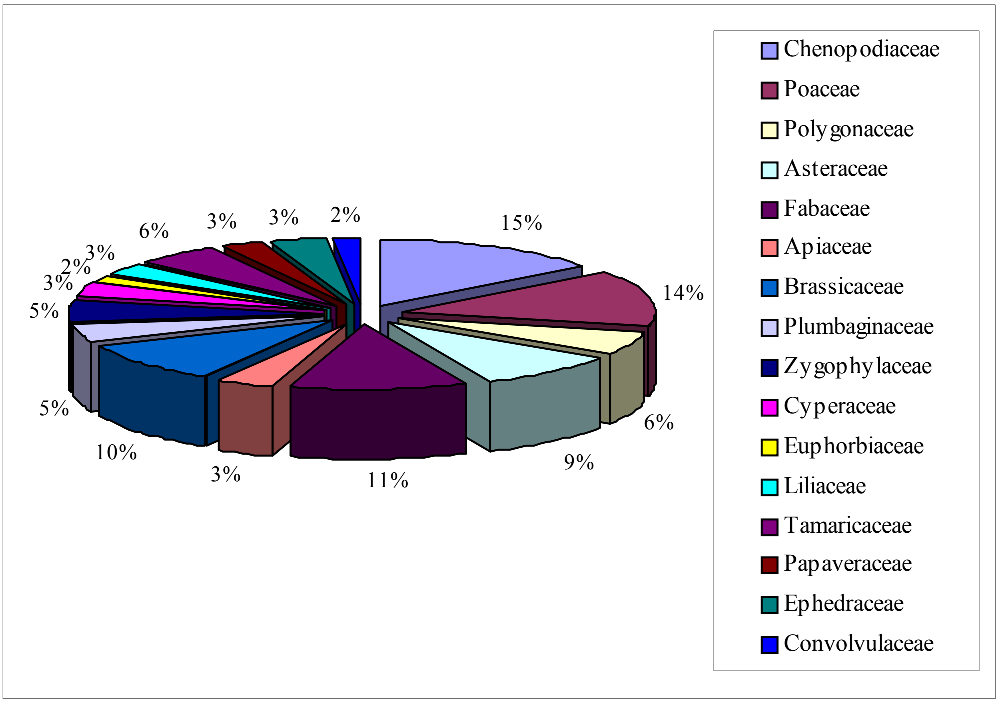


Figure 9. Families Spectrum of the Flora of Afghanistan

Preliminarily survey shows that about 14% of vegetation in Registan desert can be used both in traditional medicine and for pharmaceutical purposes. For instance, Ephedra may be used as source of ephedrine. Ferula species in a large-scale use may be recommended as a drug, gum, resin, condiment etc. Peganum harmala contains harmalol, harmin, and carbolines used for the treatment of eyes disease, rheumatism, red dye, fumigant etc. Glycyrrhyza glabra can be cultivated in large plantations as a source of liquorice, a replacement of sugar, or respiratory disease treatment. Many others species, such as Cistanche, Artemisia, Alhagi, etc. can also be used as medicinal material.

B. Grazing Resources of Registan Rangelands

Since livestock production is mainly determined by nutrition (fodder production from natural pastures and in particular by its quantitative and qualitative characteristics) this study evaluates both of these range ecology aspects.

Identification of potentially suitable fodder plants we began with a consideration of their taxonomy, habitat and life form characteristics. In the figure 10 we show that the small trees and tall shrubs represent a small number (0.2-1.9 %) of described by us species of Registan desert flora. They play a significant role in the diet of sheep at various times of the year.

The shrub/semishrublets life form group occupies a key position among the investigated desert plants of Registan and adjacent territories. They contribute to the physiognomy of the vegetation and to the bulk of the afterground biomass. They differ from the previous group in having shorter life span (12-15 years) and in an early and faster vegetative growth cycle. This group provides the most valuable forage for small ruminants and camels in spring early summer types of pastures. They can be stored and dried and occur suitable for hand feeding in droughty season.

Herbaceous plants both annual and perennial species represent more than 70% species that occur on the pastures and hay making lands of southwestern Afghanistan. Despite their high floristic diversity, herbaceous plants and perennial graminaceous species do not dominate the vegetation, and as a result, produce a little biomass and forage.

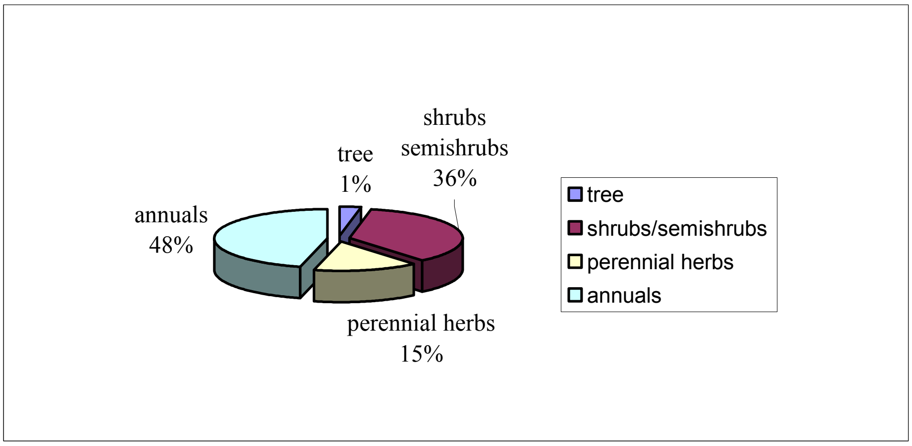


Figure 10. Relation (%) of Different Plant Life Forms of the Flora of Registan

Woody shrubs like species of genus Astragalus, Calligonum, Artemisia, and Haloxylon aphyllum are considered to be reaching maximum densities in the Spin-Manda and Panjawayi districts (Kandahar Province) than in Garmsir (Helmand Province), while the canopy cover of herbaceous plants was almost similar among described sites (fig.11).

Some grazing-induced erosion has occurred, but the scattered woody population has not yet been affected in terms of floristic composition, age structure, or density (fig.12).

Figure 11, 12. Fodder Resources of Rangelands of Registan Desert

In the Garmsir section of the Registan Desert, woody plants have increased for the past few years (shrubs of various species of Calligonum at least 4-5 years old). It seems that pastoralists subsequently abandoned this region in the Registan Desert. Therefore, the herbaceous layer (both perennial and annual herbs) recovered in many places due to some rains of 2002-2003 periods. Establishment of new woody plants was curtailed, and the woody population stabilized and matured.

The Garmsir section of the Registan Desert had apparently been heavily grazed for many decades and a high degree of wind and soil erosion has markedly changed the landscape, and consequently covers vegetation on it. The natural self-recovery of herbaceous layer was barely observed there. Besides heavy grazing, negative effects on the herbaceous layer development could also accrue from possible reduction of topsoil nutrients distribution/fertility (figure 13-14).

Encroachments of woody vegetation (almost 1/2 of plant is covered by sand) limit herbaceous growth through competition for light, moisture, and nutrients.

Garmsir sandy sites, however, can recover in the absence of grazing. To some degree grass recovery can be facilitated by the annual leaf litter from deciduous woody plants and by nitrogen fixation by woody legumes (that are widely occurs in any psammophytic plant community), which replenish top-soil nutrients. It is common in Registan that the biomass disappears during the dry season or during droughts due to fall of leaves, fruits, and/or seeds. It is a rapid decline of green biomass production, indicating the close interaction of grazing pressure and natural feed supplies.

Table 10. Biological Life Forms for Different Sites in Registan Desert

(counted in 50 m^2)

Location	Tree	Shrubs (tall)	Total numbers of plants on 50 m2 Small shrubs and semishrubs	Perennial herbs	Annuals	State for grazing
Spin Manda N 31° 25’ 31” E 64° 56’ 06” I intercept	2	4	13	25	56	favorable
II intercept	0	2	29 (1/2 almost dry)	32	67	favorable
III intercept	1	4	16	19	73	Average
Garmsir I intercept	0	1	28 (fruit maturation)	9	24	unfavorable
II intercept	0	0	17	7	39	Need improvement
III intercept	0	2	8	17	12	Unfavorable

(seed bank is completely depleted)

Figure 13, 14. Various degradation of soil and plant in Garmsir

Although woody encroachment during droughts is strongly marked in the rangelands of Registan, these sections are still in ‘reasonable’ condition because patches of high-quality ephemers -

ephemeroids (Carex, Poa bulbosa, etc.) and perennial fodder grasses. Only singular sparsely distributed trees can be seen in the vast areas in Registan. Because of the limited permanent water resources, the Registan sandy rangelands function mostly in the wet season and have a seasonal use (December-May). In addition, feed resources of Registan sandy desert and adjacent desert/dry steppe territories are completely determined not only by quantity of annual rainfall, but also by landscape and soil properties. Field observations were restricted to sites on sand dunes or other landforms with sandy top-soils, where infiltration rates are high and run-off is low; hence, response to rainfall are directly related to plant establishment and growth. Plant communities (cover vegetation) on loamy sites are mostly confined to areas with shallow soils, where surface sealing and compaction impede water infiltration and conditions for plant germination and growth are poor or do not exist.

In terms of average feed resources (maximum herbaceous biomass), sandy soils provide about 60% while landforms with shallow stony soils are less productive.

C. Carrying Grazing Capacity of Registan Rangelands

Prior to the extended period of internal conflict, approximately 15 million ha of lowlands and steppes were used for winter grazing, while 25 million ha of mountainous lands served as spring and summer pastures. The total carrying capacity of the country's current grazing lands for different ruminants (sheep, goats, and camels) has not yet been determined. In 1978-79, 40 million ha of pastures supported an estimated 25 million animals. Nomadic herding communities traveled long distances with their animals to exploit the spring and summer grazing lands in mountain ranges, returning each winter to the eastern and southeastern lowlands of Afghanistan and the border region with Pakistan. In an extreme drought year the average value is 300 kg/km^2 (standard carrying capacity being 500 kg/km^2).

However at the present moment, there is a very little recent information available for Registan desert. In order to describe a grazing management scheme in a precise manner, a discrete state-system model is defined formally. The elements of the model are:

(a) A time scale, t=0, 1, 2, ..., in appropriate units such as month, season, or year

(b) An input set X which includes

Xc – climatic variables (rainfall, temperature, wind, etc.)

Xd – action or decision variables (which range to graze or rest, when and duration of grazing, herd size and composition)

(c) The state set S which represents the state of health of the range, commonly called range condition. It should not be confused with immediate availability of forage, which may be a reflection of past weather conditions, and is considered to be part of the output. The term is used to relate the current condition of the range to the potential of which the particular area is capable (Stoddart, Smith, and Box, 1975). Indicators of range conditions are vegetal composition (dominance of desirable species), plant production, ground cover (both living vegetation and litter), and a soil erosion index.

(d) The state transition function F which calculates the elements of the state at time (t + 1) as a function of input and the state at time.

$$S(t+1) = F[X(t), S(t)]$$

The function F is actually a vector set of functions which relates the future range condition to that of the past and both the decision and climatic variables. In range management terms, the current range condition is a function of the previous range condition plus the grazing use (management actions) and the precipitation, temperature, humidity, and other climatic factors that affect vegetative growth. It is not necessary for the transition function to be given in quantifiable terms. For example, as a hypothetical case, assume the climatic variables are denoted by favorable, average, or unfavorable conditions and that the decision variable is classified as either a high or low grazing intensity. Then, if the range condition classes are excellent (EX), good (GD), fair (FA) or poor (PR), a table such as shown in Table 12 can be developed as the state transition function F (Fogel and Duckstein, 1978)

The output set which includes elements of interest to the decision maker and may include outputs from simulation models such as an indicator of range condition, forage production, vegetal composition, ground cover, soil erosion and vegetation species. Indicators of range conditions are vegetal composition (dominance of desirable species), plant production, ground cover (both living vegetation and litter), and a soil erosion index.

In Taktah Pol and Garmsir where there is the possibility of use of marginal lands for grazing and agropastoral reclamation the carrying capacity of pasture increases, whereas the situation does not appreciably different in Spin Boldak, Panjawayi, and Maiwand with the lowest rate of cultivated lands; or Jandozai, Owa Kahan and Nook Chee-regions in the south part of Registan.

