ENVIRONMENTAL VALUATION AND MANAGEMENT OF PLANTS IN WADI ALLAQI, EGYPT

FINAL REPORT

IDRC
CANADA

Trent University

AUGUST 1998

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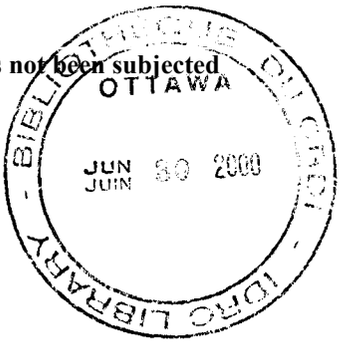
Submitted

To

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE (IDRC) CANADA

File: 95-1005-01/02 127-01



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Acknowledgements

The Project team of both South Valley and Trent Universities wish to thank the International Development Research Center (IDRC) Ottawa, Canada, for supporting the project with funding and for visiting the site. We also thank the staff of the IDRC Cairo Office for their assistance.

This report is based upon the knowledge, hard work, and support of many people and institutions. We thank the British Council for the support they have provided in training many members of the team and UNESCO for providing support for the Allaqi project and Biosphere Reserve. We appreciate the good working relationship that we have developed with the Egyptian Environment Affairs Agency. Dr. M. Kassas of Cairo University has provided valuable intellectual direction for the project. We thank C. Fararldi who has assisted the project in numerous ways and Gordon Dickinson for writing notes on establishing the visitor center in Wadi Allaqi

We wish to thank the research offices of Trent University and South Valley University. We are deeply grateful to the residents of Wadi Allaqi for their help and continued support and patience towards our project. We thank all of the above and the many others whose names we have not listed.

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This research project was funded by the International Development Research Centre (IDRC), Ottawa, Canada (Centre file 95-1005-01/02 127-01)

List of abbreviations:

BTU	British Thermal Unit
CI	Confidence Interval
CP	Crude protein
DM	Dry matter
DMD	In vitro dry matter disappearance
EE	Ether extract
EEAA	Egyptian Environment Affair Agency
FAO	Food and Agricultural Organization (U.N.)
FE	Fodder Equivalent
GDP	Gross Domestic Product
LSU	Tropical Livestock Unit
MAB	Man and Biosphere Programme (UNESCO)
MT	Metric tonne
NPV	Net Present Value
OM	Organic matter
OMD	In vitro organic matter disappearance
SE	Standard Error
SFC	Specific Fuel Consumption
UESD	Unit of Environmental Studies and Development

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Part I

1. General introduction

The purpose of this project is to extend sustainable development options for Wadi Allaqi to include the use and valuation of indigenous plants for subsistence and commercial purposes by local people and by others who are passing through or exploiting the resources of the Wadi. Thus the specific focus of this work is on the valuation and local use of plant resources as food (animal and human), fuel (energy), medicine, construction, and other uses. It is also an integral part of an environmental management and socio-economic development plan for Wadi Allaqi Biosphere Reserve and more broadly for the entire borders of Lake Nasser. The attention is directed towards maintaining a balance between the plant resource needs of the resident and transient community and exploitation of plant resources to ensure that over-use does not occur, in accordance with its designation a Conservation Area in 1989 and Biosphere Reserve (MAB Programme, UNESCO) in 1993.

The present report summarised the research carried out by the multidisciplinary team of the Unit of Environmental Studies and Development (UESD), South Valley University in collaboration with Trent University, Peterborough, Ontario, for more than two years. The report includes a socio-economic analysis of livelihood, a classification of indigenous plants according to use (fodder, medicine, fuel and others). The economic value for each use is estimated. During the project implementation, national and international workshops were held in Aswan. Conclusions and recommendations based on the team findings appear at the end of the report.

2. Rational

The current project builds and expands upon Phase 1 (IDRC P-921001, Environmental Management of Fuelwood Resources in Wadi Allaqi) which focused on energy use and conservation as a basis for the creation of a sustainable management plan for this new and ecologically fragile area. Phase 1 analyzed the patterns of use, availability, and the energy content of fuelwood species. In addition, the economic value of trees, especially in relation to charcoal production, was examined.

The current project includes more types of plant species and incorporates formal economic data and analysis to the ongoing analysis and collection of ethnographic and ecological data that formed the basis of Phase 1. This research considers the commercial and subsistence value of fodder and medicinal plants in addition to fuelwood species and an economist has joined the team in order to provide valuation analysis of the three categories of vegetation.

It is hoped that by demonstrating the high value of desert resources under current usage and by suggesting ecologically sustainable potential uses of desert plants, the current research will contribute to the creation of environmentally sound management and conservation policy for Wadi Allaqi and, by implication, for the wider region. Environmentally sound and productive utilization of natural resources will assist in improving the living conditions of the local community and in conserving the natural heritage.

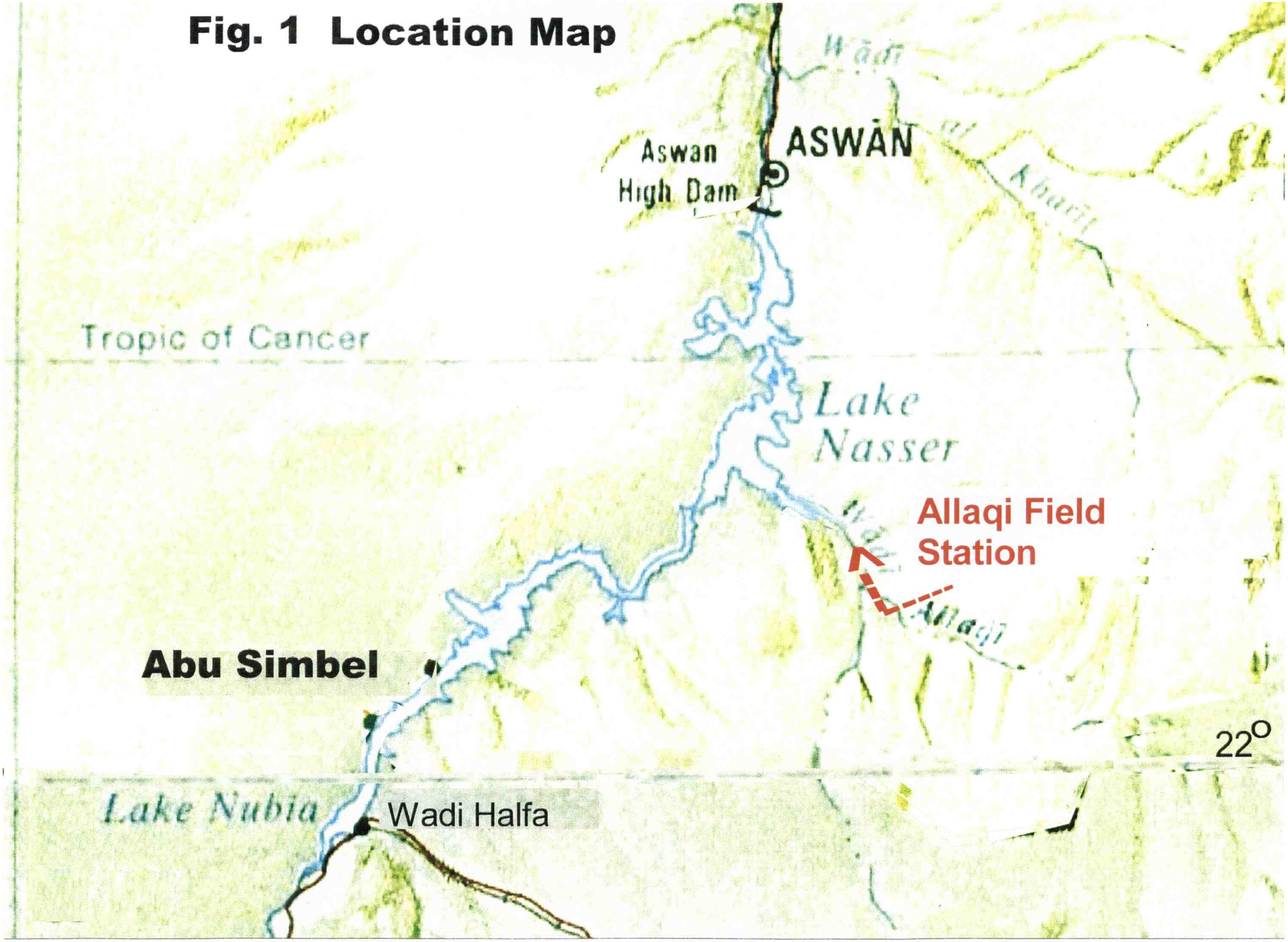
3. Description of the area

The present studies were conducted in the Nubian desert of Egypt (Fig. 1) which is characterised as a 'hyperarid environment ' with an aridity index of less than 0.05. Data from the nearest meteorological stations in Aswan show the annual mean temperature is 25.1° C. A mean minimum temperature of 8.1° C has been recorded for the month of January. However, it can be as low as -2° C (Wadi Allaqi records, January 1992). A mean maximum temperature of 41.8° C has been recorded for the month of July. However it can often reach above 45°C especially in August (Allaqi Meteorological Station, August 1997).

The data from the Aswan Meteorological Station showed the highest relative humidity in December (37%) , lowest in May and June (13%). The meteorological station located in Wadi Allaqi field station, close to the shore of Lake Nasser, recorded the relative humidity of min. 36% and max. 92 % in December 1997 and a min. 22% and max. 80% in August 1997, that indicate the significant effect of the Lake on the local climate.

The annual rainfall in this area rarely exceeds 5 mm and is highly variable in both time and space. Precipitation comes in discontinuous cloudbursts, varying from one to 15 days in a year and many years may pass without any rain. Since the rainfall is very local and there

Fig. 1 Location Map



are so few measuring stations, the rain events could not be accurately detected. According to our observations, during the last decade rainfall was recorded in the Aswan area in the autumn of 1982, October 1987, December 1990, October 1992 (only south of Aswan), very local in May 1993, October 1994, and in November 1996 which caused strong torrents in the surrounding wadis. The autumn rain events indicate that the South Eastern Desert is in a transitional zone where the pattern of precipitation gradually changes from predominantly winter rains in the north (Mediterranean type of climate) to predominantly summer rains in the south (Tropical climate).

The formation of the huge reservoir of the Aswan High Dam has brought tremendous changes in the ecology of the local desert ecosystem. Inundation from the Lake has penetrated through the wadis deeply into the Eastern Desert, a previously waterless hyperarid environment. Fluctuation of the water level of the Lake has led, during recedes, to temporal exposure of about 40 km in Wadi Allaqi, of the once inundated area where a new ecosystem has been established. This ecosystem which is generally known as an ecotone represents a transitional zone between aquatic and desert land .

Ecotonal systems differ from zonal ecosystems in that the strategy of life of ecotonal biota must provide a stable existence in an unstable environment that is characterised by frequent and a wide ranging fluctuations. Water, through extreme disturbances such as drought and flooding, is a major controller of the desert ecotone. The variation in timing and magnitude of flooding events, that are directly related to fluctuations of the water level of Lake Nasser has large random components. One metre of vertical fluctuation of the water level in the Lake causes more than one kilometre of lateral surface-water movements.

Figure 2 shows the annual fluctuation of the lake water in a 20 year period from 1977 to 1997. In 1978, Lake Nasser reached its first peak of 178 m above sea level (*a.s.l.*), but by 1988 the level dropped to 154 m *a.s.l.* Since that time, however, the lake has continued to rise again, by December 1996 it reached nearly 178,5 m *a.s.l.* and remained high all through 1997, even in summer it was much higher than in previous years. Figure 3 shows the water fluctuation of the Lake in the past five years.