Studies of the patchy distribution in both surveyed zones show that the grazing capacity of pastures is determined by the length of the dry period than by the number of animals, which existed before the drought. The state and composition of the vegetation in any particular case are unstable. A 'patchy' and scarce distribution is the common feature of native psammophytic vegetation in the Registan Desert, which changes gradually in response to soil differences along landscape heterogeneity

Table 12. Herbage Yield Estimates

Annual Precipitation, mm	Range Condition S*	Estimated Yield, kg/ha
100	P	80
	F	160
	G	270
150	P	120
	F	240
	G	400
200	P	160
	F	320
	G	530
250	P	200
	F	400
	G	660
300 (max)	G	800 (max)

*S =1.0 for good condition, =0.6 for fair condition, =0.3 for poor condition

Table 13. Carrying Capacities of ESON Project Rangelands

Annual Rainfall mm	Range condition (G-good, F-fair, P-poor)	Hectares required for one ILU[1]	
		All-season range	Seasonal range[2]
50	P	82	328
	F	36.5	146
	G	20.8	83
75	P	54.5	218
	F	24.3	97
	G	13.5	54
100	P	40.9	163.6
	F	18.2	72.8
	G	10.1	40.4
150	P	27.2	108.8
	F	12.2	48.8
	G	6.8	27.2
200	P	20.4	81.6
	F	9.1	36.4
	G	5.1	20.4

[1] The "average" animal (0.2 ILU) consumes 1.5 kg dry weight per day.

[2] Carrying capacity of seasonal range roughly estimated at one-fourth that of all-season range.

It should also be noted that the effect of the low yields level of pastures as results of droughts and human impacts not only reduce short-term feed supplies, but also lead to a general fall in species diversity. Many species, in particular long-cycle grasses, fail to reach maturity and to set seed. The total number of species from 50m^2 and the ratio between grasses and dicoteledons families in different areas of sandy soils of the Registan desert sharply differ (table 10). Woody semishrubs are pioneer species and dominate many sites. Although we found out an abundance of palatable perennial grass near in the Garmsir area of Registan, there is a strong decline in the number of shrub/semishrubs and annuals species. This is based on their density per 50 m^2.

Table 14. State Transition for Determining Expected Range Condition

Range Condition at time t, s (t)	Climatic Conditions					
	Favorable		Average Grazing Intensity		Unfavorable	
	High	Low	High	Low	High	Low
EX	GD	EX	GD	EX	FA	GD
GD	GD	EX	FA	GD	FA	GD
FA	FA	GD	FA	FA	PR	FA
PR	PR	FA	PR	PR	PR	PR

Quality and palatability rather than quantity of the forage has also been studied. Compensatory re-growth of grazed or browsed plants by different wild and small ruminants and changes of biomass productivity under different loading pressures as lacking of experimental data clearly demonstrate the analytical importance of these potential biological diagnostic criteria in attempts to understand the functioning of Afghan grazing system.

Perennial and annual Psammophytic species predominate on sand dunes and sandy fixed areas. The tree and shrub perennials are relatively unpalatable to sheep but more palatable to camels and donkeys. The perennials are important for protecting sandy fixed areas and well clusters from sand encroachment, for stabilizing the sand dunes, for shade, for fuel and for Kuchi dwellings and well construction. During the drought, many shrubs have been collected by Kuchi that travel into Registan by tractor. The shrubs are sold for firewood in Lashkar Gah and other centers.

Annual ephemeral vegetation predominates on sandy-loams and loess soils. They are highly palatable and constitute the main fodder intake of small ruminants grazing in Registan. This vegetation usually and universally rejuvenates following a significant rainfall event(s) even after a drought year and particularly after continuous drought years. The reason is because the soil seed-bank is replenished in the absence of a grazing predator of the few plants that do germinate and seed. For more detailed and theoretical explanations, the reader is referred to the “Predator Prey” relationships described by Rosensweig and MacArthur (1963) which were applied to plant-herbivore relationships by Noy-Meir (1996).

The sustainable annual carrying capacity of Kandahar Registan was that of the total production system, that is the number of animals that was maintained by the Kuchi, not only by grazing in Registan but also by migrating to other areas. In these terms it is best to refer to the length of time spent in Registan by the Kuchi as a point of reference. The time spent in Registan in any particular year was determined by soil water availability for plant growth (edible biomass) and drinking water available from wells and Nawars. The inter-dependent relationships between vegetation and drinking water availabilities for livestock were those determining transhumance of the Kuchi from Registan to the semi-arid and irrigated regions adjacent to the Helmand and Arghandale rivers.

D. Strategies for Rangelands Rehabilitation/Reforestation in Registan Desert

To cope with the fluctuation in forage yield resulting from climate variability (especially severe drought), pastoralists have developed a variety of survival strategies that have been applied in different drylands of Africa, the Middle East, and other Central Asian countries. In Registan, the cost of abandoning pastoral areas is potentially enormous. The following strategies can be carefully applied, especially for nomadic herds:

- Maximizing herd size during favorable periods so that animal losses during drought do not reduce herd size bellow available level;
- Using adapted breeds and taking advantage on animal physiological processes which make lower demand on forage during period of low supply;
- Adjusting herd composition in term of dry versus lactating females and young versus adult animals. Animals with lower nutrient requirement are kept during dry periods. For example, non-pregnant females and adult males require less forage than pregnant or young stock and can therefore better survive periods of forage shortage. It is important to keep only reproduction herds. Mating can be regulated (and timed to autumn-winter seasons) so that

lactation does not coincide with dry season. This strategy seems to be suitable for Kuchi nomads as long as they keep mainly meat-producing herds;

- Keeping herds with a mixture of animal species which feed on different components of the vegetation;
- Opportunistic or regular movement of herds to use more productive key forage resources together with less productive drylands range in the same agro-ecological zone;
- Opportunistic keeping of herds with a mixture of animal species. With the multiple-species herd, a larger spectrum of the vegetation can be used and the balance between woody and herbaceous species can be manipulated. Keeping several species also permits faster rebuilding of herds after drought, as the feeding habits and physiology of camels and goats allow them to survive droughts better than cattle or sheep;
- Regular movement of herds between different ecological zones: interzonal moving (pasture rotation); fencing of pastures in the sandy desert;
- Using crops products (grain), residues after cereal harvesting. Many pastoralists can resolve the fluctuations in forage supply by seeking links with crop farmers and by diversifying of their own activities into cropping, trade, migrant labour etc.;
- Allow regeneration of pastures by itself. For this type of work, one must be careful with settlement of nomadic pastoralists (especially in the point of view of the degree of their mobility to exploit natural resources) and also with a potential for disruption of customary pastoral land-use pattern;
- Installation of infrastructure: roads, water supplies.

Mobility and opportunistic behavior remain the best ways of managing of natural resources for pastoralists in uncertain environments of Registan Desert. As part of a resettlement program, a pasture rehabilitation program must be initiated. Fodder trees and shrubs could be established for the livestock to serve as supplementary feed. Indigenous and non-indigenous species were tested for drought resistance and suitability for Registan as part of this project. Once the most suitable plant species have been selected, palatability trials, measurements of metabolizable energy yields and component analyses of the plants should be done. The plants could then be ranked according to a quality index using metabolizable energy yields and crude proteins as variables. A number of plant species have been recommended as part of this report. Other possibilities that should be considered include *Prosopis cineraria*, *Leucaena leucocephala* and *Gliridia maculata* or *sepium*. It should be remembered that many of these trees and shrubs contain secondary compounds as defense mechanisms against herbivores and they may be toxic to the livestock.

However, at the present time, few Registan Kuchis have enough animals to provide for their families and are therefore neither interested nor prepared yet to use all above described principles. Low livestock restocking rates, sparse vegetation, and disappearance of species during drought severely limit grazing in the Registan Desert today. Environmental changes in southwestern Afghanistan are locally perceived to the result primarily of rainfall fluctuations rather than overgrazing. The possible size of herds will mainly depend on landscape topography, vegetation structure, rangeland productivity, feed intake, level of feeding, and watering points per area.

Work with pastoralist development projects in different African and Central Asian deserts shows the necessity of starting work with small groups as a starting point. A small focus group is more coherent and more able to produce immediate results/products from collective action. Small groups enable herders to make economic investments, define and enforce precise management rules of pastures, and set the boundaries of the area to be managed. In order to take into account herder mobility and the unpredictability of natural resources, both enclosed and more open spaces should be included in any rangeland grazing schemes. But any intervention for returning Registan Kuchi to their point of origin or settling them in non-nomadic livelihoods should take into account the traditional/customary system developed in the region from ancient time until present. It would be a big mistake to expect that Kuchi pastoralists of the 21st century will be the same as their ancestors have been. Involvement of any technology from abroad should be gradually adapted to the region and to Kuchi daily life no matter how well such technologies worked in others countries.

V. CURRENT STRATEGIES FOR PASTORALISM (Kandahar and Helmand Provinces)

A. A New Direction of Thinking in Pastoral Development of Afghanistan.

Enhancing tracking opportunities and reducing the chances of livelihood loss of livestock keepers through drought (or other episodic natural or human impact events) are key principles of the modern development of pastoralism activity in the Registan Desert. Effective tracking may be achieved by increasing locally available fodder by importing feed from elsewhere or by enhancing fodder production, especially drought feed, through investment in key resources sites. Reducing animal feed intake during drought through shifts in watering regime or breeding of animals with low basal metabolic rate can be considered as alternative management strategies. Although movement of flocks should be kept as a central point to the survival strategies of transhuman pastoral system, drought sales of livestock within this project should be a last resort and should be centralized by the project staff in the 'key resources site'. It would be necessary to create a specific "Kuchi market". Such an approach will consolidate the pastoral community, minimize the cost for transport, and keep Kuchi devoted to the remote pastoral area.

B. Enhancing Key Resources Areas

Such "*resources key sites*" are characterized by more than equilibrium environments (low water table or often run-on sites with highly available soil water and nutrients) where drought tolerant plant seeding and tree planting (using existing management techniques) will have some chance of success. Small high value 'key resources sites' should have heterogeneous fodder resources base, drainage lines or sinks, valley bottom or large interdunes depressions, river banks, water points, salt-licks, and strategic fodder resources such as small trees or well-developed woody shrubs. This should be part of a gradual return strategy where Registan Kuchi later return to more remote areas. Such astrategic model of 'key resources site' can serve Talukan area in Panjway district. Before the establishment of any key resources point, a mathematical herd projection model should be developed between the spatial/seasonal distribution of plant communities (including botanical diversity and rangeland productivity), average values of vegetation growth and soil loss related to spatial variation of soils erosion, topography, soil type, livestock distribution, and animals' densities in the selected key resources site.

Secondly, the existing stocking density of animals as the current stocking rate (CSR) should be increased carefully taking into account the vegetation changes of different types of rangelands of

Registan and adjacent territory in order to understand temporal and spatial variability of pastures productivity, as well as the rational use of grazing resources. Driving forces that determine production of vegetation- variability of climatic parameters, soil moisture storage capacity, nutrient status, and an availability of seed bank- should be strictly defined.

VI. AGROPASTORAL MANAGEMENT ACTION PLAN

A. Short-term Strategies for Returning Kuchi Nomads to the Previous Point

Pastoral activities of Kuchi returning should start in small organizational working arrangements that exist before droughts and build up any activity from there. Attempting to deal with complex issues at the start, such as range management or resource tenure, usually results in failure.

Water sources and strategic fodder reserves, such as trees/shrubs, should be still key points in any plan of returning Kuchis to their previous life. Water and land use by pastoralists should be accompanied by agreement signed between them and the owners of any land in Registan. Management rules should be simple: numbers of users, types, forms, and time of use.

The creation of ‘key resources sites’ or focus areas through investment in fodder and water management, reseeding, and environmental rehabilitation should be a prime starting point for the rebuilding of nomadic pastoralism or agro-pastoralism development in Afghanistan. Based on water availability and the rangelands resources assessment there should be the development of a strategic model of ‘key resources site’ in the Talukan area of Panjway district (*Fig. 15*).

Distance between each watering points (wells) should be no more than 15-20 km; migration pastoral routes are necessary to be develop within the indicated on the map zone with gradually moving into remote areas. Kuchi nomads should be primarily settled around any watering point like ‘oases agropastoral development type’.

The total dry matter produced in the study area should be about 10 tons. Assuming 1.7 kg/day as a daily intake of a sheep from rangelands, the carrying capacity of the rangelands for 120 days, the duration of the grazing period, reaches 485 animal units. The more productive land in any cycle should be allocated to the lambs and pregnant animals. Every noon herds are moved to the watering and milking points and then in the afternoon they will be sent back to the rangelands. Herds should be composed of 80% sheep and 20% goats. The average live weight of ewe is 37kg and goats 25-30kg.

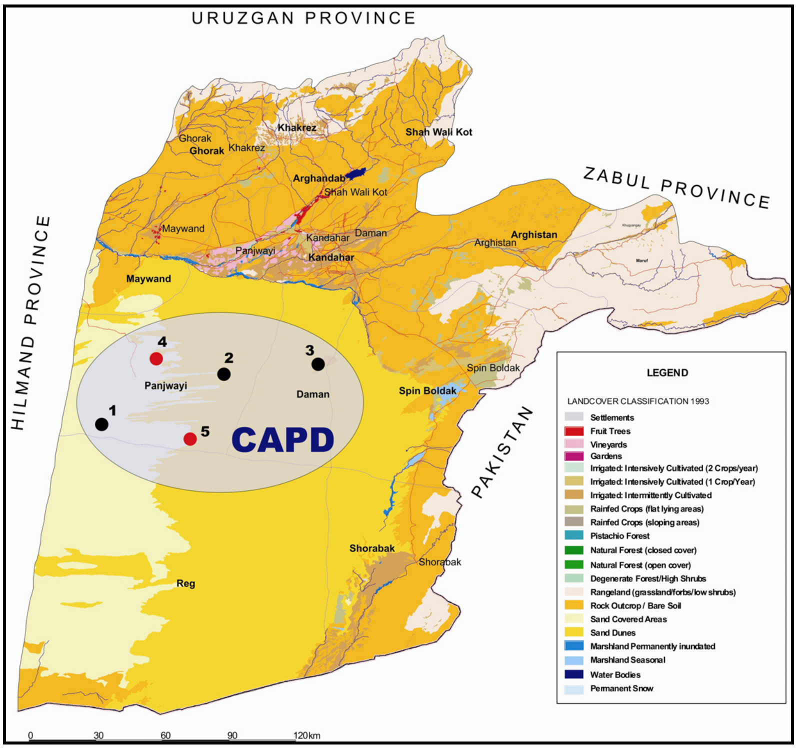


Figure 15. Map of "Talukan Key Resources Site", Kandahar

Notes: 1- destroyed well in Jamdam; 2- silted well in Tobi;
3- well that should be rehabilitated in Boq;
4, 5 – two new wells that should be constructed.

In order to cope with current situation of sustainable use of natural resources of Registan Desert, Panjwayi, Spin Manda and Maiwand districts as particular case there is a clear need to establish a special *Coordination Office* titled as following:

- – NGOs – Central Asia Pastoralism Development (CAPD)
- Center for Central Asian Pastoralism Development
- Experimental Research and Applied Station for Pastoralism Development in Central Asia Afghanistan

- Center for Pastoralism Rehabilitation and Reviving/Rebuilding of Kuchi Nomads Customs/Traditions in Registan.

The new created infrastructure should concentrate much more attention to building local capacity and professionalism to diagnose through a learning process approach that will be able to make assessments, action oriented monitoring and management of desert natural resources. The humanitarian assistance from different international organizations and donors needs to be shifted towards the desert pastoralistic key resources sites than not near the Kandahar or Helmand cities where Kuchi nomad camps are currently concentrated. In this context, focus must shift from short-term humanitarian interventions to a multi-year (3-5 years minimum) livelihoods support program that is coordinated between different humanitarian agencies**.** CADG, UNAMA, CORDAID, Mercy Corps, VARA and other organizations should focus on gaining an accurate understanding of the status of Kuchis in southern Afghanistan; including previously experiences and the functionality of the CADG priorities in target agropastoral communities.

Greenhouses and plastichouses can be used for production of some vegetables for agropastoralist families. Netafim Family Greenhouse technology is very useful for the reclamation of sandy/loamy areas of Registan Desert. Such kind of activity can be located around boreholes, watering places, functioning wells, etc. In the surroundig desert land it will be possible to initiate:

reseeding with legumes, planting singular trees from nurseries

efficient breeding for efficient fattening (pregnant animals, lactating female, young lambs etc.) operations can also easy be sustained by pastoral producers at the " key resources sites

simple thorn (from Lycium, Alhagi) fences exclude any outside intervention, including migrant herders etc.

B. Increase of the Agropastoral Incomes in the 'Key Resources Site'

Time and cost of well rehabilitation; necessity to drill new two wells in the Talikan key resources site (Panjwai, Maiwand districts);

Mapping (using GPS and new GIS technologies) of well status and distribution; get well water testing (screening) for contaminants, bacteria etc.; as well as landscape characteristics in details;

Rehabilitation (resulting) of destroyed well and drilling two new wells at the key resources sites;

Develop a rotational grazing plan to eliminate overgrazing, especially around watering points;

Re-establish eroding areas by re-seeding; if soil is poorly drained do not graze unless artificial drainage is in place;

Do not allow livestock to graze before minimum heights have been attained. Minimum heights vary greatly depending on forage species. Identify all desert areas what is critical to the maintenance;

Alternative livelihoods assistance during long-term droughts will provide a greater chance to re-entry into the livestock sector or to return to their previous point by given some credit or even small cash-for work schemes, assisted migration to remote desert areas for both their animals and families, providing with pastoral reserve in high potential zones and water supply there and provision of local income-earning alternatives may represent legitimate public investment priorities in pastoral areas;

Search of the pastoral reserve areas with a small-scale herds; small flock sizes, and the introduction of technologies that encourage new production practices;

State of marginal lands and drainage system work there; list of crops that are cultivated by local people now;

Plant mostly native psammophytic (well adapted to sandy soils) both native and introduced species (see Appendix 5, 6);

A few trees, especially from Fabaceae (legumes) in particular may be an important supplement that increase appetite and ensure maintenance of animals during of period of stress, droughts at the case of Registan desert;

Keep transhumant movement tracking strategies (where animals can be moved between different sites with different level of green vegetation biomass at any given time) with a carefully involvement (incorporation) of pastoralist in the agricultural farming system should be a primary point otherwise the opportunity for exploiting large areas of dry range will be lost. However tracking pastoral system usually involves high level of skilled labour. Only old experienced Kuchi herders know how to move and manage complex herd splitting and phased movement of different animal types or understand animal physiology, first helping at the case of disease, feed combination and selective feeding etc.);

In the surveyed by us areas very often available labor is unskilled and with limited experience. This undoubtedly reduces the efficacy of many of the tracking strategies recommended above;

When testing of Registan Kuchi nomads will start it is very important to make difference between the real pastoral herds (sheepherders) and herd owners. Sometimes they may be government officials, rich agriculturists or urban businessmen and in comparing with resident pastoralists have little knowledge of the complexities of pastoral production in dry and dynamic ecosystems. And much larger herd owners usually may be able to split herds and carry out complex form of transhumance, while poor herders may be unable to respond through mobility of flocks of animal and may be at the starting process need `safety net` support in order to avoid losing their animals in a drought;

Access to land and plant resources (botanical diversity). It is very important to become familiar with the native forage species on the rangelands. This will allow to nomads to better monitor grazing system, prevent overgrazing and erosion and renovate pastures to meet the needs of each animal´s species (goats, camels, sheep);

Establishment of pastoral communities and accept an integral role of each member; pastoral women tend to play in creating `key resources sites` a successful livelihood outcomes; a gender analysis is needed;

Starting with the establishment of ´oases´ model of nomadic pastoralist activity for Kuchis rural community.

It is known that at 10th Century travelers to the Registan region noted Garma (Jarmak) ‘oases’ (for nomadic pastorlist activity) in the Persian Basin Desert used as resting places for caravans crossing Central Asia in medieval times. In the memories of the traveler Moqaddas there is a note that “in 444/1052 through Garmsir to Tabas it was water tanks besides small dams at every 2 farrangs [distance]. The dams served to mark the route in the deep desert, which might be intended to service travelers” (Moqaddas, p.129, medieval reports). During the establishment of ‘key resources pastoralist Registan desert sites’ it is extremely important to clearly differentiate settled agriculture in the desert and nomadic life.

Plowing of rangeland and conversion into cropland has considerably increased in the Southwestern Afghanistan. Majority rangelands, for their soil conditioning and/or topographic status, are not suitable for grazing (near Gramsir as an example) or for agropastoral production; they are often abandoned after a short time of use. They are left in very poor condition and are mostly subject to progressing desertification. Fuel-wood is another destructive factor for rangelands in the region. The main reason of rangelands degradation is the lacking of plants self-regeneration. Seed bank for the majority desert plants is completely depleted. Therefore the establishment of short/long term range regeneration program is very crucial today.

However, it is extreme important to be flexible with the involvement of any technologies with taking into account landscape specificity, soil fertility and water storage capacity, irrigation system, plant adaptation etc. The assumption that Western Science and technology can provide planned solutions to particular problems under conditions of high unpredictability (drought cycles, grazing capacity etc.) and immense variability is clearly unfounded. Optimal system of transferring technologies and an adaptive management demanding flexible response and of different pastoralist groups should be developed. This learning process and adaptive management require new methods, new skills and first of all professionalism.

Multi-variety (disciplinary) survey and a well-managed initiative learning process are still needed prior intervention.

A series of phenomena should be taking into account before settlement of focus Kuchi groups in the Kandahar district:

to discuss with land owner and define the lands for CAPD activity in the Panjway, and Maiwand Districts towards enchasing new remote desert areas in Registan;

to find 100 – 250 families of potential nomadic/pastoralists Kuchi with animals who will be ready to return to their previous life; A table include name of families, members, numbers of animals: sheep, goats, donkey and camel will be prepared; The degree of Kuchi properness: education/training level;

given to grazing ecosystems to recover from drought, permitting the re-establishment of plant cover, germination and growth of bushes, reconstruction of seed reserves in the soils;

possibility of opening a tree nursery there;

Source of water and system of water and land use seasonally and by families (water tanks and water distribution through pipes; subsurface drip irrigation; family drip irrigation system near settled area or wells and navars management in remote areas).

Government road schemes in pastoral areas with an active international, NGO´s. donors and private investment should be urgently assist that may increase marketing opportunities;

VII. RANGELANDS REGENERATION PROJECT

A. Regeneration Techniques for Sandy Rangelands in Registan

Re-seeding of degraded rangeland can be carried out quite easily. Different techniques should be tested the region for range rehabilitation. Different techniques should be tested in the region for range rehabilitation. The simplest method that can be applied in the Registan Desert and adjacent territories at the end of 2004 is direct seeding both by hand or using a mixture of seeds of basic species of fodder (imitating the natural state of pastures). At the first stage of a range regeneration program, vegetation or the creation of phytocoenoses (man-made planting) should utilize a mixture of native (more than 70%) and introduced (from different desert areas of Central Asia, Iran, Pakistan, Israel) forage species. Seeds of perennial forage species, or even indigenous perennial shrubs, can be collected and dispersed over depleted rangelands without any fencing.

The following non-native psammophytes (sandy type of vegetation) species are recommended for testing in the Registan:

Psammophytic/xerophytic plants (reclamation of sandy deserts)

1. Haloxylon aphyllum (Chenopodiaceae) – tree/tree-like
2. Haloxylon persicum (Chenopodiaceae)- tree-like
3. Haloxylon salicornicum (Chenopodiaceae)- tree
3. Salsola richteri (Chenopodiaceae)- woody tree-like
4. S. paletzkiana (Chenopodiaceae)- woody-tree-like
5. Acacia ammodendron (Fabaceae)- tree-like species
6. Calligonum arborescens (Polygonaceae) – tree like species
7. C. caput-medusae (Polygonaceae)- shrub
8. C. rubescens (Polygonaceae)- shrub
9. C. junceum- shrub
10. C. setosum (Polygonaceae)- shrub
11. C.microcarpum (Polygonaceae)- semishrub
12. C. rubens (Polygonaceae) – shrub
13. Ephedra strobilaceae (Ephedraceae)- shrub
14. Halothamnus subaphylla (Aellenia subaphylla, Cenopodiaceae)- shrub
15. Salsola orientalis (Chenopodiaceae)- semishrub

16. S. gemmascens (Chenopodiaceae)- semishrublet
17. Eurotia ewersmanniana or Ceratoides ewersmanniana (Chenopodiaceae) - semishrub
18. Artemisia diffusa (Asteraceae)- semishrub
19. Artemisia iranica
19. Astragalus unifoliolatus (Fabaceae)- shrub
20. A.villosissimus (Fabaceae)- shrub
21. A. maximowiczii (Fabaceae) - shrub
22. A. gossypius (Fabaceae)
23. A. glaucocanthis (Fabaceae)
24. Ammodendron kavirensis (Fabaceae)

The following trees and shrubs from desert/semidesert areas of Afghanistan are recommended for improvement of grazing capacity and reforestation:

1. Ceratonia siliqua (Carob tree)
2. Various species of Tamarix (Chen gazai trees) for fuel in salty soil and improvement of salt-affected lands in the desert
3. Haloxylon salicornicum - tree for fuel, sand and dust stabilization forest/shelter belts
4. Prosopis spp - large bush
5. Various species of Calligonim - large bush well grazed by camels and goats
6. Various species of Ammodendron and Acacia - trees in desert/semidesert areas for fencing and fuel production
7. Zyziphus spina - large bush for improving of grazing capacity and fuel
8. Phillirea media- improvement of grazing capacity
9. Aellenia glauca- large bush for improvement of grazing capacity

To attain an optimum plant density and a diversified phytocenoses, the following seeding rates (kg/ha) are recommended:

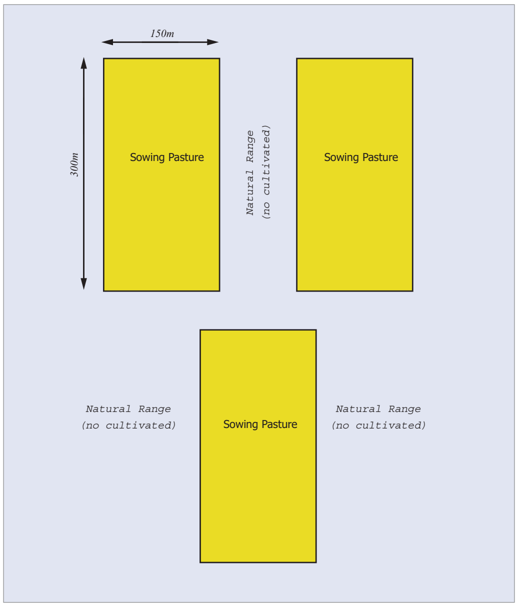
Type Of Shrub	Seeding Rate (kg/ha)
Shrubs (with a low rate of germination)	8-10
Semishrubs (with a good rate of germination like Kochia, Artemisia)	.5-3.0
Different chenopods shrubs	5-8

Legumes, as well representatives of Calligonum and Convolvulus species should have special pre-treatment of seeds and be tested for seed rate germination due to the presence of hard seeds.

In the sandy desert or sand dunes, the effective establishment practice is to furrow and strip sow. Seed sowing on sandy soils is carried out by harrowing or soil disking over wide strips (30-35mm or more) separated by 15-20m of undisturbed rangelands. On the fixed sands or interdune spaces with more compact substrate, the most efficient method is the use of open furrow which ensures water accumulation in the pits and also possible leeching of soluble salts from the top-soil layers. The optimal depth of seeding is less than about 2-3cm for most species and in all cases is always less than 5 cm. Pitting plow technology will be also available for the superficial regeneration of Registan range.

Seeding and re-seeding is to be arranged in December-January during the cold and wet weather. It is important to start seeding only after the cold weather has settled in, as rodents, reptiles, and insects are in hibernation and will not collect, store, or eat the seeds. The seeding technique in Registan Desert will coincide with the period of grazing of livestock by Kuchis. Improved ranges can be grazed with appropriate management after 2-3 years. If well managed, some good strands of shrubs and semishrubs on improved ranges last as long as 20-30 years or as long as 40-50 years when sown with Haloxylon spp and local trees (Hajo, Chen, Gazai). The life span of many perennial herbs in man-made pastures may be shorter but phytocoenoses as whole may last much longer because of self-reseeding and self-regeneration.

Plowing of rangeland and conversion into cropland has considerably increased in southwestern Afghanistan. The majority of rangelands, due to their soil conditioning and/or topographic status, are not suitable for grazing (near Garmsir as an example) or for agropastoral production. They are often abandoned after a short time of use. They are left in very poor condition and are mostly subject to progressive desertification. Fuel-wood is another destructive factor for rangelands in the region. The main reason of rangelands degradation is lack of plant self-regeneration. The seed bank for the majority desert plants is completely depleted. Therefore the establishment of short/long term range regeneration program is very crucial today. However, it is extreme important to be flexible with the involvement of any technologies, taking into account landscape specificity, soil fertility and water storage capacity, irrigation system, plant adaptation etc. The scheme of small scale range improvement in sandy desert area of Registan (within framework of “Talukan key resources site”) is given below:



Scheme of Small Scale Range Improvement

On the fixed sands or interdunes spaces with more compact substrate, the most efficient method is the use of open furrow which ensures water accumulation in the pits and also possible leaching of soluble salts from the top-soil layers. The optimum depth of seeding is less than about 2-3cm for most species, and in all cases is less than 5cm. Pitting plow technology will be available for the superficial regeneration of Registan range.

Seeding and re-seeding should be already started in December-January (2004-2005) during the cold and wet weather. It is important to start seeding only after the cold weather has settled in as rodents, reptiles, ants, etc. are in hibernation and will not collect, store, or eat the seeds. The seeding technique in Registan should coincide with the period of livestock grazing by Kuchis.

The improved ranges can be grazed with appropriate management after 2-3 years. Some good stands of shrubs and semishrubs on such improved ranges, if managed well, can last as long as 20-30 years and as long as 40-50 years when sown with Haloxylon spp and a local tree named chen gazai. The life span of many perennial herbs in the artificial (man made) created pastures may be shorter but the phytocoenoses as whole last much longer because of self-reseeding and self- regeneration.

Basic range rehabilitation efforts will be an important part of any return program for Registan pastoralists. Often the focus for rehabilitation work has been focused on water sources with little regard to pasture conditions and the sustainability of returns based on grazing resources. While the pasture has been severely damaged in many areas of the desert, an effective range rehabilitation program will assist the regeneration process.

B. Sand and Dust Stabilization Project

Establishment of green forest belts (shelter belts) by tree planting will be an effective method of sand/dust stabilization in Registan. Each sown strip should be 20-25m wide and be positioned, as much as possible, perpendicular to the prevailing wind. The tree and/or tall shrub shelterbelts and windbreak strips should be separated by undisturbed natural rangelands between 150-300m wide. With such a distribution, 10-15 ha per 100 ha can be protected from soil and wind erosion. The area to be sown can be prepared in advance by plowing to a depth of 20-25cm and harrowing after seeding. Hand seeding can be practiced. Aerial seeding is proposed to cover wide swaths of land where the soil is less arid. The optimum target density is around 900-1200 trees/ha. The labor (Kuchi work) should be paid to plant trees and shrubs in remote Registan desert areas. For example, the adjacent to Garmsir settlement towards Registan is a good candidate for the creation of 'green wall' with a sand fence along the perimeter. Drought and water tolerant species of desert plants can be arranged in optimized checkerboard patterns to create an artificial ecosystem to stabilize the dunes. A 6-foot-wide gravel platform will hold sand down and encourage a soil crust to form. The similar Project named "New Green Wall of China" was started last year for the stabilization of sands in the Taklamakan desert. In 1935, overgrazing and drought caused 850 million tons of topsoil to blow off the United States southern plains, leaving 4 million acres barren and creating the Dust Bowl. To address the problem, the newly formed Soil Conservation Service introduced the Shelterbelt Project- a 100-mile-wide strip of native trees bisecting the country from Canada to Texas. In a few years, it helped to reduce the amount of airborne soil by 60 percent.

The above-proposed range and forestation projects are not only useful for increasing rangeland productivity but also for sand dune stabilization and protecting settlements from sand and dust storms.

C. Forage Seed Production Project

One of the main reasons of low rangelands productivity in the Registan Desert is seed bank depletion for the majority of desert plant communities. Therefore the reviving and/or development of seed production for some desert plants through extension of analogous programs directly involving Kuchis pastoralists and their families is crucial needed.

At present due to lack of equipment and seed reproduction techniques the Kuchi nomads are largely dependent on the market for the supply of forage seed. From the preliminary information collected, we did not find any organized seed introduction or a program for seed testing and improvement. There is no any large-scale system of identifying the appropriate desert test areas for seed production. An example is the experimental plots near Garmsir and seed/testing field experiments in the Boulan (CADG Experimental Farm) that has been established in spring 2004 by using of different drought tolerant fodder desert plants both from Afghanistan, Uzbekistan and USA (Appendix 6).

However there is still a need to start an organized Program. The required seeds or cuttings/ can be produced by local staffs during the project implementation phase. These commercial nurseries should be managed as reserve living material and a dependable source of seed. It is essential to ensure continuity, management and maintain of these nurseries to form a reservoir of local and introduced forage desert species that can provide pastoralists with planting materials and researchers with a pool of genetic material for various breeding purposes. Establishment of local forage seed production system will generate an alternative income for the local pastoralists and even farmers.

Many desert plants, especially legumes in Registan have the potential to improve soil fertility and can therefore promote sustainable crop-livestock integration. Such opportunities mean that seed production of these valuable species should be developed. However rangeland forage species seed production require handling and special pre-treatment that are somewhat different from filed traditional crops. Regeneration of rangeland productivity through seed production on –the-ground relief, education and extension programs directly involving farmers, mostly women and their children should be of high priority. Therefore the creation of a core of well–trained seed technologists and staff training is an essential element and useful tool to strengthen the seed production capabilities of national programs.

Plans should be set to establish the research –trial fields (small-scale experimental plots) and to cultivate native drought tolerant plants, as well as seeds varieties that have been tested in the desert conditions of Taklamakan (China), Kyzylkum (Uzbekistan, Kazakhstan) and Karakum (Turkmenistan) deserts. No doubt that existing technologies on drylands crops farming in these countries would be adaptable and useful for Northwestern Afghanistan that has almost similar edafic-geographical conditions. Seeds and crop improvement team including both experts from neighboring riparian countries and afghan scientists would primarily focus on testing, multiplying and distributing drought-resistant plants and crop varieties to farmers.

VIII. LARGE REHABILITATION LIVESTOCK INCOME GENERATION

While meteorological records indicate an annual rainfall ranging from 140mm/yr in eastern Registan to 70mm/yr in western Registan, productive desert range can be developed with as little as 60mm of rainfall per year. Water harvesting, thoughtful species allocation and management are critical factors in the development of productive dry range. The 100km x 100km Registan area could support a thriving economy through livestock production. Perhaps half has sufficient water holding capacity to be useful in water harvesting efforts. As part of this study, large-scale range rehabilitation is proposed based on the development of livestock production. In an area of $10m^2$ (a pit), 100mm of rainfall adds up to one cubic liter of water per year. If water harvesting is 50% successful (trapping half the rainfall), that means that a plant growth zone $1m^2$ would have access to a column of water equal to 500mm. That's far more than is required for highly productive forage crop production. Pitting plows that can produce catchments will permit water harvesting with an efficiency of approximately 50% or better and allow for the planting of 10% of the useful landscape. If successful, this will dramatically reduce both wind and water erosion, converting at least half of Registan into economically productive land.

This is a large-scale work plan to pit and plant huge areas of Registan Desert. Assuming that productivity is 1/10 that of reasonable rangeland elsewhere (4t/ha), this still equals 20 million tons of forage and feed- enough to support 10 million animals. In terms of income generation, four million animals harvested annually for meat at $100/head equals $400 million. Annual wool production based on 6 million sheep (producing wool worth $20/head) equals $120 million.

The pitting plows needed for this type of project have been available for decades, and were widely utilized to help establish vegetative cover in the arid West of the United States. They till, compress, and form soil into small bowls. One pitting plow can prepare approximately 100ha/day. One thousand plows would prepare one hundred km^2 per day. The 'tillable' part of Registan could be pitted in four years, utilizing the cool season for pitting and planting. Perennial, persistent plant species that are well-adapted to the microclimates available in Registan should be used for this program.

This provides an excellent system for the use and training of Kuchi IDPs, possibly as part of a WFP-sponsored food-for-work program. They can provide the labor force needed to produce the thousand seedlings required per hectare, and this labor force can also be utilized to plant the seedlings. Keeping the planting up with the pitters would require about 5,000 laborers. Managing the plastic houses and coldframes for seed germination would require another 1,000 laborers. All participants (equipment operators, greenhouse workers, planters) would require training and adaptation.

A. Small-Holder Farming and Semi-Nomadic Pastralism System

Cultivated rangelands as feed alternatives during drought can be applied only in key resources sites, where livestock may be herded in relatively restricted areas and within an agropastoral setting. This will not be possible in remote areas of Registan, where more extensive pastoral production systems are required involving frequent transhuman movement. Before such intervention, however, it is important to know how most pastoral herds use the fodder landscape in dry areas, dry seasons, and dry years. These are the 'key resources' that sustain animals in times of fodder shortage (Scoones, 1994). Moreover some annual chenopods like Salsola paulsenii, S. schlerantha, Climacoptera lanata, Krashenikovia lanata, Halimochnemis villosa, Gamanthus gamocarpus, Horaninovia ulicina, Atriplex spp., annual and perennial grass Poa bulbosa, Eremopyrum orientale, Bromus tectorum, Agropyron desertorum, Aeloropus litoralis, and Carex physodes were tested in man-made pastures of Central Asian deserts as a component of improved or regenerated rangeland (Appendix 7). The listed in the Appendix 7 psammo-xerophytic species of plants are selected according to climate conditions, type of soils, and rainfall availability.