Fig. 2 Change in Lake Nasser water level and its effect on the sites of different activities in the past 20 years (1977 - 1997)

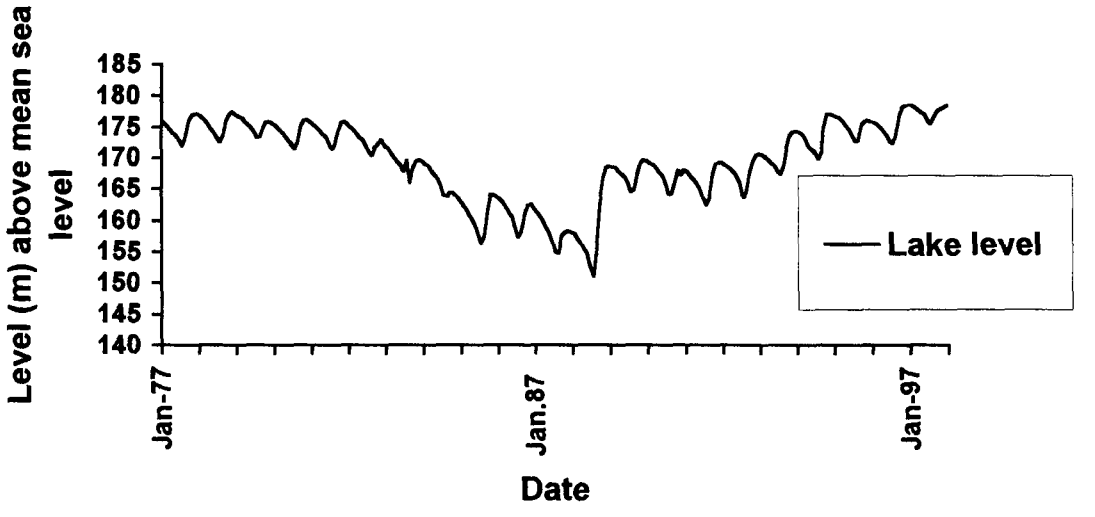
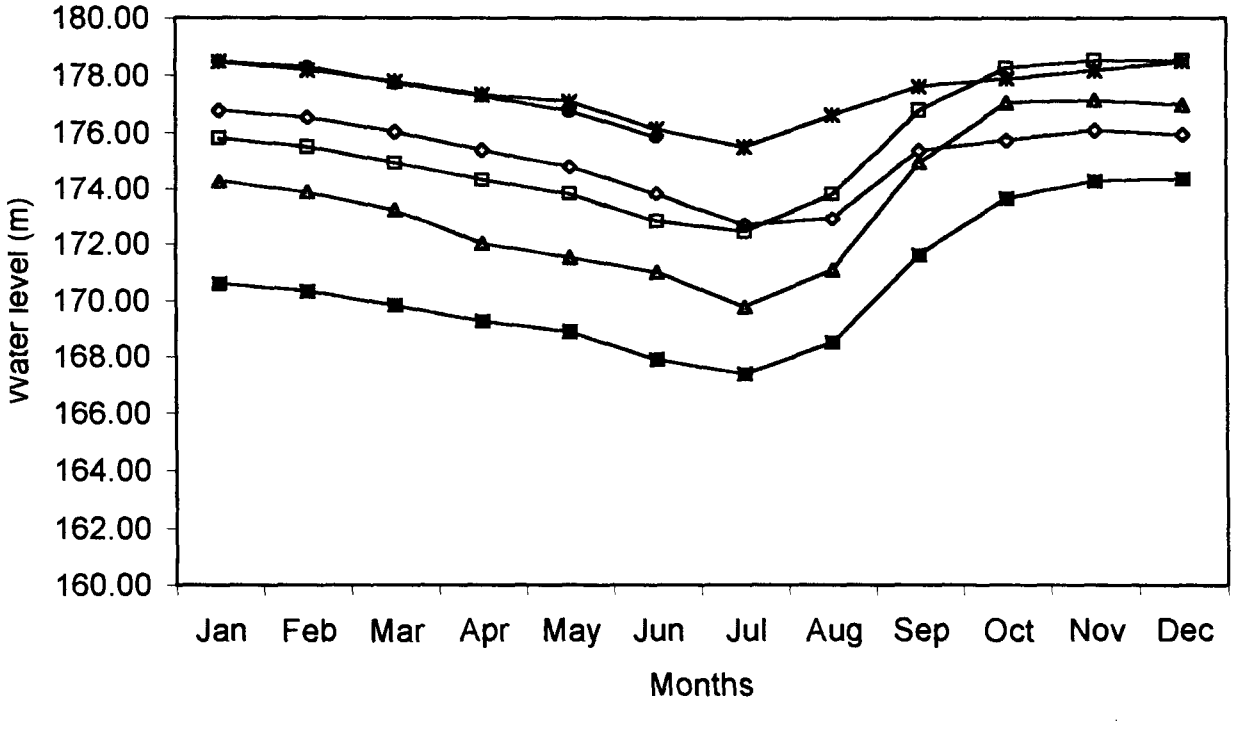


Fig. 3 Water level of Lake Nasser in period from 1993-1998



4. Socio-Economic System

People

Human habitation of Wadi Allaqi has great antiquity; pharaonic remains have been identified and gold mines in the region have been exploited intermittently since Pharaonic times. While it is difficult to determine with precision from the historical remains the identity and permanence of desert dwellers in the distant past it is likely that the ancestors of many of the current residents were people referred to as Blemmyes in Roman times (Hjort and Dahl 1991). Eventually, the residents of the Southeastern Egyptian Desert (and Northeast Sudan) became known as Ababda and Bishariin. Most written sources regard both groups as members of the Beja ethnic group (Murray 1935, Hjort and Dahl 1991, Palmisano 1991, Mekki n.d.) but within Egypt some argue that the Ababda, like their northern neighbours, the Ma'aza Bedouin, have Arabian roots. It is likely that current desert residents represent a mix of Arabian and Beja influences although contemporary boundaries between the homelands of the different Bedouin and Beja groups are widely acknowledged. Nonetheless, intermarriage occurs and reciprocal use of territory is common. Within Egypt Beja peoples are generally referred to as Bedouin, a generic term referring to desert nomads.

The Beja are considered part of the Cushitic language group that includes peoples along the Red Sea Coast in Sudan, Eritrea, Djibouti, Somalia, and parts of Ethiopia. The Bishariin, whose origins are in Northeast Sudan, speak a Cushitic language, to-bedawie (tebdawait), the Ababda (single, Abadi) speak Arabic. In addition to the Beja, transients from other parts of Egypt, Africa, the Middle East, and elsewhere have passed through Wadi Allaqi for various amounts of time and purposes for thousands of years.

History

Increasingly ethnographers recognize of the dangers of assuming that contemporary practices of rural peoples represent an unchanging past. While certain customs may have a long tradition and pastoralism has probably characterized the life of Eastern desert residents for centuries their current mode of life and cultural practices must be viewed as emerging from a long history and changing circumstances. Desert residents have been in

contact with urban based peoples and those to the south and east for thousands of years. In Pharaonioc and Roman times desert residents worked in the gold mines, they traded with and pillaged Nile Valley residents (Hjort and Dahl 1991:18) and occasionally fought for the Pharaohs (Mekki n.d.).

Significant new economic opportunities emerged approximately 2000 years ago as camel use and breeding became common in the region. Trade between the Nile Valley, the Red Sea, and the interior of Africa increased at this time and desert routes, some through Wadi Allaqi, became frequent caravan trails. The Beja participated extensively in the trade as guides, attendants, traders, and camel breeders. Eventually the Beja became renowned for rearing high quality transport and riding camels and the Bishariin, in particular, for breeding the 'best riding camels in the Arab world' (Hjort and Dahl 1991:163). Even today, the camel races of Northeast Sudan are popular events attracting observers from accross the Middle East.

Beja pre-eminence in desert trade and control over its routes continued for many centuries and still plays a role in their economic system. However, new trade routes emerged over the years, especially in the past two centuries with the creation of the Suez Canal and the development of rail, vehicular and road transport in the region. For Wadi Allaqi residents, a tarred road connected the area to Aswan in 1992 and has been significant for trade. Wadi Allaqi camels are still in demand at Egyptian markets and live camels are trekked through Allaqi from the Sudan for sale at Egyptian markets. Some trade still occurs in conjunction with these camel caravans (dabuka) but the camel's central role in long distance trade and transport is a thing of the past. In Addition, according to Fawzy (quoted in Hjort and Dahl 1991:163) with the building of the Aswan Dam and the inundation of parts of Nubia, the Beja lost critical and rich camel pasture lands. However, this last factor is counteracted by the presence of water and new pasture resources, especially *Tamarix*, that only emerged after inundation. Camels continue to have vital social and symbolic value for Allaqi peoples and are used for internal transport when people migrate to the hills and wadis to graze small stock and produce charcoal. But since the advent of the tarred road to Aswan, goods, especially charcoal, and small stock are transported to town by road. However, changes in trade and the desert economic system should not be viewed simply as loss for the Beja; as some opportunities close, others open. The Beja now have permanent water and new pasture resources; they are more involved in commercial small

stock production and, in general, have more active market relations with Aswan that are facilitated by the new road. In addition, since inundation the presence of both government and private sector institutions and companies in the desert has resulted in numerous employment opportunities for desert residents (these will be detailed below) and there has been an increase in the provision of social services.

Human Settlement in Wadi Allaqi

At present downstream Wadi Allaqi is in Ababda territory and upstream is in Bishariin; the middle part is very dry and supports no permanent human habitation. This ethnographic discussion predominantly concerns downstream Wadi Allaqi where most of the research has been conducted.

Precise population figures are difficult to obtain for nomadic peoples; a 1986 census revealed 218 people in the area with 89.5% of Abadi origin and 10.5% Bishariin (Mohamed et al 1991). Subsequent research indicates a slight increase in population - perhaps to 230 and a definite increase in the proportion of Bishariin who now comprise 20 to 30 % of the local population. Bishariin families have arrived since inundation and cordial relations exist between the two groups although the Bishariin are considered guests - their homeland being to the southeast. Intermarriage is occurring between the groups and no substantial conflicts over resources have yet occurred between the two groups.

Wadi Allaqi residents do not consider themselves fully settled although a process of sedentarization is evident. Movements are taking place within the Wadi itself, albeit very much on a local scale, but entailing the re-location of settlements. These movements are largely tied to the changing lake level (Mekki and Briggs 1991). There are seasonal movements into other wadis and hills to graze and charcoal but usually these people return to Wadi Allaqi. Many Ababda and Bishariin make extended visits to urban based relatives in Aswan, Shelateen, and other towns.

In downstream Allaqi, Ababda and Bishariin live in camps of closely related individuals consisting of approximately ten to thirty people. They live in tents that are easily dismantled and rebuilt; the tents are constructed of *Tamarix* wood frames and covered by palm mats, blankets of goat and sheep wool (shamla), and purchased plastic floor mats

are becoming popular. The most important factors in choosing a place to settle are access to water, fuelwood, grazing, and proximity to relatives' encampments. Of these grazing is arguably the least important as fodder is collected or purchased elsewhere and brought to animals and animals can be taken to grazing areas. Other important factors include access to social services, wage labour, and to trade opportunities. The latter point is well illustrated by the location of the two wealthiest households in downstream Allaqi. Each has positioned itself at opposite ends of the area; one at the bottom of the road in order to take advantage of passing vehicles. The household is the most active in charcoal production. The other is on the dabuka caravan route; this household trades extensively with the drovers and provides other lucrative services to the dabuka such as healing sick animals, locating strays, and caring for pregnant camels.

A. Dynamic System

Since inundation in 1969 and the subsequent partial filling of Wadi Allaqi with water changes in circumstances (ecological, socio-economic, and political) have been rapid and, in most cases, unprecedented. Thus it is difficult to speak of established patterns or cycles in terms of exploitation of the environment. For example in late 1997 at the height of the lake virtually all *Tamarix* was covered rendering a resource to which the Ababda and Bishariin had become accustomed to utilizing in the last decade largely unavailable. One cannot ask how the desert residents adapted during a similar previous occasion because there never was one. The last time the lake was so high the Tamarix had not yet emerged and the Ababda and Bishariin were less permanently settled in the region.

The most dramatic change in recent history, the presence of water in a hyperarid area, has drawn many Ababda and Bishariin into semi-permanent residence around the water. They use the water for domestic purposes and for livestock; they do not fish nor do they utilize the water for transport. Previous attempts at agriculture have been largely unsuccessful although there is renewed interest in cultivation (see section of agriculture below).

As the lake retreated after its initial high levels in the 1970's new vegetation emerged to which local people readily adapted. The availability of this vegetation itself alters from season to season and year to year depending upon the lake level.

In 1992 a tarred road connected Wadi Allaqi to Aswan; desert residents rapidly took advantage of the road to engage in commercial activity. They now transport their charcoal by vehicle to Aswan, they have altered their marketing strategies with regard to small stock, and, general, the economy is becoming increasingly monetized.