B. Greenhouse/Plastichouse Installation

These can be used for production of some vegetables for agropastoralist families. NETAFIM Family Greenhouse technology appears to be very useful for the reclamation of sandy/loamy areas of Registan desert. Such kind of activity can be allocated around boreholes, watering places, functioning wells, etc. In desert land it will be possible to initiate:

- reseeding with legumes, planting singular tree
- efficient breeding and for efficient fattening (pregnant animals, lactating female, new borne lambs etc.) operations can also easy be sustained by pastoral producers at the " key resources sites"
- to encourage women participation in pastoral development and natural resources management
- simple thorn (from Lycium, Alhagi) fences is needed to exclude any outside intervention, including migrant herders etc.

C. Necessary Establishment

For the realization of such activity it is necessary to establish the following:

Plastic tunnel:

Use of germination plastic tunnel according to specification: Size; 8 meter x 25 meters with sprayer, and fog irrigation. Plastic trays sized of 20 x 35 centimeters approximately. Soil or propagation substrate should be of light structure; 35 percent sandy soil and not more than 25 per cent of clay, 40 per cent soil or inert substrate. Advisable pH is in between 6.5 and 8.2. The plastic tunnel will be placed in such a way that air ventilation can be performed. Optimal germination temperature is 28 degrees centigrade during the day and not less than 16 degrees centigrade during the night.

Transplantation:

After germinating, plants will reach the size of 2.5 up to 3.9 centimeters on average and will be transplanted to plastic containers or plastic bags the size of; 8 x 20 centimeters (one-liter bags).

Nursery growth conditions:

The plastic bags will be protected against excessive radiation of the sun by a black net which only 70 percent of the sun light will pass through. The size of the "black net" nursery will be 90 x 48 meters, which makes 4300 square meters. On the floor of this "nursery tend," a black plastic sheet should be placed ("Palrig") in order to prevent weed germination and facilitate transport in the nursery while soil is wet. The nursery will produce forest plants which will be planted in the forest during the winter (December 2004 till February 2005). Plantation will be performed in three plots based on environmental characteristics- desert region and semi-arid region. Representatives of the Ministry of Agriculture and Animal Husbandry (MAAH), will select the trail plots. Each plantation trail represents forest species; trees and shrubs both from native and introduced Floras (see Appendix), according to its needs or goals and to the specific environment.

Land preparation:

Minimal land preparation must been done before seeding. A rough tillage is necessary to provide sufficient moisture and eliminate competition from undesirable plants. The optimum depth of seeding is less than about 1-2 cm for most above-indicated species and in all cases less than 5cm.

Transplantation:

After germinating plants reach the size 3.9cm –4.5cm they will be transferred into the field.

Bahoric agriculture

This is a type of crop farming in the rainfed/non irrigated arable lands in Central Asian countries.

Various drought-tolerant species and varieties of Hordeum, Agropyrom, Cecale, Triticum, Sorghum, Zea mays, Cicer, Medicago sativa (alfa-alfa), Onobrichys chorsanica, sandberg bluegrass, russian wildrye, inland saltgrass, and alkali saltgrass can be tested within seminomadic pastoralist farms.

Introduction and cultivation of different varieties of Gossypium hirsutum (cotton), Hordeum, Secale, Cicer and other drought tolerant perennial grasses for grain production in the edge/sandy areas of Registan should be of great interest as well.

D. Cash Crop Farming

Charthamus tinctorius (saflora) from Asteraceaeis

This is a kind of sunflower strongly recommended for cultivation on the foothills or marginal lands of Registan for oil production. In addition, this plant is also good forage for all livestock as well as a potential plant for silage or winter concentrate. This plant can be easy introduced under desert/semidesert environments of Southwestern Afghanistan

Carthamus tinctorius L. at the stage of flowering/beginning of fruit maturation (Karnabchuli steppe, Uzbekistan).

photo after Gus Gintzburger

Taking into consideration of CADG experience and on the base of peanut factory the oil-production from this plant can be started in 2005. High quality seeds may be available from neighboring countries like Uzbekistan and Tajikistan. Species of genus ***Sesame indicum (kunjut), Linum humile, L. mesastylum, Helianthus*** could be also recommended for oil-production.

E. Biosaline Agriculture in the Registan Desert

For the reclamation of the sandy to clay saline wet soils, it is recommended to use different species of Tamarix for reforestation and sand-dunes fixation (on high saline water table). Fuelwood, carpentry, and building material and additional benefits of Tamarix reforestation could be expected. People can also use Tarmarix to treat gastric disturbance, respiratory disorders, rheumatism, and arthritis.

Phragmites Plant Communities

In the natural desert/tugai communities, especially on dry river banks or on the soils with high water table, this plant always forms pure stands that can be used by local people as common building material, a raw material for paper, and chemical industries. It is also used for handicrafts. All drainage canals in the Helmand Province, mainly nearly Lashker Gah, are completely full of dense stands of Phragmites (red grass). Phragmites can be easy propagate vegetatively and use for hay and silage making as rough forage.

F. Sericulture Production

The marginal lands of Maiwand, Panjwayi, and Takteh Pol can be used to cultivate Morus alba, M. nigra and M.seratta both for ornamental purposes and feed for silkworm. Wood of all species and ecoforms can be recommended for building, constructions, etc. The bark and leaves of these species can be used for yellow and black dyes. The fiber of branches is suitable for rough spinning. Paste from branches is a good material for manufacturing paper. Sericulture production will be of good benefit for IDP's despite that 50% of trees have not survived the drought. For such a program it is necessary to establish a small experimental demonstration plots on the territory of a governmental farm. Work should start with the reproduction of two local Morus species (M. alba, and M.setaria including its hybryds: M. bombycis x M.alba, M.alba X M. multicaulis and others forms and varieties) from cuttings.

The operational technique is similar to agriculture with grapes or pomegranates. A plot of about 1,600 plants in total is optimal for a start. This process may be initiated at any time and will take at least 2-3 years to obtain a mature tree for full exploitation. Such plantations at well manage can be used for 20-35 years or more. Sericulture training should be start immediately with involvement of specialists from centers in Afghanistan, Central Asia, and China. Silkworm feeding lasts 2-3 months and may be timed to January/February –April (seasonal activity). It is an optimal home activity for women and their childen until livestock keepers graze their flocks in the Registan Desert. To establish this at the selected "key resources sites" of IDPs special sheds and trays for keeping silkworms during their ontogenetic development are needed. There two alternative variants: 1. Individual shed/trays for one family or 2. Small groups (3-5 families together). A responsible person or skilled staff should manage their activity to determine the market of silkworm 'kokons'. It may be more profitable to open a small-scale silk-worm production farm. Silk could be utilized in local manufacture of carpets, which are much more expensive than wool-made ones, as well as for embroidery (Chinese and Japanese experiences should be promoted).

IX. ADDITIONAL ACTIVITIES

A. Traditional Medicine and Pharmaceuticals

The following native species can be tested and after transfer into special plantations on the marginal lands of Registan. IDPs can assist in the collection of seeds from the Registan desert and adjacent territories. Amygdalus species, mostly A. spinisissima Bge, is a valuable source of oil in perfume and confectionery industries. It has been used as a medicinal plant as well. Lycium turcomanicum or L. ruthenicum is a perennial shrub (height 60-1.25m) very prickly –thorny from Solonaceae. It is well distributed on the marginal lands of Afghanistan in Helmand and Sistan River Basins. This species can be recommended as a honey-making plant due to its long flowering period. The plant is also suitable for live impenetrable fences. Burns well. Berries (fruits) can be used in medicine.

Glycyrrhyza glabra–one of the most popular medicinal plants for treatment of respiratory, gastricand skin (eczema) disorders and stomach ulcers. Powder and extract from roots is widely used in the food industry instead of sugar. The extract from this plants can be used as a cosmetic, for tanning skin, and for dyeing wool in different colours. It is also a potential plant for range improvement, pastures and hay in the western of Afghanistan.

Artemisia spp. – aboveground green biomass contains volatile oil used in traditional medicine (tincture from dry leaves is used to induce appetite and for the treatment of gastric complaints).

Peganum harmala – *it is a p*oisonous and not touches by livestock when green. However this plant is used in traditional medicine as emmenagague, emetic and diuretic. The over ground biomass is rich in alkaloids that are potential for use in the pharmaceutical industries. Also is recommended as a colorant –dye plant (dark red).

Caparris spinosa – can be used in the traditional medicine as a treatment of for bronchial asthmaand gastric digestive illness. Extract from roots used for hepatitis (liver deseases), as well as for mouth disorders and as a green dye.

Cistanche flava (CAM.) Korsh.– long underground, tuberous whitish stem rich in alkaloids for treatment of gynaecological and urological (kidney) problems. In China this plants is special cultivated in large-scale for development of traditional medicine.

B. Wool Treatment/Spinning

Prior to starting this kind of activity it is necessary to interview older women in order to define: 1. hand wool proceeding -cleaning, spun by hand with small spindle or simple for manufacture of “ kurpacha” patchwork quilt. In Central Asian countries cotton is used instead of wool. 2. Spinning wheels seem profitable only for younger ladies (20-45). A special vocation training course should be done. Wool can be sold at the markets or Kuchis women can make clothes, socks etc. that make them much expensive that pure wool.

C. Sheep/goat Skin Processing

Manufacture of ‘postak’ (turkish word) or ‘ovchina’ – a treated and cleaned skin of ram, sheep, and goats which is used to make clothes for herders or to lay on the floor as a rug, especially in their temporary camps/yurtas etc.

D. “Yurta” or “utov” Construction

This is an alternative nomadic camp house for families of pastoralists. An expert from Kazakh steppes would be invited to train them. This kind of living is much more comfortable and strong against sand and dust storms (for a numbers of years if maintained well) than tents.

E. Manual or Simple Constructions for Grains Processing

Keli (Turkish) is a handy or motor driven grinder for small grain and cereal frequently used by pastoral communities in the desert. Qo’l tegirmon is a hand or electrical mill used to make flour from cereals.

F. Poultry-Keeping or Farming

Mainly chickens for eggs and meat.

G. Carpet Weaving, Sewing and Embroidery (Machine and Needlework)

In areas of the Central Asian deserts, particular in Turkmenistan, Uzbekistan, and Kazakhstan women make carpets and rugs using simple homemade construction and after sell it at the market. To make traditional typical Baluch and Pushtun dresses.

H. Bricks and Ceramics Production

Local people are skilled enough for this activity.

X. ENVIRONMENTAL POLICIES FOR REGISTAN EDGE AREAS

Expansion of arable lands into pastures in both surveyed provinces requires examining the water and land use of these areas in the broadest sense. Clearly this represents a policy decision ultimately determined by political/governmental leading processes, but pastoralists should have a major advantage in the access of land and water use of these marginal areas.

The elaboration of optimal environmental policies for the sustainable development and conservation of marginal lands of Helmand and Kandahar Provinces is crucial.

There is much conflict around resource use associated with such areas. This is in particular semi-arid lands, where land and water resource use is valuable since resources pressures are at their most intense with the competition between agricultural and pastoral use of lands. Some areas are effectively open access (Garmsir) while others areas are managed communally according to locally negotiated rules (coordinated access, common property) as particular case in the Helmand River Basin and others areas used exclusively (effectively private) as an illustrative case in the Tanaka River Basin .

This system can brought pastoralist into increasing conflict with settled agro-pastoralists (semi nomadic type). The expansion of arable farming so close to border of Registan undoubtedly decreases the potential grazing areas in drought years. In addition the intensive irrigated agriculture gradually will induce sandy movement and encroachment of the adjacent settlements

Despite of the herders found out in such areas a various fodder intake by the increased used of crop residues with high nutrient content, the use of arable follows rich in legumes or careful grazing of animals between fields and along field boundaries makes maximum use of available fodder resources.

Nevertheless the special environmental policies of use and sustainable development of marginal lands should be reconsidering. Adaptation or gradually moving of Kuchi nomadic pastoralists through such still 'fruitful' lands requires new flexible tenure arrangements both from local, regional and international levels. These may involve restriction of intensive irrigated agriculture system during the cultivation season within agropastoral communities so that mixed livestock-crop farming can continue successfully for the new centuries. This is why effective pastoral institutions (governmental control, stable social groupings or even clan and tribal networks) are important to be developed.