International political relations impact upon local arrangements. In 1996 as a result of increased political tensions between Sudan and Egypt the dabuka camels coming from Sudan to Egyptian markets were detained with their drovers for approximately ten days. Before they passed quickly putting little pressure on local resources but in ten days they put unprecedented pressure on local forage, particularly, *Tamarix*. The Ababda and Bishariin maintain a powerful commitment to a common property model - 'The trees are from God and no one owns them; they are for all to use.' - is a typical statement. However, the severe depletion of local pasture precipitated new definitions of property relations and residents insisted that arrangements be made to circumscribe areas where dabuka camels could graze. Eventually, dabuka camels were forced to stay away from local pasture and the military brought fodder from town for the drovers to purchase. Most recently the Egyptian government reduced the period of detention but has requested the Sudanese drovers to return home from Wadi Allaqi. Local Egyptians are now hired to bring the camels to market. The military still supplies fodder for sale for the dabuka camels.

As a result of the tarred road, the presence of water, and the strategic location of Wadi Allaqi along the Sudanese border, Nile Valley influence is unprecedented in the area. Desert residents are now in intense contact with government, military, and companies in their own territory. By late 1997 there was a Social Affairs Office, Medical Facility, two High Dam Lake Authority buildings, a Locust Control Station, a Village Council, a Mosque, a EEAA Administration building, the Allaqi Project Field Station, Allaqi Project Farm and associated buildings, Military buildings, and there were mines, quarries, fishermen, other government authorities drilling wells and constructing roads, farmers, dabuka drovers, and other transients in the area. Thus the presence of the formal sector is very strong and the size of the transient population in Wadi Allaqi continually grows.

The rapid and dramatic changes that have occurred in Wadi Allaqi in the last three decades afford a unique setting in which to examine the dynamism of integrated social-economic-ecological systems. Egyptians from Wadi Allaqi and elsewhere have generally

responded opportunistically to new possibilities in the region but not in all instances. The fact that the Ababda and Bishariin do not fish and have not taken to cultivation with great enthusiasm reflects amongst other factors, the strength of their livelihood and cultural preferences in which pastoralism represents a more dignified life than agriculture and fish is an unclean food. The fact that they do not use the lake for transport reflects their inexperience with and slight distrust of water travel.

Livelihood

Before detailing the major components of the livelihood system it is useful to reiterate some of the significant long and short-term changes in livelihood strategies that have occurred in the region. Camels, once prominent in the local economic system, have declined in importance in the past two centuries as new and faster forms of transport emerged. A similar and more extreme pattern has been observed in other Arab countries where camels have been neglected and, in some instances, have returned to a feral state (M. Kassas, personal communication). Small stock, both for subsistence and commercial exchange, are now increasingly important. Small stock require different fodder and husbanding-labour arrangements than camels.

As circumstances change in the Wadi Allaqi region we witness a shifting relationship between pastoralism, charcoal production, trade, and wage labour; in response to these shifts some residents are altering their livelihood strategies. Pastoralism and charcoaling require transhumance while wage labour requires a sedentary life. There are means to obviate the contradictory demands of these practices; relatives can take one's animals to the hills and can charcoal for a group and wage labour can be on a seasonal or casual basis. But ultimately, this remedy can place strains on or exhaust the capacity of those still migrating to the hills. In addition, some employment opportunities require full time work. Thus, increasingly, some men are being forced into decisions regarding which occupation(s) they will emphasize over others and some men may choose to eliminate one or more of these occupations permanently or temporarily from their livelihood strategies.

The major components of the local economic system are pastoralism, charcoal production, wage labour, agriculture, dabuka and trade, and medicinal plant collection (cf. Mekki and Briggs 1991). They are described below.

A.Pastoralism

The Ababda and Bishariin have a long history of pastoralism; it is one of the few economic activities sustainable in this hyperarid environment. Camels, goats, and sheep are the most important animals. Some households keep donkeys and these are used for transport. Chickens have been introduced by outsiders and some women keep them. Women desire chickens for the meat and eggs but chickens need to be fed purchased food and they limit mobility. They are also prey to wild carnivores. All animals have both subsistence and commercial value.

The social and symbolic value of animals cannot be overestimated; their exchange and/or consumption mark every stage of the life cycle and virtually all rituals entail a feast for which animals are slaughtered. Indeed, not to have animals renders one not only materially poor but socially bereft. While meat is not regularly consumed, animals, largely small stock - goats and especially sheep, are slaughtered to mark birth and at naming ceremonies for babies; they are slaughtered at weddings, and for funerals. Thus to be a proper person - to be born, to marry, and to die requires animals. Animals are slaughtered for various Islamic feasts including Eid when most households slaughter and meat abounds and they are slaughtered to display hospitality for special guests.

Both men and women own animals; according to Islamic inheritance rules daughters inherit half of what their brothers do and wives inherit one eighth of their husbands' property. Women also receive animals from their husbands and parents upon marriage. While women maintain some control over their animals all public activities such as sale or exchange must be conducted by men. In addition, women are prohibited from milking or slaughtering animals. Animals are exchanged at marriage and are paid to compensate crimes.

Camels:

Camels are owned by the majority of Allaqi households but their distribution greatly varies. The wealthiest household owns at least one hundred while most camel owning households own only a few and some households own none. Camels require little labour; they wander

on their own to find grazing and can go for days to weeks without water. Their migratory patterns are well known and they can be easily located. Only a few are kept near the settlements for transport. They are branded (brand - titto).

Camels are only rarely slaughtered for food and they are milked irregularly. They are sold to markets in Aswan and Daraw; in the late 1990's their average producer price was LE 2000. Camel meat is desired for kofta and for the fact that it is low in fat and cholesterol. Camels are also desired by Upper Egyptian farmers at harvest time to transport crops.

While the golden age of camel caravan trade is past, camels are still important for local transport within the desert. Ababda and Bishariin relocate their tents frequently; all their belongings are loaded on camels for the move. Camels play a critical role in charcoaling and grazing; these activities entail trips of several months into the desert. People must bring all their supplies for this time and then load the camels with upwards of 250 kilograms each of charcoal on the return trips. Those poor in camels are dependent upon wealthier individuals to make the trips; the nature of these arrangements will be discussed below.

According to Mekki (n.d.:4) camels are the basis of wealth and social distinction in Ababda and Bishariin society. Not only is a person's worth measured in camels but so is their life. Camels are the primary dia payments; crimes, including murder are compensated by such payments and the amount is determined by Sheiks presiding over Agawids (councils).

Small Stock:

While camels may be the prestige animals, sheep and goats are the most important on a daily basis both in terms of the labour required in their care and their immediate economic returns. Small stock are widely but unevenly owned; some households own hundreds while others own only a few. They are considerably more numerous than camels. Unlike camels, who wander on their own to find grazing, small stock are kept near human settlement in enclosures and are taken to water and grazing.

Small stock eat a variety of plants (see section of fodder plants) but the most palatable species are the annual and ephemeral plants that appear after rain events (see section on environment for rainfall patterns). After the rains which come in the fall (approximately

October through December) animals are taken to the hills where there has been rain - this is often in conjunction with charcoal production. Male labour, camels for transport, and enough supplies are necessary. Thus some households pool their resources and take each others animals and some do not take their animals at all. A shortage of male labour, often as a result of employment, can prevent households from taking their animals to the hills. Conversely, a wealthy household can attract extra household labour by supplying camels and supplies to send poorer people to graze its animals. In this 'customary' labour arrangement labour is paid by being given a share of the animals born - usually half .

For much of the year the small stock are kept in downstream Allaqi and even when the animals are taken for grazing some are left behind. Here they require a good deal of care; they must be fed, watered, and enclosed at night. This is the work largely of women and children. Women and children collect food for the animals which often requires them to go in the water to collect *Tamarix,* to collect and dry aquatic plants (Shilbeka or *Najas*) on the shoreline, and to look for any other species that may be palatable for the animals. One household was observed to have collected grass from as far away as Aswan. Households, especially wealthier ones, purchase grain (sorghum and maize) in Aswan for small stock and teben which is a combination of grain and the outer husks. Teben varies in quality and price depending upon the proportion of grain relative to outer husks. People say teben just keeps their animals alive in a bad year but does nothing to promote lactation, fertility, and good health in general. Animals are also fed left over food. The amount of purchased given to animals is related to the incidence of rainfall (years can pass with no rain); if rain induced pasture is available this is the preferred fodder.

Small stock provide for a variety subsistence needs; their milk is taken daily except in severe conditions, they are slaughtered for ritual occasions (see above) and for hospitality for special visitors, their hides are tanned by women and made into a variety of containers, and their hair is woven into blankets (shamla). Bedouin women make butter from the milk in skin sacks; they consume the butter and use it to rub on their skin and hair. The desert is very dry and butter is one of the few moisturisers available. *Acacia nilotica* pods, generally purchased in Aswan, are used for tanning. Containers are made to hold water and dry goods; some are beautifully decorated with cowrie shells. Some shamlas are elaborately designed with stripes of contrasting colours and interspersed goat and sheep hair. Occasionally these are sold in Aswan markets for as much as LE 250.

There is a lively commercial trade in small stock which has increased since the completion of the tarred road to Aswan. Small stock are sold locally largely to transients in the desert and they are sold in Aswan markets. They are sold throughout the year but sales peak at certain times such as the Eid feast when sheep are in high demand. Otherwise sales are seasonal and are highly dependent upon the occurrence of rain. In a year of good rains people will keep animals, fatten them from the annual and ephemeral pasture, and sell them in the spring or summer. If the rains fail, people will sell animals in fall and winter before they lose condition for lack of pasture or to avoid the expensive alternative of purchasing fodder to see the animals through the lean season. In addition, in a promising year people will buy small stock (usually in Aswan) in the fall in the hopes of fattening them through the winter for subsequent sale. This sort of commercial strategy of buying and selling has intensified and is greatly facilitated by the road and the ability to transport the animals by vehicle to and from Aswan. In Aswan, Nile Valley farmers often purchase Allaqi small stock in order to fatten them for resale. Most households sell animals on a contingency basis when the need for cash arises. But some of the wealthier households have a more businesslike attitude and market animals on a regular basis. In early 1997 the average price in Aswan for Allaqi goats was LE 150 and LE 225 for sheep.

There is a perception amongst Wadi Allaqi residents that they consume less milk than they did in the past. They speak romantically of the days when they consumed vast quantities of milk compared to the present situation in which children get small quantities of milk and they put some in their tea. They tend to attribute this to diminished milk production on the part of the animals as a result of inferior fodder consumed in downstream Allaqi. This may be true but other factors must be considered. Because of their proximity to Aswan, the tarred road, and their greater integration into the market, Wadi Allaqi residents now have more food alternatives and purchase more grain and other foods such as macaroni - they also buy clarified butter and, occasionally, powdered milk. In Addition with the increased emphasis upon marketing small stock it could be that they are milking animals less to allow the young to suckle freely, mature more quickly to reach reproductive age and market prime more rapidly.

B. Charcoal

Charcoal production was analysed and described in our previous 1995 report, Environmental Management of Fuelwood Resources in Wadi Allaqi (Egypt) (I.D.R.C. File: 92-1001-01); it will only be briefly discussed here. Bedouin make charcoal from the dead branches and trees of the acacia species and then market it in Aswan where it costs between LE 1.2 and 2 a kilogram depending upon the quality. Our research indicates that approximately 18 tons of charcoal were produced annually from the area in 1996 and 1997. The mean price in 1996 per kilogram of charcoal was LE 1.8. Thus we can estimate that the annual harvest of charcoal for 1996 and 1997 was worth LE 32,400 rendering it a very significant source of income for many households.

Charcoal production entails controlled burning of the wood in the sand - it takes several weeks to produce and people often stay away for months as they charcoal in more than one location. It is a winter activity and often done in conjunction with grazing small stock in the distant hills and wadis. Like grazing small stock it requires up-front assets as supplies are needed to sustain the men charcoaling and camels are needed for transport. Thus it is an activity carried out more by wealthier households or by men who enter into 'customary' labour arrangements with wealthier men who supply them with camels and foodstuffs. The men charcoaling retain a percentage of the product.

The price of charcoal depends upon the following factors: (1) size - bigger pieces are more valuable and broken dusty pieces are less valuable; (2) how well burned it is - no wood should remain; (3) colour - black is more valuable than green; and (4) 'shake' - well burned charcoal makes no noise when it is shaken. In the past charcoal was taken by camel to Aswan but now it is loaded onto any passing vehicle. Camels are natural 'shock absorbers' and deliver the charcoal to market in larger pieces. But since the tarred road people have accepted the reduced value of charcoal rendered by vehicle transport in exchange for the speed and ease of transporting their charcoal to market by road.

C. Wage Labour

One of the most significant changes in livelihood strategies in recent years is the rise of wage labour opportunities for Wadi Allaqi residents. Only men take formal sector

employment; women are prohibited from virtually all public transactions and their formal sector relations are almost always mediated by men. Based upon a survey conducted in 1991 in which 31 of the men interviewed were still alive in 1997, the number of men employed in full time or casual work has increased from approximately 7% in 1991 to approximately 41% in 1997. In discussions with Allaqi project members in 1997, we calculated that 13 Bedouin men (some had moved to the region since 1991) were involved in full time wage work at the time and many more had casual employment.

It is difficult to obtain information from Wadi Allaqi residents regarding their salaries and thus we can only estimate the amount of money earned by local people. The EEAA pays its full time desert workers LE 200 a month; this is considered high for regular work and the monthly average may be closer to LE 100. Part time work is more variable and may entail only a few days a month with earnings as low as LE30 (or less) or it can be highly paid temporary and intermittent work such as dabuka droving. In 1997 the military hired four men at a time to take Sudanese camels from Allaqi to Aswan; the leader was paid LE 500 and the three assistants were paid LE 400 each for less than a week of work. If we take an average of LE 120 for 13 men working full time and an average of LE 60 for ten men working part time for a month we can estimate that the monthly aggregate income from employment for Allaqi residents is LE 2,160. Then the yearly income is LE 25,920 (a sum approaching the annual value of charcoal production). While this figure is only an estimate it does point to the significance of wage labour in the region.

The rise in employment is correlated to a number of factors. It is both a cause and effect of sedentarization and is tied to a growing desire for cash as people become more market integrated, and to the increased availability of employment. Employment opportunities have increased for a number of reasons. Wadi Allaqi's location on the Sudanese border is important; given the political tensions between the two countries in recent years it has been Egypt's policy to increase military and government presence in the region. Most important, however, is the presence of water and thus development opportunities and, critically, the tarred road.

Sources of employment include EEAA, the Wadi Allaqi project, High Dam Lake Authority, Allaqi Village, Locust Control, Clinic, various Mines and Quarries, Road Construction, Aswan Farmers, Water Development, Military, Scientific surveys, and dabuka (men to

drive camels from Allaqi to Aswan). Jobs include manual workers, guards, military 'intelligence', guides, drovers, etc. Some jobs are temporary and intermittent such as when Allaqi resdients are hired as guides for archaeological or geological surveys and to guard mines or offices when regular workers return home for holidays.

Employment has increased the amount of cash circulating in Wadi Allaqi. It is also contributing to a shortage of male labour available for other economic pursuits (see White 1995 and Briggs 1989 who spoke of a shortage of male labour even prior to a significant rise in employment). This is placing a greater burden upon women and children. In addition, as mentioned earlier in this report, it is leading some men to de-emphasize migratory activities such as charcoaling and grazing, or to rely more upon their relatives for these pursuits. For some of the poorer households who were reliant upon others for the resources to engage in these activities, wage labour is a way out of dependent relations and a source of more or less independent income.

D. Agriculture

Since the creation of the High Dam Lake various agencies have encouraged agricultural production for Allaqi residents and to this end they have offered material incentives. In the late 1980's several households had cultivation plots for which they received food and other items from FAO. These were labour intensive; they needed to be fenced, irrigated, and moved to follow the changing shoreline. All these old plots are now under water. Generally these agricultural experiments were unsuccessful and the Bedouin regard cultivation as a less dignified way to make a living than other activities. It is reported that the harvest was often fed to the animals.

More recently there has been a renewed interest in agriculture which may reflect a growing acknowledgement amongst some people that they are leading a more sedentary life. Some women have started plots and others have expressed interest. One woman, a poor widow, was actively trying to grow vegetables for her family. She had a well and had fenced her plot with slate from the mountains and old fish net. Now that water is being piped from the lake, irrigation may prove to be less labour intensive and agriculture will be easier for households to pursue.

One concern regarding agriculture is the soil contamination from *Tamarix*. *Tamarix* droppings contain high amounts of salt and it is said that only a few salt tolerant species will grow where *Tamarix* has been.

E. Dabuka and trade

Wadi Allaqi residents have traded with camel caravans for centuries and still trade with the current Dabuka drovers. It is estimated that over 100,000 camels make this trip annually from Sudan; Wadi Allaqi is a stopping point enabling the camels to drink and graze and the drovers to replenish themselves with water and to trade for supplies. Ababda and Bishariin sell food and other items to the drovers. Other products are traded as well. In addition to the Dabuka drovers, Wadi Allaqi residents trade with the many other transients (fishermen, military, miners, government employees, etc.) that come into the desert. Some households appear to maintain a monopoly on this trade; one household even owns a balance to facilitate its commerce.

Wadi Allaqi residents (a few in particular) provide other services to the Dabuka. Sick animals are left to be healed by the Bedouin and pregnant camels are left to give birth. Local Bedouin also find stray Dabuka animals. They are paid, usually in kind, for these services.

Not all households participate in these activities and the ones that do are generally the wealthier. For them it is an important, but supplementary, economic activity.

F. Medicinal Plant Collection

Medicinal plant collection is an economically important activity in upstream Wadi Allaqi where the medicinal plants are more abundant. Many of the medicinal plants and herbal teas to be found in Aswan shops were collected and sold by Bishariin from upstream. Our household survey revealed very little medicinal plant collection in downstream Wadi Allaqi; the most frequently collected plant was *Senna Alexandrina*. It is one of the most common medicinal plants in the downstream area, helps relieve the constipation that may result from the Bedouin's low fibre diet.

G. Trends

There are many livelihood trends evident in Wadi Allaqi. Some may be genuine movements and represent long term trajectories, while others may be cyclical or temporary in nature and result from yearly variation or particular short-term circumstances. These trends require further longitudinal observation and research. They will be briefly listed below :

Occupational Specialization. The Bedouin are characterized by occupational diversity and this certainly continues; however, the data suggests that certain households are focusing their energy more on certain livelihood strategies than others. In some instances, choice in involved and in others, force of circumstances is leading households to focus on particular activities.

The two wealthiest households, as mentioned earlier, appear to be specializing in (1) charcoal production and pastoralism and (2) trade and pastoralism. It is said about the second that 'he is so rich, he doesn't even bother charcoaling any more - he just grazes his animals in the hills.' This may be an exaggeration but our data does indicate that for the two year period for which we have data on charcoal production, more was made in the second year but by fewer households. In addition, trade, which has become more lucrative due to the increased number of transients in the desert, is occupying more time of those households involved.

Some men, especially poorer ones, who maintain full-time employment are participating less in charcoaling and pastoralism. They have not abandoned these pursuits but because they are restricted from migrating to the hills, their involvement is diminished.

Sedentariazation. A process of sedentarization is evident; people are spending more time in downstream Wadi Allaqi. They are moving less throughout the desert and migrating less to the hills for grazing. The reasons for this have been detailed above. Indicative of this process is the increased ownership of large

material items by local desert residents. For example, one woman explained that she now stores water in a clay jug whereas in the past she used skin bags. The clay jug keeps the water cooler but, as she notes, is more difficult to move because of its size, weight, and fragility. Since they move less she has chosen to use the jug. Some people have metal bedsteads, stoves, and other bulky material items that are hard to transport. It is difficult to determine the exact increase in material items but if the trend is genuine, and it appears to be so, it resonates with the classic dictum about nomads that 'a pure nomad is a poor nomad.'

An important consequence of increased sedentarization is the greater pressure put upon local plant resources in downstream Wadi Allaqi. As more people and animals spend more time in the area their dependence upon local plants increases and may eventually reach a point where environmental degradation occurs.

Division of Labour and Gender. A combination of male wage labour and increased sedenatriazation has increased the workloads of women and children who now spend a good deal of time tending to the needs of small animals. The is especially true for those households that no longer pursue transhumance on a large scale.

While Ababda and Bishariin society still remains highly sex segregated, we have observed a relaxing of gender relations during the years we have worked in the desert. This may reflect the fact that people are now comfortable with the Allaqi team but it may also reflect a trend to which our presence has contributed. Male Allaqi project members now speak directly to women which they did not do 5 years ago. This may enable desert women to feel more confident in seeking help for agriculture and other activities from project members and from the formal sector in general. This will be especially helpful in their dealings with medical personnel.

Market Integration and Commercial Activity. These processes have been detailed above. Allaqi residents have more cash; they trade more, they eat

more purchased food, and the marketing strategies for small stock have altered with more strategic buying and selling of young and mature animals. Wadi Allaqi residents now fine tune their marketing to respond to changing environmental conditions and market demand. Tied to this and to the decline in transhumance is diminished milk consumption.

Wealth. One could speculate that downstream Wadi Allaqi households have become in the recent past wealthier; they have more resources, money, and employment. While it appears that material standards of living have risen in general, it also seems evident that there exists greater economic discrepancy between the rich and poor. Thus in spite of a general rise, the economic gap is wider, and in a relative sense, the rich are getting richer and the poor are getting poorer (cf. Briggs, personal communication). This is indeed speculative and requires further investigation.

There also seems to be greater provision of social services. Widows receive an allowance and the government supplies basic food items periodically (for example, before the Eid feast). Such services are not necessarily new or unique for desert residents but they are more easily accessed in Wadi Allaqi because of increased sedatarization and formal sector presence.

Property Relations. Property relations with regard to trees were analysed in our previous report and similar rules pertain to other plant resources. As mentioned above the commitment to a common property regime is still very powerful amongst the Bedouin but it was severely challenged in 1996 when dabuka camels, detained for ten days, overgrazed the *Tamarix*. Bedouin insisted that the dabuka camels be restricted from consuming the tamarisk and taken elsewhere. Whether this new and more restrictive definition of property rights represents an isolated incident related to extreme and unusual circumstances or is, perhaps, a trend towards more narrowly defined property access with regards to natural resources, is a subject for further research and observation.

5 . Methods

A. Plant uses

The potential and actual uses of the plants found in Wadi Allaqi were investigated by: 1 - literature review, 2 - direct observations of nomads' life-styles and their livestock and 3 - informal interviews with nomads. The results as presented in Table 1 (Annex XXXX) provide an indication of the importance of each species to the local economy. An *importance value* is given for each species for each of seven different uses. This *importance value* is derived as follows:

Criteria	**Score**
1. Life-cycle strategy	
Annuals	1
Perennials	2
2. Abundance	
Rare	1
Abundant	2
3. Use	
Use only mentioned in literature	1
Use observed/described by local people	2
4. Palatability/Commercial Value/Effectiveness (as a construction material etc.)	
Low palatability / no commercial value	1
High palatability / has commercial value	2

Thus for each species an *importance value* of 0 for a particular use indicates no potential economic value for that species. A score of 4 suggests minimal potential use, while a maximum of 8 suggests the species is abundant all year round, palatable/effective/of commercial value and already in frequent local use.

The sum of the *importance values* for all uses is further expressed as the relative percentage of a maximum possible score. This *Total Importance Value*, expressed as TIV in the equation below, can be taken as a measure of the potential importance of the plant

to the local economy:

$$TIV\ \% = \frac{(U_1 + U_2 \ldots\ldots U_7)}{56} X \quad 100$$

U = *importance value* for each particular use (U_1 - medicinal use, U_2 - timber ..)

A maximum value (8) for all seven uses gives an overall maximum value of 56 which would produce a *Total Importance Value* of 100% for that plant species.

B. Chemical analyses of the fodder plants

The monthly monitoring of the chemical compounds of the ten plant species[1] was conducted in the downstream Wadi Allaqi in the period from December 1994 till December 1995. For each plant species the mixed sample from different locations was prepared every month. Four representative samples were taken from the mixture to carry out the chemical analyses.

The mineral content and organic constituents of ten plant species[2] were analysed from samples collected in May 1997 from different parts of Wadi Allaqi . Four replicas were uses in plant analysis. The plant material was washed with distilled water and kept for analysis. Moisture content was determined in plant material by drying at 105°C. The total ash content was determined by ashing plant material at 550°C.