As far as women are direct users of natural resources: collecting and working wood; gathering wild cereals; fetching water; straw for the camp etc. they should be vastly involved in any agro-pastoral development system in Afghanistan.

XI. STRATEGIES FOR PASTORAL REVIVAL

A. Water Points

Water deficits of various duration and severity are commonly observed in the surveyed regions along with deterioration of water quality;

-water capacity; duration of flow; ease of access;

-the proportion of rangelands in relation to distance to water. It is defined that in extra arid conditions one-day watering are usually confined within 15 km –20km. Beyond the 20 km limit, range utilization is expected to be low, owing to inadequate access to water source for livestock;

re-charge rates of many ground water (aquifers) are poorly understood. So their exploitation, especially through the use of tubewells for agriculture purposes should be handled with care;

"Navars" in the desert should be gradually rehabilitated ;

Catchment area (watershed) from mountains/slopes and rains should be re-considered; Check dams for store water or creation of artificial water reservoir from where water will be distributed gradually. That will decrease level of underground water; will prevent soil erosion; water can be used gradually and be managed for artificial forest etc.;

Short-term projects include rehabilitation of irrigation canals and existing systems, especially for areas that are located in river basins and main sources of cultivation should be initiated in 2004-2005;

Transport of fodder (In the small -scale sector)

They´re various options including:

-provision of credit to allow herders to buy their own fodder;

subsidized transport and distribution of fodder;

establishment of animal feeding centers to which fodder (groundnut and cottonseed cakes; briquettes, strikes); can be brought

reallocation of fodder to drought mitigation amongst pastoral herds;

Provision of Credit is much more reasonable to be given to the pastoral Association Leaders;

Restocking and recovery schemes in the post-drought period;

Provision of veterinary services to ensure greater survival rates of animals;

Diversification of incomes (craft work and additional activities);

-Monitoring system to alert and inform pastoralists about grazing conditions;

Other measure of post-drought rehabilitation is to encourage and teach herders and their families to other forms of livelihood: irrigation scheme development and crop/forage production (enabling them to become self-sufficient producers).

XII. OUTSTANDING NEEDS:

A. To set up an Early Warming System or to Establish an Experimental Meteorological Station

Establishment an early warning system based partly on empirical indicators such as rainfall, vegetation production, animal and cereals prices, and also on perceptions and indicators gathered directly from pastoralists. Attempts to develop early warning system using satellite technology and modern GIS mapping of soils, vegetation, carrying capacity of rangelands, fodder availability maps etc of Registan Desert will be of great appreciation in the management and sustainable development of enormous pastoral areas both in Helmand and Kandahar districts.

B. Subsurface Drip Irrigation (SDI) Promotion for the Reclamation of Abandoned and High Degraded Rangelands.

However, more thinking is needed, however, to rehabilitate the previous or to set up a new model of pastoral development in the Registan Desert of Afghanistan.

Subsurface Drip Irrigation (SDI) is an ultimate example for it. It is a low-pressure irrigation system that uses polyethylene drip lines that are permanently buried below the soil surface. SDI is the slow, frequent application of small amounts of water to the soil through driplines located beneath the soil surface. SDI does not use unnecessary water evaporation into the atmosphere and does not use underground water that contains salt and cause of deserticication. SDI allows for highly productive crop production without leaching or runoff. Only the amount of water needed by the crop on a daily, or other very frequent basis need be diverted from a stream or reservoir, thus helping to also protect water quality. Similar technology is applied as a conventional Drip Irrigation.

Conclusions:

1. In highly droughty, highly non-equilibrium environments land and cover vegetation degradation are not the major issues that it was once assumed. Water supply and distribution of water points continue to be a crucial priority in the desert areas of Registan.
2. Maintaining the mix herds (different animals, mostly sheep, goat, donkey and camels), its optimal size and health of animal populations through transhumant grazing system and investment in veterinary case also remains a priority.
3. Range management (rotational grazing systems, carrying range capacity, tricking trials, grazing pressure, grazing in relation to watering points, plant communities and biomass production) and rangelands improvement are crucial, especially on sandy deserts near Garmsir, Panjway and Mandai districts
4. Starting a Project with a small `key resources´ Kuchis pastoral groups - lively potential legitimate contributors to the country economy. New directions in research and training are required to achieve in these focus agropastoral areas.
5. Initiation of any agroforestation Program (shelter, windbreak belts) and a sand and dust stabilization Project
6. Centralized selling through a special " agropastoral Kuchis Market.
7. Studies, rational use and conservation of marginal lands as a buffer ecological zone in the Registan Deserts
8. Exchange of seed and planting material with institutions from Central Asian countries, China, Israel with similar eadaphic-climate conditions
9. Promotion of links between national institutions, NGOs involved in the seed industry and International organizations active in the field of desert forage species seed production, research and technology of irrigation and cultivation.
10. A final idea is to build underground reservoirs, near the nawars, cover their walls with impermeable clay, and siphon the nawar water into these " underground storage tanks" in the event of an excess of water. This will minimize evaporation and allow storage of water for long periods, even during the summer. Again, the problem here is that an engineering plan is needed and professional supervision is probably essential. Local soil would have to be tested to see if it contained enough clay and could be impermeable enough for such a storage cave.

APPENDIX 1. INTERVIEW OF KUCHI IDP

Interviews of livelihood/interest and opportunities of Kuchi Internally Displaced Persons from Maywand district (Kandahar Province)

The almost total loss of livestock was the main concern. Consequently, IDPs cannot return to their homes, and migration remains in a south-north direction. It is unlikely that they can return to the desert before the late autumn 2004, the start of the next rainy season.

I feel sometimes like a beggar at the bazar: you have to wait and see what food you get and when?

Winter rains were an estimated 25% of the average and brought little relief to communities or the environment. It was insufficient to generate proper pastures and refill traditional water reservoirs.

Many pastoralists Kuchi groups acquire to promote diversification of pastoral occupation, for example placing family members in different occupations, most of them non-pastoral, and increasingly none cropping either.

When times get hard, we tends to eat less, to turn to cheaper food and wild plants, to sell assets, and in some cases, move out of the area.

"We never used to let our daughters marry people from the city because if they settled they would be like a bird in a cage. Now we are like a bird in a cage."

Please teach us something so we can earn some money ourselves. Our men complain that they are doing all the work and that we do nothing but sit lazily around

We cannot even heat ourselves, how do you think we can heat chicks?

On the question" if you had only one blanket, which would get it: you or your camel? A Kuchi elder had a quick answer : " My camel, because I depend upon him; I even try to give some of the food-aid wheat to my sheep with lambs and they give me milk in exchange".

After training we have no money to buy inputs and there is no market for the products in the camp. Therefore we suggest that the project would sell the products for us or still even better provides us with the material and then we will produce carpets and dresses for the project for the salary".

Some claims highlight the question of where do nomadic pastoralists have their areas of origin?

A little boy felt to needed to explain his chore " we must save the young sheep"

He doesn' t want his own eight children to carry on their nomadic life. Instead he wants them to get an education and job.

He doesn' t want his son or daughters to have the same Kuchi life as he had, no matter how good it was in past.

If they carry on, some day will be drought, their animals will die and then they will be left with nothing. So, let them have an education and jobs and their life will be better

But Afghanistan' s Deputy Ministry of Frontier and Tribal Affairs Mirza Ali, as atamant Kuchi culture will not be allowed to disappear

Some way give up but most of them like this life. But we need to keep them on the move

APPENDIX 2. SOILS CHARACTERISTICS

Table 1. Results of Soil Sample Analyses of Various Helmand Districts.

District	Nawa	Kajaki	Bollan	Garamseer	Musa Qala	Nahre Seraj
Soil pH (1:1)	7.8	8.12	8.05	8.08	8.07	8.18
EC (1:1) S/cm	21.30	227	863	3940h	871	22.5
O.M. (%)	1.27	0.72	1.16	0.94	0.23	0.96
Available P	11.1	12.6	8.96	16.4	4.63	6.48
K (ppm)	664	169	216	373	356	297
Ca (ppm)	4,562	3,971	4,557	4,514	4,558	4,497
Mg (ppm)	498	281	490	813	348	455
Na (ppm)	323	62.5	151	863	229	66.2
Fe (ppm)	4.57	5.24	5.34	3.92	1.33	5.98
Mn (ppm)	11.5	8.42	12.4	8.25	5.06	7.59
Zn (ppm)	1.03	0.34	0.67	0.51	0.28	0.33
Cu (ppm)	1.24	0.69	1.05	1.27	0.68	1.46
Cl (ppm)	304	32.1	70.0	512	198	23.6
CEC(me/100g)	6.54	4.36	8.48	7.69	9.54	7.94

Table 2. Summary of Soil Analyses of West Kajaki Area.

Analysis		High	Low	Mean	Remarks
Soils	Saturation %	90	35	45	
	pH (Paste)	8.9	7.8	8.3	
	pH (1:10)	9.7	8.0	9	Very few over 9.3
	Sand	64	10	20	Local sandy areas
	Silt	58	10	40	
	Clay	54	23	40	
	Texture	Clay, Silty clay, silty clay loam, clay loam sandy loam			
Saturation Extract	Ecx 10^3	10.6	0.57	2.25	
	PH	9.0	7.2	8.3	
	Na (me/li)	55.0	1.25	7.0	Less than 25% over 20
	Ca+Mg "	77.0	1.55	12.0	
	Na "	2.85	0.04	0.40	
	Esp	30.0	0	4.0	Very few over 15%
Permeability (Cm/Hr)	Initial	1.91	0.33	0.76	
	Final	2.30	0.76	0.76	

APPENDIX 3. CLIMATIC DATA

Table 3. Temperature and Relative Humidity, Lashkar Gah, Helmand

recorded at CADG Lashker Gah, May 10, 2002 – May 10, 2003

Months	Temperature (ºC)		Relative humidity (%)	
	Max	Min	Max	min
January	21.3	1.5	72	31
February	29.8	0.6	86	20
March	35.8	0.3	68	30
April	42.3	10.6	60	20
May	46.3	17.1	60	16
June	46.5	20.3	44	16
July	48.5	22.1	43	16
August	46.2	21.3	52	18
September	41.2	13.8	46	16
October	36.1	13.3	41	20
November	31.1	4.7	51	21

Table 4: Temperature and Relative Humidity, Lashkar Gah-Helmand

May, 2003 - May, 2004

Months	Average temp. (°C)		Average relative humidity (%)	
	Max	Min	Max	Min
January	19.5	6.7	80.9	60.1
February	23.1	7.2	70.3	46.6
March	29.3	12.5	49.6	30.4
April	34.5	17.4	38.3	24.3
May	37.5	19.2	30.4	20.1
June	45.0	25.4	31.1	17.7
July	48.8	29.7	38.4	20.5
August	44.0	25.2	33.4	19.0
September	36.5	19.1	33.3	20.1
October	31.0	12.3	36.0	21.4
November	22.7	6.4	51.6	32.9
December	19.2	3.7	70.2	46.9

Table 5 : Climatic Data of Kandahar & Nimroz Provinces

Province	Kandahar (Elevation: 1000m)					Nimroz (Elevation: 490m)			
Months	Mean Monthly Temp (C)	Mean Monthly R.H. (%)	Mean Monthly Precip (mm)	Mean Monthly Evap (mm)	Mean Monthly Wind Velo (km/hr.)	Mean Monthly temp (C)	Mean Monthly R.H. (%)	Mean Monthly Evap (mm)	Mean Monthly wind velo (km/hr.)
January	6.7	61	50.8	73.0	6.4	6.5	55	124	10.5
February	10.0	58	35.8	84.0	6.8	10.5	55	124	12.9
March	15.0	49	37.1	149.0	7.2	14.6	50	204	13.7
April	20.6	43	23.4	201.0	8	22.3	42	315	12.1
May	25.0	37	7.6	326.0	6.4	28.4	35	451	13.7
June	28.9	33	0.0	415.0	7.2	31.6	30	622	19.3
July	31.1	30	2.3	459.0	8.8	33.9	30	702	24.1
August	28.9	26	0.0	421.0	5.6	30.9	25	737	24.1
September	23.3	26	0.0	335.0	4	25.4	27	523	16.1
October	16.7	34	0.3	233.0	3.2	19.3	35	326	10.5
November	11.7	44	4.3	141.0	4	14.9	45	205	7.2
December	8.9	54	20.3	90.0	5.9	9.9	55	133	7.2

Table 6 Climatic Data of Helmand Province

Location	Kajaki (Upper Helmand)			Average of Lashker Gah Marja and Cha-I-Anjir		Lashker Gah (Lower Helmand)		
Months	Mean monthly Temp(C)	Mean monthly precip (mm)	Mean monthly evapo (mm)	Mean monthly R.H. (%)	Mean monthly Wind speed (km/hr.)	Mean monthly Temp (C)	Mean monthly precip (mm)	Mean monthly evapo (mm)
January	7.2	65	61	76	6.9	7.8	21.1	85.3
February	10.0	44	82	54	8.5	10.6	16.0	100.7
March	16.7	35	114	54	9.2	16.7	21.0	169.0
April	20.0	16	190	42	13.7	20.6	13.0	227.4
May	24.4	6	270	35	9.3	26.7	3.0	332.7
June	29.4	0	351	33	10.5	31.1	0	430.3
July	30.0	3.0	381	30	6.4	32.8	0	441.0
August	27.8	0	318	31	6.1	30.6	0	398.0
September	18.9	0	235	30	5.9	25.6	0	309.0
October	18.3	0	214	38	5.3	19.4	0	216.0
November	11.7	6	130	48	5.8	12.8	3	118.0
December	8.3	28	70	59	6.9	5.0	12	93.0

APPENDIX 4. WATER QUALITY

Table 7. Quality of surface water from Helmand River.

Ecx 10^6	320
Na %	20
PH	8.1
Dissolved salts (ppm)	258
SAR	0.75
Irrigation class	C2-S1
Ca (me / li)	1.46
Mg (")	1.26
Na (")	0.7
K (")	0.14
CO_3 (")	0.25
HCO_3 (")	2.33
Cl (")	0.49
SO_4 (")	0.49

S = exchangeable sodium hazard
S1 = Low, S2 = Medium, S3 = High
S4 = very high or unsatisfactory for irrigation use

C = Salinity Hazard
C1 = low, C2 = medium,
C3 =high and not suitable for soils with, restricted drainage,
C4 = very high, and unsatisfactory for use except for special crops and highly permeable, freely drained soils.

Table 8. Water Quality of Wells in Different Areas of Helmand.

Location	Lashkergah Wells	Girishk Wells	Chah-I-Anjir Wells	Nad-I-Ali Wells	Marja Wells	Darweshan Wells
EC x 106	990	865	960	1,360-7,444	1,500-5,566	1,500-3,400
Na %	46	72	57	32-79	62-65	51-60
PH	7.7	7.3	7.7	7.4-8.6	7.6	7.1-7.4
Dissolved Solids(ppm)	994	991	-	989-5,164	1,075-3,483	1,065-2,728
SAR	3	1.20	3.60	2.0-18.0	6.2-12.5	4.2-8.0
Ca (me/li)	2.9	4.19	1.96	2.87-11.90	2.0-10.27	3.0-6.15
Mg "	2.96	2.98	2.08	2.93-15.20	3.20-7.33	4.34-10.65
Na "	5.02	2.06	5.37	4.68-56.80	10.0-21.80	7.92-23.90
K "	0.04	2.26	0.05	0.06-0.48	0.10-0.16	0.16-0.30
CO3 "	0.0	0.0	0.0	0.0	0.0	0.0
HCO3 "	2.63	6.22	3.45	2.20-19.25	2.13-3.10	6.42-10.0
SO4 "	4.99	1.81	3.50	2.15-35.65	8.01-24.55	5.68-18.70
Cl "	3.3	1.46	2.51	3.25-45.60	5.16-31.02	3.33-12.30
Irrigation Class	C3-S1	C3-S1	C3-S1	C3-S1~C4-S4	C3-S2~C4-S4	C3-S1~C4-S2

Table 9. Quality of Ground Water (Karezes) West Kajaki.

Karezes	EC 10^6	% Na	pH	Dissolved salts (ppm)	Class of water	Ca (me/li)	Mg (me/li)	Na (me/li)	K (me/li)
Bebanak Karez	620	15	7.7	396	C2-S1	2.64	4.04	1.18	0.04
Uen-I-Karez	620	13	8.8	396	C2-S1	2.84	5.49	1.00	0.04
Deep Well	680	34	7.5	435	C2-S1	2.13	3.20	2.64	0.00
Nicha Karez	800	14	7.7	512	C3-S1	2.96	5.91	1.54	0.06
Gondam Karez	820	13	7.8	525	C3-S1	3.86	5.49	1.38	0.04
Hak-I-Garan Karez	710	24	8.1	455	C2-S1	2.23	4.52	2.20	0.08
Kala-I-Gul Karez	740	26	7.5	465	C2-S1	2.44	4.57	2.16	0.04
Haider Bojai Karez	540	31	8.1	346	C2-S1	1.66	2.66	2.04	0.06
Bugal Khail Karez	710	18	7.8	455	C2-S1	3.00	4.36	1.60	0.04

Table 10. PhysicoChemical Characteristics of Surface Water of Kandahar Province

	Kishki-Nakhud Well	Arghandab River	Arghansan River	Tarnak River
EC 10^6	440	1107	1715	700,0
Na %	24	49	63	42,0
pH	8	8,3	7,4	8,1
Dissolved Salts (ppm)	321	960	1100	495,0
SAR	0.81	3.75	6.2	2.2
Irrigation Class	C_2-S_1	C_3-S_1	C_3-S_2	C_2-S_1
Ca (me/li)	2.06	1.02	6.44	1.76
Mg (")	1.20	6.43	–	2.48
Na (")	1.03	7.19	11.10	3.25
K (")	0.60	0.16	0.18	0.10
CO_3 (")	0.45	1.84	–	0.13
HCO_3 (")	3.30	3.65	–	3.20
Cl (")	0.37	3.07	–	4.26
SO_4 (")	0.23	6.24	–	0.0

Table 11. Water Salinity in Kandahar and Helmand Provinces; April, 2004

Province	Name of the District	Source of Water	Water Salinity % Salt	Water Salinity EC x 10^6	Remarks
Kandahar Province	CADG Office	Drinking	0.05	833 (Class-3)	1
	Houz-e-Madad	Underground	0.14	2333 (Class-4)	2
	"	Underground	0.16	2666 (Class-4)	3
	Naib Canal	Surface	0.07	1166 (Class-3)	4
	Kadanay River	Surface	0.02	333 (Class-2)	5
	Kuchi Camp (Registan Desert)	Drinking	0.10	1666 (Class-3)	6
	Marginal Lands (Naibullo Settlement)	Surface	0.01	167 (Class-1)	7
	Spin Manda N 31 03 22.64 E 64 59 55.05	Surface: drainage collector canal from Arfhangab river	0.41	6833 (Class-6)	8
Helmand Province	Helmand River	Surface	0.01	167 (Class-1)	9
	Darweshan Canal (Near Registan)	Surface	0.06	1000 (Class-3)	10
	Lashker Gah	Tube-well	0.07	1166 (Class-3)	11
	Lashker Gah (CADG Office)	Drinking	0.06	1000 (Class-3)	12

Remarks:

1	Medium to high salinity water should be used only on soils of moderate to good permeability. Needs regular leaching and special management. Plants neede with moderate to good salt-tolerance.
2	High salinity water can be used for irrigation only on soils of good permeability and where special leaching is provided to remove excess salts. Only salt-tolerant crops should be grown.
3	High salinity water can be used for irrigation only on soils of good permeability and where special leaching is provided to remove excess salts. Only salt-tolerant crops should be grown.
4	Medium to high salinity water should be used only on soils of moderate to good permeability. Needs regular leaching and special management. Plants needed with moderate to good salt-tolerance.
5	Moderate salinity water can be used for irrigation with all but extremely salt-sensitive plants. With soils of low permeability, some leaching precautions may be necessary.
6	Medium to high salinity water should be used only on soils of moderate to good permeability. Needs regular leaching and special management. Plants needed with moderate to good salt tolerance.
7	Low salinity water can be used for irrigation with most crops on most soils with little salinity to develop. Some leaching may be required.
8	Excessive salinity water should not be used for irrigation.
9	Low salinity water can be used for irrigation with most crops on most soils with little salinity to develop. Some leaching may be required.
10	Medium to high salinity water should be used only on soils of moderate to good permeability. Needs regular leaching and special management. Plants needed with moderate to good salt-tolerance.
11	Medium to high salinity water should be used only on soils of moderate to good permeability. Needs regular leaching and special management. Plants needed with moderate to good salt-tolerance.
12	Medium to high salinity water should be used only on soils of moderate to good permeability. Needs regular leaching and special management. Plants needed with moderate to good salt-tolerance.

APPENDIX 5. FLORA AND BOTANICAL DIVERSITY

I. Chenopodiaceae

1. Haloxylon pesicum
2. H. salicornicum
3. H. multiflorum
4. Aellenia glauca
5. S. kali, var. praecox,
6. S. colina
7. S. foetida
8. S. arbuscula
9. Salsola tomentosa
10. S. dendroides
11. S. baryosoma
12. Agryophyllum minimum
13. Halarchon vesiculosus (endemic and monotypic genus of Afghan Flora)
14. Anabasis setifera
15. Haloharis violacea
16. H. Afghanica
17. Sueada salsa
18. S. Dendroides
19. Seidlitzia rosmariamus
20. Halochnemum strobilaceum
21. Atriplex spp. (a few species)
22. Atriplex hastatum
23. Chenopodium spp.
24. Kochia scoparia
25. K. Odontoptera
26. Panderia pilosa
27. Halarchon vesiculosus

II. Poaceae

28. Aristida piñata
29. A. plumose
30. A. pungens
31. Eremopyrum spp.
32. Stipa spp.
33. Stipa subbarbata
34. Sorgum spp.
35. Sorgum halapense
36. Stipagrostis spp.
37. Bromus spp.
38. Festuca spp.
39. Phragmites australis
40. Thypha angustifolia
41. Scirpus lacustris
42. S. Triqueter
43. S. maritime, var macer
44. Cyperus rotundus (along water course)
45. Cynadon dactylon (loess hills)
46. Distihlys spp.
47. Lolium loliaceum
48. Sorghum halapense
49. Hordeum leparinum
50. Pennisetum dichotomum
51. Eleocharis transcaucasica
52. Eremurus stenophyllum
53. Aegilops spp.
54. Agropyron cristatum

III. Polygonaceae

55. Calligonum molle
56. C. intertextum
57. C. comosum
58. C. turkestanicum
59. C. amoenum
60. C. microcarpum
61. C. setosum
62. Atraphaxis afghanica
63. Polygonum afghanicum
64. P. glaberrimum

IY. Asteraceae

65. Artemisia scoparia
66. A. turanica
67. A. iranica
68. A. herbae-alba
69. Artemisia dermana
70. Artemisia spp.
71. Scorzonera nuristanica
72. S. tunicata
73. Cousinia (this genus include about 40 endemic species)
74. Cousinia arida
75. C. gatchsaranica
76. Cousinia afghanica
77. Potentilla spp.
78. Karellinia spp.
79. Centaurea iberica
80. Erigeron spp.

Y. Boraginaceae

81. Heliotropum rudbaricum

YI. Ranunculaceae

82. Ceratocephalus falcatus var orthoceras
83. Delphinium afghanicum

YII. Fabaceae

84. Astragalus spp. (species from this genus are endemics for flora of Afghanistan. need special studies)
85. Astragalus glaucocanthus
86. A. gossypius
87. A. shurabicus
88. A. noziensis
89. A. afghano-persicus Kitam.
90. Astragalus holdichianus var. giganteus Kitam.
91. Ammodendron karivensis
92. Onobrychis spp.
93. Alhagi maurorum
94. Alhagi pseudoalhagi
95. A. sparsifolia
96. Prosopis farcta
97. Acacia modesta
98. A. eburnea
99. Caragana afghanica
100. C. ambigua Aitchison
101. Ammothamnus Lehmanni Bunge
102. Cicer chorassanicum (Bunge)
103. Halimodendron argenteum
104. Goebelia alopecuroides (L) Bunge var tomentosa Boiss
105. Psoralea drupaceae Bunge
106. Malcolmia africana, var. intermedia
107. M. cornuta
108. M. strigosa var. macrantha
109. M. Bungei var. glabrescens
110. Sophora hortensis (Boiss et Buhse) synonym Edwardsia persica (endemic for Afghanistan)

YIII. Apiaceae (Umbeliferae)

111. Ferula assa-foetida
112. F. Jaeschkiana
113. F. afghanica
114. F. suaveolens F. Stewartiana var. afghanica
115. Dorema aitchisoni
116. Eryngium spp.