Mineral contents:
Dissolution of mineral constituents in plant materials was prepared by dry-ashing and extraction with HCl and HNO_3 for Ca, Mg, Na, and K according to Allen (1989). Ca and Mg were determined by titration against versenate according to the procedure described by Allen (1989). Na and K were determined by Flame photometer (Jenway PFP7). For Cl, plant materials were dry ashed with calcium oxide and extracted with hot water. Cl in the

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[1] *Tamarix nilotica, Acacia raddiana, A. ehrenbergiana, Aerva javanica, Senna alexandrina, Pulicaria crispa, Glinus lotoides, Hyoscyamus muticus, Asragalus vagelii, and Najas sp.*

[2] *Acacia raddiana (shoot), Acacia raddiana (fruits), Balanites aegyptiaca (shoot), Balanites aegyptiaca (fruits), vegetative parts of:Crypsis schoenoides, Fimbristylis bis-umbellata, Eragrostis aegyptiaca, Tamarix nilotica, Psoralea plicata, Citrullus colocynthis, Euphorbia granulata, Astragalus vogelii.*

extract was titrated with standard silver nitrate. For P, plant material were dry ashed with an excess of magnesium nitrate. The ash was taken up in acid and P was determined by molybdenum blue method (Chapman & Pratt, 1961).

Organic constituents:
Total lipid content was determined in the plant material by extraction with a mixture of petroleum ether-hexan (1:1 V/V) according to Allen (1989). Crude fibre (CF) and ether extract (EE) were determined according to the procedure described by A.O.A.C. (1984). The anthrone sulphuric acid method was used for determination of carbohydrates (Schlegel, 1956). The Kjeldahl method was used to estimate total protein in plant materials (Allen, 1989).

C. Economic

Economic methods for estimating values of environmental goods are generally classified by two characteristics. The first is whether the data used in the evaluation is taken from direct observations of actual economic decisions, rather than hypothetical responses to contrived decision situations. The second characteristic is whether the method yields direct estimates of monetary value or whether these values are inferred indirectly as a residual of another decision.[3] The three surveys conducted within the context of this project were designed to provide us with direct observations of both market prices and individual production and consumption decisions. The market survey was used to provide a sample from a wide range of products which could act as viable proxies for non-market decisions about production and consumption being made by Allaqi inhabitants. The household survey collected data on both use and production of a wide variety of plant species indigenous to the region. The livestock survey collected data from livestock markets on the prices obtained for various categories of animals.

In general, the economic method utilized in this research employs techniques which provide economic values for environmental goods through application of surrogate market techniques. At the outset, it should be emphasized that economic values are defined only to the degree that the good itself can be defined. For example, in our estimates of the

[3] Pearce et.al. (1988) provide a simple explanation of the economic theory and its application to environmental valuation. Freeman (1993) offers a comprehensive and technical discussion of economic theory as it relates to environmental valuation as well as a broad survey of valuation applications.

economic value of fodder we define the good as protein available in forage. Needless to say, the plants that we analyze as fodder could be defined by some other characteristic and thereby assume a different economic value. Surrogate market techniques rely on the use of observed market prices for goods which share the relevant characteristics with non-marketed goods. These shared characteristics can be valued, using observed market prices. The market price is not, generally in terms of the specific economic characteristic of the good; the particular set of transformations used depend on the market good and the specific characteristic being evaluated. For example, *Tamarix nilotica*, is used as both fodder and fuel-wood in the Allaqi region and so different characteristics are analyzed in estimating economic values for fodder and fuel-wood and different market goods are used as proxies in each case.

Although measuring economic value involves the use of economic theory and technique, other types of knowledge are crucial to the process. Estimating the value of fodder, for example, requires biological, ecological and anthropological knowledge to understand how and why inhabitants choose forage as fodder and what impact their choices have on the environment. Lack of knowledge of these relationships is often a crucial barrier in effectively estimating economic values for environmental goods.

D. Statistical

Data

The surveys designed and administered as part of this project rely on two different sources of data.

Quantitative Data

The Market Survey: Monthly observations on local market prices for a wide variety of goods. These prices included samples of fuel, fodder, medicinal plants, food and products such as blankets, pots and bags which are also produced though not marketed by inhabitants of the Allaqi region.

Survey Data:

The Household Survey was conducted approximately quarterly, during the period of this research in order to gather data on household decisions and choices. The survey had four

quantitative components: Demographic variables, Fodder use variables, Charcoal production variables, Livestock production variables.

The Livestock Survey was designed to gather quantitative data on both consumer and producer prices for camels, sheep and goats. Because livestock prices could not be observed in conventional fixed price markets, the livestock instrument relied on more extensive interviews at livestock selling in traditional market forums.

Qualitative Data

Survey Data[4]: In addition to quantitative data, the household survey also gathered qualitative data on medicinal plant collection and perceptions about availability of grazing, abundance of fodder and general environmental perceptions.

Design of the Survey:

The overall principal guiding the design of the research instruments used in this research was the need to generate knowledge both about market decisions as they are reflected in market prices and the preferences and decision context of the population which was the primary target for this research. The variables and concepts utilized in the survey were identified through participant observation and open-ended interviews in Wadi Allaqi. Simultaneously, other members of the Allaqi research team provided the ecological and biological context needed to produce valid economic valuations.

In general, the household surveys measured the variables of interest in terms of interval scales administered by interviewers. This type of measurement instrument was judged to be most appropriate for the particular population both because of the administration technique being used and the cultural context of the research.

The livestock survey collected extensive data on livestock producer and consumer prices for camels, sheep and goats. In addition to the price, data was collected on age, sex and weight of animals bought and sold. It was anticipated that this survey data would be collected quarterly. In fact, this phase of the research was not completed by the end of the project.

[4] The survey data is included in Annex 3.

The market survey measured prices in standard units, in the local currency. Two random samples were obtained for each individual item on the market survey each month.

Data Collection

Market Survey: The market survey generated 74 observations on 32 separate products. Shops in both Aswan and Kom Ambo were used in the survey.

Household Survey:

The household survey generated 31 observations on the population living in Allaqi. A random sample of 5 households was conducted for each survey period in the project. Given the transitory nature of the population, which is estimated to be approximately 220 individuals, this represented a sample of between 10% and 25% of the households.

Data Analysis

We have relied on conventional data analysis techniques to in constructing our estimates of economic value. The reader is directed to any standard statistics textbook for explanations of statistics such as mean, median, standard deviation and standard error. Judge et.al.(1989) provide a comprehensive discussion of statistical applications to economics problems and discusses the limitations of inferential statistics in small sample contexts. Where possible the estimates of economic value have been conducted using different techniques and different data in order to facilitate an evaluation of the estimate itself.

Summary of Statistical Terms Used in this Report:

Mean

$$\bar{X} = \sum_{i=1}^{n} \frac{X_i}{n}$$

Variance

$$s^2 = \frac{\left(\sum_{i=1}^{n} \frac{X_i - \bar{X}}{n} \right)^2}{n - 1}$$

Standard Deviation

$$s = \sqrt{\frac{\left(\sum_{i=1}^{n} \frac{X_i - \bar{X}}{n} \right)^2}{n - 1}}$$

Standard Error

$$SE = \frac{s}{\sqrt{n}}$$

E. Sociological

In addition to the surveys, members of the team conducted in Wadi Allaqi, on an intermittent basis, qualitative research utilizing the techniques of participant observation and open-ended interviews. Participant observation enables greater rapport to be established between researcher and subject than survey techniques by allowing more relaxed interaction. In addition, it is more able to capture what people do in concrete circumstances as opposed to simply what they say in a formal interview situation. Open-ended interviews afford the researcher a greater understanding of people's motivations and of the contingencies of daily life that impact upon their behaviour and decisions.

The qualitative and quantitative components of this research complement each other.

Part II

1. Classification of plant species according use.

The vegetation of desert wadis and particularly Wadi Allaqi is of considerable economic importance to the desert-dwelling people who use it. For them, what grows in the dry land they inhabit provides food, clothing, shelter, protection, health, and recreation. We may break down this indigenous use of desert plants as follows:

1. Plants for medicinal use:

The list of medicinal plants found in desert areas is very lengthy. Products are used locally and, in addition, their collection provides an important source of cash income for nomads.

2. Timber:

Timber trees are important, especially in areas near large settlements.

3. Forage for livestock (goats, sheep, camels):

The exploitation of desert vegetation as pasture is the most significant aspect of land use. Rainfall, and hence annual plant growth, is unpredictable both in time and location and is found only in a limited area for a limited time. Pastoral nomads move with their livestock to the places where the rain has fallen, in order to take advantage of the short-lived ephemerals. In rainless periods, which occur at least seasonally but can extend up to a few years, woody perennial plants provide the main food for the nomads' livestock.

4. Food:

The fruits, grains, leaves, roots, stems, and flowers of some of the desert plants are edible.

5. Fuel:

Almost all desert shrubs, trees and woody perennials are liable to be cut for fuel. Nomads usually use only dry branches and dry plants, but the attitudes of strangers in the desert are different. People who may be travelers, workers in the mines, or other transients, cut green plants when they cannot find dry ones. Cutting live wood reduces the availability of browse and causes erosion. Reduction of woody cover is already being experienced in rural areas where the demand for fuel wood exceeds supply.

6. Charcoal-making for commercial purposes:

This is another important activity for which nomads use selected plants, mainly *Acacia* spp. The distance from markets and the availability of transport have an obvious effect on the extent of charcoal-making.

7. Other uses:

These include the production of oil and fiber, and the use of plants for tanning leather and in making mats, ropes and baskets. Of less direct economic use to man, but of considerable importance, is the provision by trees and shrubs of shade and hedges, and their role in soil stabilization. Desert plants, particularly those of the Leguminosaea family, also play a vital role in nitrogen enrichment of soil by hosting nitrogen fixation microorganisms.

Table 1 (Annex 1) details the useful species present in Wadi Allaqi and their potential and actual use by local nomads. Among a total of 127 species recorded in the Wadi Allaqi area, only 32 appear to have no use potential.

Nearly half of all recorded species in Wadi Allaqi (56), are of known medicinal value or are under investigation for medicinal compounds (e.g. *Glinus lotoides, Cocculus pendulus).* However, only a proportion of this considerable number are currently collected by the nomads. Among those regularly collected, the more important are: *Citrullus colocynthis, Senna alexandrina, Solenostemma arghel, Salvadora persica, Balanites aegyptiaca,* and *Cleome droserifolia, Cymbopogon proximus.* There is some evidence that *Hyoscyamus muticus,* which has recently achieved a dominant position along the shores of Lake Nasser, could be included in the list of important plants for commercial use.

Animals, both domestic and wild, can graze and browse on 58 of the species growing in Wadi Allaqi. Among the most palatable of these are Leguminosaea, (with some exceptions such as *Indigofera* spp. and *Cassia* spp). Selective use of plants by animals is described by several workers and provides an example of resource portioning among grazing animals. The camels' diet is of a wider variety than other domestic animals. In addition to the highly palatable species camels can graze on 23 species that are usually avoided by other animals. *Fagonia* spp., *Leptadenia pyrotechnica, Morettia philaeana, Zygophyllum simplex, Caylusea hexagyna* and *Schouwia purpurea* are good for camels. Sheep prefer *Cotula cineria* and *Psoralea plicata.* The green *Crotalaria aegyptiaca* is grazed by camels and gazelles, but is poisonous to sheep and goats and suggests that its use by grazing animals should be carefully controlled, because of its toxicity and carcinogenicity. *Tamarix nilotica* is apparently good for camels and goats, but not for sheep while *Aerva javanica* and *Salsola baryosma* are

the main food for gazelles but domestic animals avoid these plants.

Observation and interviews in Wadi Allaqi indicate a considerable seasonal variation in grazing. Ephemerals provide the main forage in winter time and in dry periods phanerophytes (mainly *Acacia* spp.) are the main browse. In this context, it might be noted that *Tamarix* has a better palatability in winter, than in summer, because the high salt content in its foliage makes animals thirsty. Subsequent high water consumption can be harmful under hot conditions.

The use of plants for timber is limited in Allaqi. Nomads very rarely cut trees, preferring to use them for other purposes (browsing, charcoal). Only in the upstream part of the Wadi do the Bishari people use wood to build houses. Examples of important timber plants are *Balanites aegyptiaca, Hyphaene thebaica* and *Salvadora persica*. The wood of the last two is termite resistant and is widely used in Upper Egypt .

Observation and interviews indicate that most of the perennial plants growing in Allaqi are used at least occasionally as firewood and that *Tamarix* is the species most frequently used. Being relatively abundant, at least in downstream Wadi Allaqi since the inundation by Lake Nasser, it is currently exploited not only by nomads, but by workers in the local mines, fishermen and other strangers.

The fruits, flowers and vegetative parts of some plants are important sources of vitamins for pastoral nomads. Consumption of the fruits of *Balanites aegyptiaca, Hyphaene thebaica* and *Ziziphus spina-christi* has been observed amongst the Allaqi nomads. Tea derived from *Pulicaria incisa* and *Cymbopogon proximus* is well known throughout Egypt; *Portulaca oleracea*, *Asphodelus* sp. and *Launaea capitata* are good in salads. Kassas (1967) describes the collection and human consumption of *Panicum turgidum* grains by desert-dwellers, especially in dry years when cultivated crops may fail. The slimy fruits, young twigs, seeds and the tuberous root of *Leptadenia pyrotechnica* are often eaten by nomads.

Among the other economic uses of plants, the use of *Imperata cylindrica* in mat, rope and basket making is worthy of mention. Fibres of *Hyphaene thebaica, Calotropis procera* and

Leptadenia pyrotechnica can be used for making ropes and the seeds of *Balanites aegyptiaca* and *Ricinus communis* contain edible oil. *Lupinus varius* sub spesies *orientalis* can play an important role in nitrogen fixation and the roots of this plant are rich with nodules.

We could conclude that the economically important diversity of the group of species present in Wadi Allaqi is high. Out of all the recorded species 74% are known to be of potential value and 35% are known to be useful in more than one context. Plants with multi-uses have a highest importance value compared to the plants that used are only in one context.

Plants which have been chosen for further quantitative studies on valuation of biodiversity in Wadi Allaqi Biosphere Reserve are economically important plants:

a) with medicinal uses which have commercial value and sold in shops or use in pharmacology,
b) pasture plants growing in the downstream part of Wadi Allaqi where the grazing pressure is high, as well as,
c) fuelwood species intensively used as the main source of energy.

This group of plants is already threatened or at dangerous stage by overusing.

2. Fodder Plants

a. Characteristics of Pasture Plants

The specific focus of the present work is to elucidate the indigenous species, estimate the value of commonly utilized species, and describe their use and availability. In addition, plants identified to have high grazing value could be used for improving the desert pastures, taking advantage of the newly available water of Aswan High Dam Lake.

According to availability the desert pasture plants can be split into three groups. The first group comprises the perennial plants (trees and shrubs) that form the permanent but limited source of fodder for livestock. These are scattered and can be difficult to reach, for example the trees forage and fruits. For animals, suitable shade will reduce water loss and lower respiratory energy consumption.

The second group is perennials that life- span is in accordance with water availability stored in the wadi- fill deposits after the rain events.

The third group is composed of annual and ephemeral plants that provide temporal (a few months) but abundant (high biomass and high nutrition) pasture for livestock. These emerge after rain events which do not necessarily occur every year.

Group 1: Trees and shrubs

The indigenous desert trees, *Acacia* spp (A. *tortilis, A. raddiana*, *A.ehrenbergiana* and *Balanites aegyptiaca)*, are the most common and important fodder plants in Wadi Allaqi. *Tamarix nilotica* is also an important pasture plant that provides permanent fodder; it grows in previously inundated parts of downstream Wadi Allaqi..

Acacia

Acacia trees (*A raddiana*, *A. ehrenbergiana* and *A. tortilis)* form a principal element of desert plant communities in Egypt's South Eastern Desert. They are widespread in remote desert areas but sparse near settlements and urban areas as a result of human impact. *Acacia* trees play an important role in the function of desert ecosystems.

The scarcity of water in the hot desert enhances the young tree to grow a deep root system that is able to make the best use of the available moisture in the soil. The growth of branches above the ground is slow whilst this is happening, and the tree can remain in dwarf form for many years before growing on to reach maturity.

Because of slow growth grazing adversely influences the seedlings more than the mature trees. Very often plants stay in dwarf form waiting the fortune of the rain. As soon as favourable conditions come, they grow quickly. Usually this happens when rain falls in two successive years. This gives considerable grazing for livestock on ephemeral pasture , hence the grazing pressure on *Acacia* will decrease, and, using the available moisture, trees will quickly establish themselves (Springuel *et al.*, 1995).

Observations in Wadi Allaqi shows that under sufficient water supply and protection from grazing the trees can reach a mature stage and height of seven meters in less than 10 years, while in natural conditions it can take approximately 50 years (Springuel & Mekki, 1994).

Acacia trees are of considerable importance as fodder plants in the desert. They are the drought reserve fodder, which is only fed to stock at times when other food is very scarce. The importance of permanent trees as a drought reserve and as the stable source of food upon which people can always rely is also noted for peoples living north and southeast of Allaqi (Hobbs 1989, Hjort and Dahl 1991).The ripe pods of this species, called *ollaaf,* are important fodder for domestic animals, particularly during the dry summer months. *Acacia* trees are nutritious and contain high values of protein, ranging between 5% and 14% in young shoots and 21.20% in fruits (Annex XXX). Also the protein content shows high variability according to the seasons. It is higher in the wet season and low in the dry season. Data in Table 2. (Annex 2) show that in December 94 (after the rain of November 94) the protein content of forage was higher that in dry December 95 when the rains failed for the year.

Balanites aegyptiaca

Balanites is the most widely distributed tree in Sudan from where it penetrates to Southern Eastern Nubian Desert of Egypt. In Egypt it is confined to water-receiving sites such as wadis and river banks. Small populations of this tree are found in the wadis of the Southern part of the Eastern Desert and in Red Sea wadis. Relatively larger undisturbed populations of *Balanites* occupy the upstream part of Wadi Allaqi. It also grows in Kharga Oasis .

Ongoing experiments on cultivation of the *Balanites aegyptiaca* in desert farm in Wadi Allaqi began in 1991. The preliminary results of these studies shows that *Balanites* grows slowly. The growth rate is high in the first two years, low in the next years. Average growth rates of 0.75 meters in height over two years, 1.6 meters over four years, 4.2 meters over seven years, and between 5.5 and 8 meters after 15 years are recorded in Wadi Allaqi.

Balanites is a useful tree for livestock farmers, as a source of shelter, protection and fodder for their animals. It is especially good for providing shade for livestock because the trees have a dense cover of dark green leaves and often keep their leaves during the dry season when most other trees are bare.

In places where there is an abundant mixture of different pasture plants, or in the rainy season when pasture is easily available, livestock will often feed on other plants in preference to *Balanites*. However, when other fodder sources are scarce, especially towards the end of the dry season, animals do not hesitate to feed on the tree.

The foliage of *Balanites* is nutritious. The fresh green young shoots are also palatable but have less nutrition value than the leaves, particularly they are poor in carbohydrates and fat (Annex 2.)The leaves and young shoots of *Balanites* have a high mineral content (calcium, magnesium, sodium, potassium, phosphorus and chloride); some of these may be beneficial to animals while others may be harmful.

The seeds of *Balanites*, enclosed within the hard woody stones of the fruit, are also edible and nutritious. The seeds are particularly rich in oil and protein (Annex 2.). The fruits contain 8.80% of protein and high amount of carbohydrates (26.64%). The mineral contents of fruits are less than what are present in young shoots except for phosphorus (Annex 2).

Tamarix nilotica.

Tamarix nilotica, known locally as "Aabal", is the dominant plant in the downstream flooded part of Wadi Allaqi. It is a multiform species, varying in size from three to eight metres, with very small scale-leaves and white or pink flowers. Its foliage is green or greyish, which sometimes covered with salt crystals. Its racemes are highly variable in size and shape.

Tamarix nilotica forms extensive monospecific stands, especially in the central section of the downstream part of the wadi. There exists, however, a clear serial zonation of the vegetation over the 30 km stretch of the wadi, which is subjected to inundation. *Tamarix* grows in dense thickets that can be impenetrable which results in only its perimeter being used and hence overused while the interior remains under-utilized. Its denseness has created additional problems. Small animals can get lost in *Tamarix* groves and dangerous species such as hyenas, snakes, and scorpions can be concealed in the *Tamarix*. In some areas the dense *Tamarix* can prevent access to the lake shore. This plant is specially adapted to dramatic fluctuations in water availability. In times of abundant water (flood or inundation) it becomes a water spender, losing water at a high rate. In very dry conditions, *Tamarix nilotica* reverses its strategy and becomes a water saver. It is thus highly adapted to the fluctuations characteristic of the High Dam Lake shoreline.

Tamarix nilotica is a grazing plant but was considered by the Bedouin inferior for this

purpose. Goats and sheep, particularly young ones, graze on the *Tamarix* but it has limited nutrient value and people claim that mature animals become thin, their fur becomes spotty, milk production lessens after a steady diet of *Tamarix*, and they reproduce less frequently. As the Bedouin become more familiar with this new species they are altering their views and beginning to attribute greater value to *Tamarix*.

Results of the chemical analyses of the leaves and branches show a high content of the protein varies from 14% to 18% (Tables 2 and 3 in Annex 2) that indicate relatively high nutrition value but the high mineral content, especially Cl and Mg (2.66% and 1.44% respectively) most probably contribute to low palatability of this plant.

Tamarix is considered at its best as a grazing source when it is young and particularly when it is still under water as its leaves, twigs, and shoots are less salty at this time. However grazing on very wet foliage presents another problem as the animals fill their stomachs with water and do not eat enough solid food.

Group 2: Perennial plants

Common perennial plants growing in the middle and downstream parts of the main wadi channel and its tributaries were selected to evaluate their nutritional status and to identify the potential suitability for grazing. *Senna alexandrina, Aerva javanica, and Pulicaria crispa* and are woody perennials that grow as under-shrubs. *Citrullus* colocyntus grows prostrate on the ground. These plants are available in dry periods, usually the second year after the rain, but they dry after extended rainless periods. *Aerva javanica* and *Pulicaria crispa* have a low score for grazing value (Annex 1) , while *Citrullus colocyntus* and *Senna alexandrina* were reported to have no grazing value. However we often observed the partly eaten fruits of *Citrullus* in Wadi Allaqi. Bedouins explained that only wild animals can eat this plant. Also it is interesting to note that both plants (*Citrullus* and *Senna*) have high medicinal value. Chemical analyses (Table 2,3 and 4, Annex 2) show that during the dry period *Citrullus* has a low protein content but a high amount of minerals. *Senna alexandrina*, *Pulicaria crispa* , and, especially, *Aerva javanica* and show a high protein content in the wet season which decreases sharply in the dry season.

Psoralea plicata is perennial, drought resistant herb that is usually available as animal food up to two years after a strong rain event. It can produce new off-springs even following a light

shower. It has a high grazing score because it is abundant and has high nutrition values even in a dry season (Table 2, Annex 2).

Group 3: Annual plants

During the summer season an annual pasture is available on the shore of Lake Nasser in the downstream part of Wadi Allaqi as result of the annual water fluctuation of the lake. Short living annual plants *Eragrostis aegyptiaca*, *Fimbristylis bis-umbellata*, *Crypsis schoenoides*, *Glinus lotoides* form the temporal pasture (April till September) on the lake shores. *Eragrostis aegyptiaca*, *Fimbristylis bis-umbellata* and *Crypsis schoenoides* are the short grasses with moderate crude protein, carbohydrates and fibre contents except *Eragrostis* which has a high fiber content. Amongst these plants, *Glinus lotoides* is the most abundant, however it has a low grazing score (Table 1, Annex 1) compared with most other species. *Glinus lotoides* only appeared in abundance after inundation; it is possible that the Bedouin will find new uses for it. Research also suggests that *Glinus* consumption by animals may contaminate their milk and the Bedouin claim that it enlarges the animals and can kill them. The Bedouin say its 'like stuffing their stomachs with cotton'. Low palatability of *Glinus* could be attributed to the plant characteristics (for example alkaloids) which are not included in the present study. *Hyoscyamus muticus*, which also appears on the shoreline, was previously reported to have no grazing value. However, our experiments reveal that *Hyoscyamus muticus* is rich in protein (Table 2, Annex 2). We observed small amounts of this plant being given to young animals.

Astragalus vogelii and *Euphorbia granulata* are ephemerals with a short life cycle (3-5 months) that grow in the desert after a rain event. Both plants provide temporal pasture for livestock.

Astragalus vogelii has a high grazing score (Table 3 and 4, Annex 2) that is confirmed by high protein contents while *Euphorbia granulata* has low protein and a zero grazing score (Table 3 and 4, Annex 2)). *Astragalus vogelii* is highly valued as fodder by the Bedouin who claim it encourages fertility and milk production in their animals.