IX. Brassicaceae (Cruciferae)

117. Malcolmia/Strigozella
118. Reseda spp.
119. Allysum desertorum
120. A. marginatum
121. A.persicum
122. A. turkestanicum
123. A. campestre
124. Erysimum afghanicum Kitam.
125. E. ischnostylum
126. Isatis emarginmata
127. Lepidium kabulicum Rech.
128. L. latifolium L.
129. L. Draba (Cardaria Draba) var chalepensis
130. Malcolmia africana var. intermedia C.A. Mey.
131. Sameraria stenophylla Rech.
132. Sisymbrium Irio
133. Tetracme elongata
134. Stubendorfia afghanica
135. Leptaleum spp.
136. Merendera persica

X. Plumbaginaceae

137. Acantholimon spp. (Statice)
138. A. auganum
139. A. brachyphyllum
140. A. distachyum
141. A. erinaceum
142. A. longiflorum
143. A. polystachyum
144. Limonium spp.
145.

XI. Zygophylaceae

146. Zygophyllum tetrapterum
147. Zygophyllum spp. (undentified)
148. Z. fabago var oxianum
149. Z. eurypterum
150. Peganum harmala
151. P. crithmifolium
152. Nitraria schoberi L.
153. Tribulus terrestris

XII. Cyperaceae

154. Carex physodes
155. Carex spp.
156. C. pseudofoetida
157. Cyperus spp.
158. Scirpus spp.

159. Scirpus vulpinicolor

XIII. Convolvulaceae

160. Convolvulus hamadeae
161. Convolvulus spp.(undentified)

XIY. Euphorbiaceae

162. Euphorbia cheirolepsis
163. E. helioscopia (L.)
164. E. laterriflora

XV. Liliaceae

165. Allium spp. (four undentified species)
166. Allium capitellatum
167. Eremurus spp.
168. Gagea afghanica
169. Merendera spp.

XVI. Tamaricaceae

170. Tamarix aphylla
171. T. macrocarpa
172. Tamarix spp (locally named chengazai)
173. Tamarix pentandra
174. T. leptostachys
175. T. articulate (Helmand river basin)
176. Reamurea persica

XYII Ephedraceae

177. Ephedra foliata
178. Ephedra major
179. E. sarcocarpa
180.

XVIII Orobanchaceae

181. Cistanche flava

XYIX Elaeagnaceae

182. Elaeagnus angustifolia

XX Salicaceae

183. Salix babylonica

XXI Solonaceae

184. Lycium ruthenicum

XXII. Papaveraceae

185. Papaver dubium var laevigatum
186. P. somniferum L. (known as khok-nar)
187. Roemeria refracta var. rhoeadiflora Boiss.

XXIII. Crassulaceae

188. Sempervivum mucronatum var. glabrum Kitam.

XXIY. Rhamnaceae

189. Zyzyphus nummularia

Species Often Occurring in the Marginal Desert/Semidesert Lands

190. Cedrus deodora (overgreen tree)
191. Picea smitiana
192. P. spectabilis
193. Pinus gerardiana
194. Juniperus zerafshanica
195. J. semiglobosa
196. J. excalsa
197. Abea spp.
198. Populus diversifolia
199. Quercus laleot
200. Amygdalus brachuica
201. A. communis
202. A. kuramica
203. A. eriocada
204. A. eburnea
205. Fraxinius xanthoxylodes
206. Morus album
207. M.nigra
208. M. serata
209. Rosa spp.
210. Pistacia vera
211. P. khijuk
212. P. atlantica
213. Olea ferrunginea
214. Reptonia buxifolia
215. Dodonaea viseosa
216. Cotoneaster spp.
217. Pteropyrum spp.
218. Tribulus longpetalus

219. Punica granatum
220. Fortuynia garcini
221. Capparis spinosa
222. Vitis vinifera¶.

¶ This species is largely cultivated on the marginal lands in Afghanistan There are many cultivated (by using of traditional and SDI irrigation) forms in Afghanistan. The local name for Vitis vinifera is "tak".

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APPENDIX 6. TRIAL EXPERIMENT IN BOULAN CADG FARM, Lashker Gah (April 2004)

Seed material of the below described species was collected from different arid and semiarid zones in Uzbekistan and proposed to be tested in Helmand Province as follows:

Salsola orientalis (12 bags)	Kochia prostrata (12 bags)
Halothamnus subaphylla (12 bags)	Ceratoides ewersmanniana (12 bags)
Haloxylon aphyllum (12 bags)	Agropyron desertorum (12 bags)
Artemisia turanica (12 bags)	Artemisia turanica (12 bags)
Agropyron desertorum (12 bags)	Agropyron desertorum (12 bags)
Agropyron desertorum (12 bags)	Agropyron desertorum (12 bags)

The tested species of plants are characterized by the following botanical and pastoral significance:

1. Kochia prostrata (L) Schrad, variety Otavnyi, Chenopodiaceae Perrenial semishrub (height 30-95 cm).
   Life span 7-12 years. Expected yield: biomass 1.2-2.0 t/ha. Used for haymaking.
2. Aellenia subaphylla or Halothamnus subaphylla C.A. Mey, Chenopodiaceae
   Polymorphic woody buch (height 5-160 cm), grenish, glabrous, strongly branched. Life span 7-25 years. Propagation by seeding and cutting/ transplanting is available.
   It is a good fodder plant for sheep, camels, goats, especially in late spring, autumn and in winter. Widely also used for rangelands improvement. Expected yield: forage biomass-0.5-0.8 t/ha; seed production: 0.15-0.30 t/ha.
3. Haloxylon aphyllum (Minkw) Ilijin- Black saksovul, Chenopodiaceae

Tree or tree like species (height 4-10 m), aphylous, stem succulent, strongly ramified. Life span- 50-90 years. One of the most important range plant in the Middle and Central Asian arid/semiarid zones. Young vegetative stems, fruits are valuable food for all livestock nearly al year round. Shepherds consider it a highly calorofic plants. Extensively used for rangelands improvement; regeneration, creation of shelter foresty belts, fuelwood.

4. Ceratoides ewersmaniana or Eurotia ewrsmannianna Stschegl. Ex Losinsk
   Perennial small medium schrub (height up to 120 cm) strongly branched at the base. Rough forage. Good for cattle and horses all year round. Good for rangeland improvement and natural pastures diversification. Also used as fuelwood. Expected yield: 0.03-2.0 t/ha.
5. Salsola orientalis S.G.Gmell or S. rigida Pall.
   Perennial, dwart schrub (height 15-70 cm), much branched from the base. Life span 7-25years. Excellent forage, grazed eagerly by all livestock. Good value fodder in autumn-winter. Used for hay-making. Drought and salt tolerant plant. Used for pastures regeneration. Expected yield varies from 0.81-1.07 t DM/ha to 2.16 on improved cultivated pasture. Easy to introduce. Well grow on the gray-brown soils, clay, gravelly salty soil.
6. Agropyron desertorum (Fisch) Schult, Poaceae
   Perrenial loose, tough bunch grass (height 25-90 cm) Root system filamentous, extending to depth 1.0-1.5 m. Reproduction: sexual and vegetative (rootstock and rhizomes). Excellent forage for all livestock and gazelles before flowering in the spring early summer. Very competitive with other plants on the range, especially weeds; Drought and cold resistant and moderately salt resistant. Used for hay-making and concentrated forage. Improves soils structure as well.
7. Armemisia turanica H. Krasch ex. P.Pol Asteraceae,
   Perennial low shrub (height 30-50 cm). Life span 7-25 years. One of the best rangeland feed for all livestock. Drought and frost tolerant. Valuable for the creation and/or rehabilitation of autumn winter pastures, as well as for the improvement of degraded arid lands. Expected yield: 0.25-2.54 t/ha depending on soils and state of pastures. Is also valuable for hay making. Local people can use as fuelwood.

The following species of both drought and salt tolerant plants are at the moment testing in the Kandahar CDAG agriculture office in Zhari Dasht):

1. Atriplex canescens
2. A. lentiformes
3. A. numoleria
4. A. amnicola
5. A. helimes

A nursery (poly pots) of ornamental trees (more than 14280) are prepare for testing of the following ornamental trees seeds sowing in Zhari-Dasht CADG Experimental demonstration Plots:

Eucalyptus commaldulensis

Acacia modesta

Robinia pseudoacacia

Pinus Roxburgii

Leucena leococephalla

Thoja orientalis

APPENDIX 7. NATIVE PLANTS IN DESERT/SEMIDESERT

Ceratonia siliqua (Carob tree)

various species of Tamarix (Chen gazai trees) for fuel in salty soil and improvement of salt/affected lands in the desert

Haloxylon salicornicum (tree for fuel, sand and dust stabilization by using of forest/shelter belts etc.)

Prosopis spp (largr bush)

various species of Calligonim)largr bush well grazed by camels and goats)

various species of Ammodendron and Acacia (trees in desert/semidesert areas for fencing and fuel production)

Zyziphus spina-Christi (large bush for improving of grazing capacity and fuel)

Phillirea media (improvement of grazing capacity)

Aellenia glauca (large bush for improvement of grazing capacity

Psammophytic/xerophytic plants (for reclamation of sandy deserts)

1. Haloxylon aphyllum (Chenopodiaceae) – tree/tree-like
2. Haloxylon persicum (Chenopodiaceae)- tree-like

3. Salsola richteri (Chenopodiaceae)- woody tree-like
4. S. paletzkiana (Chenopodiaceae)- woody-tree-like
5. Acacia ammodendron (Fabaceae)- tree-like species
6. Calligonum arborescens (Polygonaceae) – tree like species
7. C. caput-medusae (Polygonaceae)- shrub
8. C. rubescens (Polygonaceae)- shrub
9. C. junceum- shrub
10. C. setosum (Polygonaceae)- shrub
11. C.microcarpum (Polygonaceae)- semishrub
12. C. rubens (Polygonaceae) – shrub
13. Ephedra strobilaceae (Ephedraceae)- shrub
14. Halothamnus subaphylla (Aellenia subaphylla, Cenopodiaceae)- shrub
15. Salsola orientalis (Chenopodiaceae)- semishrub
16. S. gemmascens (Chenopodiaceae)- semishrublet
17. Eurotia ewersmanniana or Ceratoides ewersmanniana (Chenopodiaceae) - semishrub
18. Artemisia diffusa (Asteraceae)- semishrub
19. Astragalus unifoliolatus (Fabaceae)- shrub
20. A.villosissimus (Fabaceae)- shrub
21. A. maximowiczii (Fabaceae) – shrub
22. A. gossypius (Fabaceae)
23. A. glaucocanthis (Fabaceae)
24. Ammodendron kavirensis (Fabaceae)
25. Dorema aitchisonii (Apiaceae) – perennial herb
26. Ferula spp. (Apiaceae)- perennial herb

APPENDIX 8. PROVISIONAL TECHNOLOGY TO GENERATE RANGELANDS

The following sandy/loamy semidesert xero-mezophytic fodder species are valuable for regeneration of rangeland under foothill semidesert condiitions:

1. Kochia prostrata (Chenopodiaceae)- shrub
2. Camphorosma lessingii (Chenopodiaceae)- shrub
3. Kochia scoparia (Chenopodiaceae)- shrub
4. Artemisia turanica (Chenopodiaceae)- shrub
5. A.halophylla(Chenopodiaceae)-shrub
6. Agropyron spp. (different species from this genus Poaceae)- perennial grass
7. Hordeum spontaneum (Poaceae)- perennial grass
8. H. vulgare (Poaceae)- perennial grass
9. H. bulbosum (Poaceae) – perennial grass
10. H. ischnatherum (Poaceae)- perennial grass
11. H. ithaburense (Poaceae)- perennial grass
12. Mellilotus officinalis
13. Onobrychis sativa (Fabaceae)- biennal plants
14. Trifolium spp. (Fabaceae)-
15. Astragalus alopecias (Fabaceae)- perennial herb
16. A. agameticus (Fabaceae) – perennial herb
17. Alhagi pseudoalhagi (Fabaceae) – perennial herb
18. A. persarum (Fabaceae)- perennial herb
19. A. canescens (Fabaceae)- perennial herb
20. Cicer spp. (Fabaceae)- biennal or annual herb
21. Caragana grandiflora (Fabaceae) – tree
22. Acacia spp. *should be tested what species from this genus)- tree
23. Glycyrzrhiza glabra (Fabaceae) – perennial – forage and medicinal plant
24. G. aspera (Fabaceae) – perennial herb
25. G. zaissanica (Fabaceae) – perennial herb
26. Secale spp. (wild species), Poaceae- perennial herb
27. Sorghum spp.(Poaceae)- perennial herb

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