Special attention should be paid to the aquatic plant *Najas* sp that grows in shallow water close to the shores. These are frequently collected by the local population (mainly women) to feed livestock, especially young sheep. This plant has moderate nutritional content ((Table 2, Annex 2) but is important because few other plants are available at this time of year near to the lake where most people are living. It is also valued by local Bedouin because it can stored and then saved for a time when other fodder plants are scarce.

b) Economic Value of Fodder

To the degree that purchased fodder is a substitute for gathering fodder, the *shadow price* of fodder can be estimated using observations on the price of traded surrogates. Alternatively, the productivity of fodder, in terms of market value of outputs of meat and milk can be estimated using market survey data on the price of these outputs. Both of these valuation methods were used to calculate an economic value for fodder plants in the region. Household surveys undertaken as part of this project indicate that households use purchased fodder less than once a day on average. The use of purchased fodder, however, was dependent on both family wealth and season. The following two tables summarize household responses to ordinal scale questions regarding fodder decisions. Not surprisingly, wealthy families use more purchased fodder and use it more often: for both poor and medium wealthy families, the median response (4) was no use at all. The median response for wealthy families was less than once a day (3).

Table 1 **Fodder Use by Wealth**

Variable	Wealth	Mean	Median	StDev	SEMean
% Aswan fodder	Poor	0.0769	0.0000	0.2774	0769
	Medium	0.444	0.000	1.014	0.338
	Rich	2.375	3.000	1.506	0.532
How often	Poor	3.9167	4.0000	0.2887	0833
	Medium	3.778	4.000	0.441	0.147
	Rich	2.571	3.000	0.976	0.369

Surrogate Market Approach

Evaluation methods that are directly tied to market prices rely on the ability to express the value of a non-market good such as forage in terms of a related product which does have an observable market price. In this case we can use the market price of the related good as a proxy for the price of the non-market product. In order to estimate accurately the value of the particular characteristics which the market and non-market products share, it is necessary to adjust the market price into units which reflect these characteristics. Of importance in evaluating the value of fodder, energy value, dry matter content, crude protein provide the necessary weights to represent the market price in constant quantity terms. Thus, in the calculation of a shadow price of fodder, we find the price per kilogram of energy in dry matter units of crude protein. These calculations were affected using both data gathered in related research projects undertaken by Allaqi research group members and external, public data sources such as FAO Tropical Feedstock Database. We have included both *Sorghum* and 'Teben' in the analysis to produce a range for the shadow price. These results are summarized in the table below.

Table 2 **Shadow price of fodder**

	Mean	Standard Error	
Market Price of Sorghum	1.143	0.020	LE/kg
Price of Fodder Equivalent	1.049	0.019	LE/kg
Price of DM unit of Fodder Equivalent	0.524	0.009	LE/kg
Price of DM unit of FE of CP	0.682	0.012	LE/kg
95% Confidence Interval .66-.71 LE/kg			
	Mean	Standard Error	
Market Price of Teben	0.412	0.005	LE/kg
Price of Fodder Equivalent	0.381	0.005	LE/kg
Price of DM unit of Fodder Equivalent	0.258	0.003	LE/kg
Price of DM unit of FE of CP	0.438	0.006	LE/kg
95% Confidence Interval .43-.45 LE/kg			

Change in Production Technique

In order to assess the surrogate market results, another valuation approach was adopted. The Change in Production approach uses the market value of livestock products to value an incremental unit of dry matter. As such, this technique relies on the conversion of fodder inputs to outputs such as meat and milk, which have observable market prices, to establish an implicit value for fodder. In the following table, we summarize this estimation process. Note that the shadow price estimate using 'teben' as the proxy for fodder provides an underestimate of the true value of fodder which reflects uncertainty about the nutritive value of any given kilogram of 'teben'. This uncertainty is reflected in the market price.

Table 3 **Implicit Price of fodder**

Production Parameters						
Species	Meat(kg)	Milk(l)	Meat LE	Milk LE	Herd	Value of output
Sheep	4.7	30	12.5	2	1936	229900
Goats	6.6	40	14.5	2	992	174294.4
Camels	14	600	9.5	1.5	800	826400
						1230594.4LE
				Fodder Equivalent	LSU	MT DM/yr
				0.12	232.32	534.336
				0.12	119.04	273.792
				1	800	1840
						2648.128MT DM/yr
Implicit price of fodder						0.4647LE/kg DM

In the table below, we provide a summary of our estimates of the economic value of fodder. Note that this estimate is consistent with other published estimates.

Table 4 **Economic Value of Fodder**

	kg DM/CP)
Livestock Production	.465 LE/kg
Surrogate market: sorghum	.682 LE/kg
Surrogate market: teben	.438 LE/kg

In the livestock production calculation of the implicit price of fodder only milk and meat were used to calculate the value of livestock output. This method therefore understates the true value of livestock production to the degree that outputs such as wool and hide are not included. Moreover, it is generally recognized that livestock provide intrinsic values unrelated to output production; again implying an underestimate of the economic value of fodder.

Extensions of the Approach

In addition to the data collected directly under the terms of this research project, the valuation assessment incorporates research being conducted by other members of the Allaqi research team on the chemical composition of ten species of fodder plants which are indigenous to the Wadi Allaqi region (Tables 1and 2 Annex 3). The inclusion of this supplementary analysis of plant values (as fodder) in the region will allow us to compare values of fodder used in practice with fodder equivalents such as sorghum which are commonly used in valuation studies. Moreover, this detailed analysis of value for different species of fodder allows us to suggest specific strategies for resource conservation. These estimates of the shadow price of fodder are shown in the table below.

Table 5 **Other Fodder Species**

Tamarix nilotica	0.262LE/kg
Hyosimus nuticas	0.115LE/kg
Najus aromata	0.130LE/kg
A. radianna	0.437LE/kg
A. ehrenbergina	0.367LE/kg
Senna alexandrina	0.232LE/kg
Aerva javanica	0.367LE/kg
Pulicaria crispa	0.310LE/kg
Glinus lotodus	0.130LE/kg
Astrogulus vagelle	0.140LE/kg

Moreover, we can combine responses from the household survey with this data to incorporate seasonal variability into our estimate. The table below demonstrates this calculation for one of the species. *Acacia radianna*. This estimate reflects changes in the chemical characteristics of fodder plants over wet and dry periods. Extensions of this approach would prove valuable in analyzing household fodder decisions under varying climatic conditions.

Table 6 **Seasonal Variability**

A. radianna	Avg DM	Avg CP	Shadow Price
Wet	71.57	9.59	0.41LE/kg
Dry	65.99	7.73	0.47LE/kg

Transient Fodder Use

Dabuka have maintained a long-standing relationship with the inhabitants of the Allaqi region, sustainably transporting large number of camels through the region without endangering indigenous fodder stocks. However, recent experiences have demonstrated that this balance is fragile and it is worthwhile examining the implied cost of transient livestock populations in the region.

Table 7

Energy requirements(kg) per camel/day	6.30
Implicit fodder price(LE) per camel/day	2.93

While 2.93 LE/day appears to be a relatively trivial cost, typical transient camel herds can exceed 100,000 annually. Thus the potential cost for detaining each dabbuka for merely one day could exceed 293000 LE. This translates into a total fodder requirement of 630 MT DM/yr, an amount that could seriously jeopardize local fodder stocks.

3. Medicinal Plants

a) Characteristics of Medicinal Plants

The following is a brief description of common medicinal plants that grow in Wadi Allaqi and their uses.. The plants are divided into two groups. The first group comprises plants which are collected mainly by the Bedouin and are sold in shops. The second group includes plants used locally by Bedouin for medicinal purposes but not sold and those whose medicinal properties are known from literature or from our own research but are not generally used by local Bedouin.

Group 1. Plants with commercial (market) value

Balanites aegyptiaca was described above in the section on fodder plants, however, in Egypt, the fruits of this plant is mainly known for their medicinal value. These are used by desert dwellers and sold in primarily Upper Egyptian and Kharga oasis shops.

Balanites aegyptiaca is widely used in East Africa in various folk medicines. The seeds, fruits and even the flowers are sold in African food markets. The root is used for treatment of abdominal pains, as a purgative, and as an antihilminthic, while the bark is employed as a detergent, fish poison and also as a remedy for malaria and syphilis. Fruits are used for treatment of non-insulin dependent diabetes. Fruits and leaves are used for treatment of rheumatism and skin problems. The root, bark, kernel, fruit and branches are used for gastro-intestinal problems, treatment of cold, flues and fever, and also have been shown to be lethal to molluscs, and a concentrated emulsion of the fruits has been recommended for

treating stagnant water. The planting of the trees alongside infested waters was once suggested so that the fruit could drop into the water spontaneously. The molluscicidal activity of the plant was tested with the isolation of the potent saponin glycosides balanitin 1, 2 and 3. From the chloroform extract of the stems, 3 furanocoumarins have been isolated, namely bergapten, dihydrofuranocoumarin and (+)marmesin, respectively. The wide use of *Balanites aegyptiaca* and the diversity of its active constituents isolated, throw light on the importance of this plant as a natural source rich in biologically active substances.

Citrullus colocynthis was described above in section of fodder plant. However this plant mainly is known because its medicinal value. It is used by the local population in Wadi Allaqi, in other Egyptian desert areas, and its fruits are sold in shops in Egypt.

The chief constituents of colocynth pulp appear to be an alkaloid producing very drastic purgation even in small doses, and amorphous resins soluble in ether and chloroform which are also powerful purgatives. Other constituents are crystalline alcohol citrullol, and the glycoside of cucurbitacin E (a- Elatrin); neither of which is purgative. Colocynth pulp also contains from 1.0 to 1.3% of fixed oil. Seeds contain 15 - 17% fixed oil.

Colocynth is used as a gastrointestinal stimulant or irritant and is one of the most powerful of well known purgatives, acting as a hydragogue cathartic. It is employed as an occasional purgative to produce free evacuation of the bowels in bilious derangements of chronic constipation, but as it causes gripping , is seldom prescribed alone. The detailed morphological and histological characters of the pulp and seeds were studied for the purpose of identification. There are no reports about the use of colocynth leaves in medicine. It is the pulp and seeds which are most frequently used. It is used by local people to treat mange of camels and it is used in tanning skins.

Cleome droserifolia is a perennial, densely glandular under-shrub growing in tributaries of Wadi Allaqi on shallow silt deposits. This plant is used by local people as well as sold in shops. *Cleome* species have been reputed as a remedy for infantile convulsions and as a antihelminthic and counter-irritant in chronic painful joints. Some researches isolated the anticancer coumarinolignans and cleomicosin A and B from the seeds of *Cleome* species; also flavonoid aglycones and glycosides have been reported. Investigation of *Cleome droserifolia* showed the presence of the flavonoid compounds artemetin, bonanzin,

kaempferitrin and isorhamnetin-3-0-neohesperidoside (El-Emary & Springuel, 1993).
In Chinese medicine, some *Cleome* species are used internally to treat rheumatism and intestinal parasites, and externally to treat inflammation of the ear. An infusion is applied to skin diseases; the roots are used as a remedy for scurvy; the vapour from a steaming decoction of the whole plant is inhaled to treat head ills; the crushed leaves are rubbed on the lumbar region to quiet pain in the loins and the leaves are also said to be expectorant and stimulate digestion.

Cymbopogon proximus , local name 'halfa barr' is perennial aromatic grass, densely tufted with narrow leaves, panicle reddish. A very small population of this plant grows in upstream Wadi Allaqi on sandy ground. *Cymbogon proximus* is widely used all over Egypt as refreshment drink as well as it is used in Egyptian pharmacological industry. It is the main component of PROXIMOL (Halphabarol) that is a new potential antispasmodic drug with efficient propulsive effect. It has unique antispasmodic properties as it produces relaxation of the smooth muscle fibre without abolishing the propulsive movement of the tissue. The success of PROXIMOL in the propulsion at renal and ureteric calculi could be attributed to these pharmacological characteristics where ureteric dilatation occurs without paralysis and preserving the propulsive waves. In addition pharmacological studies have proved that PROXIMOL has a bronchodilat or effect and this may justify its trial as an antiasthmatic drug. All Wadi Allaqi households have *Cymbogon proximus;* it is a popular drink prepared as a tea and sweetened. Downstream Wadi Allaqi households purchase it in Aswan, while some upstream collect it.

Haplophyllum tuberculatum, local name 'oarn el-gazal', is densely glandular-tuberculoid perennial herb which is usually grows in the main wadi channel on the silt deposit. It is known for its distinctive odor, considered unpleasant by most people but not by Bedouins. Wadi Allaqi Bedouins use it to relieve pain (stomach, chest, headache and tooth ache).

Hyoscyamus muticus is a stout fleshly puberulent perennial herb, richly branched from the neck. It is common in the downstream parts of the Wadi, close to the shore of the Lake, on soft deposits accumulated between the rocks. The plant is reputed to contain a large number of tropane alkaloids like atropine and hyoscine which are used widely medicinally as a

medriatic , antispasmodic and antiasthmatic. The production of this plant on a commercial scale is worthy of study as a local natural source for drugs. *Hyoscyamus muticus* is believe to have narcotic properties and thus its sale is prohibited.

Pulicaria incisia, local name 'chay gabali', is procumbent perennial plant with yellow ray-florets. It is common in the middle parts of Wadi Allaqi on soft deposits. This plant is characterized by strong pleasant smell. Leaves, flowers and small branches are used to make a tea that is a very popular drink in Upper Egypt. It is used locally by Bedouins as well as sold in the shops.

Salvadora persica L., local name 'arak', is a shrub with pail green or white branches and coriaceous leaves. Fossil remnants of this plant are present in the main channel of Wadi Allaqi forming 'phytogenic hillocks'. Living individuals are widespread in the upstream part of the wadi. This plant can grow as tree, prostrate shrub, or as a creeper on rocks.
Cuttings of *Salvadora* branches are used by local people as tooth-brush and sold in the shops all over Egypt. *Salvadora persica* is used in folk medicine as an anti-rheumatic, analgesic, stimulant and tonic in amenorrhoea. The fruit is edible being carminative and analgesic. Five flavonoid compounds, viz., kaempferol, quercetin, quercetrin, rutin and quercetin glucoside, were isolated from the root of the plant. Some drug companies have started to produce tooth-paste from extracts of this plant.

Senna alexandrina, local name 'senamekki', is a glabrous undershrub with acute leaflets and straight legume and is common in the principal wadi channel and its tributaries. It is used by local people in desert, sold in herb shops and used in pharmacological industry where it is the compound of purgative drugs. The laxative principles of the leaves and pods of this plant were isolated and characterised as anthraquinone glycosides such as some free aglycones like rhein and aloe emodin which give its purgative characteristics. This is the most commonly collected medicinal plant in downstream Wadi Allaqi.

Solenostamma arghel , local name 'hargal', is an erect perennial plant with white flowers in auxiliary umbles, fruits ovate green-purple. It grows in upstream Wadi Allaqi close to rocks on soft deposits. It is used by local people living in the desert and sold in many city shops.

Solenostamma is mainly collected by Bishari people in the upstream Wadi Allaqi and it is an important source of income for those living in such remote areas. Its common use in folk medicine is for treatment of cough and is also much used as a purgative. A wide variety of active compounds have been isolated from the plant parts including saponin glycosides, flavonoid glycosides, quercetrin, rutin and B-sitosterol, a- and B-amyrin, dihydrostigmasterol and ethoxy vangurolic acid in addition to the glycoside argeloside and argelin.

Group 2 - Medicinal plants not currently marketed

Acacia species. The bark of most of the *Acacia* species yields gum which is used as a demulcent. Also, it is generally used as a powerful astringent and tonic. Recent reports on *Acacia* species growing in Egypt, revealed the isolation of different types of saponin glycosides, in addition to tannins, phenolic compounds and catechins.
There are five *Acacia* species growing in the area; their medicinal properties and the Bedouins knowledge of their medicinal uses require further study.

Aerva javanica had been described above in the section of fodder plants. It also has a medicinal value. A paste of the roots of *Aerva javanica* is applied to acne-like conditions of the face but this has not been observed locally. In addition it is believed by Bedouins that smoke from burring its leaves affers protection against the 'evil eye'.

Cleome chrysantha is densely glandular-hispid under-shrub with ovate leaves, almost acute; one-nerved. It is recorded in the downstream Wadi Allaqi on coarse deposits. *Cleome* species have been reported as a remedy for infantile convulsions and as an anthelminthic and counter-irritant in chronic painful joints. We isolated from *Cleome chrysantha* some new dammarane triterpene such as aglycone and saponin, which have a tonic effect similar to that of the popular Asian ginseng root.

Crotalaria aegyptiaca is one of the well known toxic desert plants. It is characterized by the presence of large quantities of the hepatotoxic pyrrolizidine alkaloids. *Crotalaria aegyptiaca* has already been studied and its pyrrolizidine alkaloids and its N-oxides have been isolated. Other constituents like steroids and flavonoids are reported. The use of *Crotalaria* by grazing animals should be carefully controlled, because of its toxicity and carcinogencity.

Reports from the U.S.A have shown that fatalities of children taking herbal medicines contaminated with plant materials containing pyrrolizidine alkaloids have occurted. On the other hand, some pyrrolizidine alkaloids and their N-oxides isolated from some *Crotalaria* species are reported to have antitumour activity, like the crispatine and fulvine alkaloids. Therefore, an, extensive study of *Crotalaria* species constituents is necessary to evaluate their potentiality for use in medicine.

Heliotropium supinum, is one of the Boraginaceae members which is widespread on the shore of the Lake Nasser and in the downstream part of Wadi Allaqi. In the interest of public health, present knowledge of plant species containing hepatotoxic pyrrolizidine alkaloids should be diffused as widely as possible and brought particularly to the people who are most at risk. The alkaloids from some pyrrolizidine alkaloid bearing herbs have been found at the level of 1 - 4 ppm in milk and honey from cows and bees which had been foraging on this species (Hamed *et al.*, 1993)

Glinus lotoides was described above in section of fodder plants. Local people living in wadi Allaqi did not know about medicinal uses of this plant however various species of the genus *Glinus* are used in folk medicine for treatment of diarrhoea, bilious attacks, boils, wounds and pains and for strengthening weak children and are antiseptic and anthelmentic. From this plant we isolated seven compounds which were identified by spectroscopic methods (two phenylpropanoids and five triterpenoidal saponins) (Hamed *et al*, 1996) and we found great bioactivity against the water snails associated with *Schistosomiasis* (bilharzia) which is one of the most widespread and damaging environmental diseases in Egypt. It is caused by a flatworm which lives part of its life-cycle in these snails and the other part in people.

Psoralea plicata, known in Arabic as *marmid*, is a widely distributed in the Wadi Allaqi area. It is a good fodder plant, as it was described above and it has been used in folk medicine (information obtained from literature but not from nomads) for the treatment of skin-photosensitizing activity and is anthelmintic, antipyretic, analgesic, anti-inflammatory, diuretic, diaphoretic, and useful in bilious infections, leprosy and menstruation disorders. The seeds of some *Psoralea* species are reported to be used as aphrodisiac and tonic to the genital system; they are prescribed as roborant-excitant to treat backache, ache in the bones from

cold, weak kidneys, impotence, emmission and irregular menstruation. Its essential oil has a powerful effect against cutaneous streptococci. When administered orally, it has undesirable side effects. The seeds contain fixed and volatile oils, oleoresin, psoraline (active against leucoderma), psoralen, isopsoralen and psoralidin.

Tamarix species have been described in section of fodder plants. Medicinal uses of this plant have been obtained from literature and are not know by Bedouins living in Wadi Allaqi. As they become more familiar with this species which has only grown in the area for the past two decades, perhaps the Bedouin will learn of its medicinal properties. *Tamarix* have apparent tonic and astringent properties mainly due to the presence of tannins and /or flavone glycosides. *Tamarix* shrubs have an aromatic odour but only a slightly salty flavour. They are used as a diuretic, depurative, and sudorific ; they are prescribed in Chinese herbal medicine to help measles erupt, also as an emollient for urination, and further to treat alcoholic poisoning; externally, they are used as a wash for skin allergies and as a carminative. Also, the branches and leaves are combined in making a bath or lotion to bathe children with measles. The bark of *Tamarix* contains tannins, called tamarisk-tannin. The leaves as well as the roots of *Tamarix* spp. contain several polyphenolics and flavonoids like the flavonoid glycoside tamarixin. Flavonoids are also reported e.g. isorhamnetin, kaempferide and kaempferol 4,7'dimethyl ether and its monoglucoside and rhamnocitrin.
Although most of the active constituents of *Tamarix nilotica* have been reported, little is mentioned in the literature about the gummy excudate of the branches, a property which should be studied carefully to understand the extensive use of this plant by grazing animals in the Allaqi area. The biblical 'manna' was believed to be the sweet exudation produced by small scaly insects feeding on its branches.

b) Economic Value of Medicinal Plants

While there is relatively little information available about either the use of trade of medicinal plants which are indigenous to the Allaqi region, some indication of availability and preference can be inferred from the household survey which recorded collection activity for 10 indigenous species. However, these plants play an important role in the trade and excange between Allaqi inhabitants and people from upstream Allaqi. The collection

activities of upstream inhabitants could not be captured in this survey, so that actual collection activity is certainly understated in these results. The survey does indicate that, for several commonly marketed medicinal plants, Allaqi inhabitants make use of indigenous supplies. For example, the household survey suggests that 19-54% of the households collect *Senna alexandrina* while up to 20% of the households collect both *Cymbopogon proximus* and *Solenostemma arghel* (Annex 3).

Table 8. Market price and use of indigenous medicinal plants

	Unit	Mean (LE)	Standard Error	Median	Mode	Standard Deviation	Sample Variance	Confidence Level (95.0%)(+/-)
Balanites	Kg	8.0676	0.563475845	8	15	4.847203	23.49537208	1.123006502
Citrullus	Fruit	0.5872	0.084070262	0.25	0.25	0.7232	0.523017864	0.167551904
Cassia Senna	Kg	3.5514	0.479116811	2	0	4.121519	16.98691596	0.954879074
Cleome	Kg	11.876	2.594148579	2.8	0	22.31571	497.9909071	5.170134169
Cymbopogon	Kg	3.7676	0.219268989	4	4	1.886223	3.557837838	0.437002762
Haplophyllum	Kg	10.689	0.70695641	15	15	6.081469	36.98426509	1.408963049
Hyoscyamus	Kg	4.027	0.642927223	0	0	5.530669	30.58830063	1.281352976
Pulicaria	Kg	14.135	0.991695306	14.5	25	8.530886	72.77600889	1.976447234
Salvadora	Each	0.4555	0.025406918	0.5	0.5	0.217077	0.047122336	0.050647733
Solenostemma	Kg	6.4315	0.311089292	7	8	2.657948	7.064687976	0.620144782

Household Collection	Mean	Stan. Error	Stand. Dev.
Citrullus	0.033	0.033	0.183
Balanities	0.000	0.000	0.000
Senna alexandrina	0.367	0.089	0.490
Cleome	0.033	0.033	0.183
Cymbopogon	0.100	0.056	0.305
Haplophyllum	0.000	0.000	0.000
Hyoscyamus	0.000	0.000	0.000
Pulicaria	0.033	0.033	0.183
Salvadora	0.033	0.033	0.183
Solenostemma	0.100	0.056	0.305

Cymbopogon proximus

One medicinal plant for which additional information is available is *Cymbopogon proximus*, the chief constituent of PROXIMOL (Halpha-bar). 20MT of this plant were traded through Allaqi in 1997. Depending on the level of processing, the price for *Cymbogon proximus* ranges from 3-4000 (LE/MT) to 5-6000 (LE/MT). In pharmacological applications, PROXIMOL is produced from *Cymbopogon proximus* at a rate of 1.5% (by weight). The final product has a selling price of LE3.4 per 60 gm of Proximol (which contains 18.5 gm of extract).

Table 9. **Market Value of 20 Tonnes of *Cymbopogon proximus***

Plant(Dry)	3500	LE/MT	70000
Plant(crushed)	5500	LE/MT	110000
Extract(Proximol)	3.4	LE/18.5gm	55135

It is interesting to note that the value, in Egypt, of ***Cymbopogon proximus*** as a dry plant exceeds the market value of the processed extract. This illustrates the effect of state-controlled pharmaceutical industries in the country.

4. Fuel-wood plants

a. Characteristics of Fuelwood Plants.

Fuelwood species, their characteristics, distribution, use patterns, and energy content have been presented in detail in our previous 1995 report, Environmental Management of Fuelwood Resources in Wadi Allaqi (Egypt) (I.D.R.C. File: 92-1001-01). We will not repeat here but briefly describe some of the recent changes in fuelwood use patterns.

In 1996 the High Dam Lake reached its highest recorded level and dramatic rains produced torrents in Wadi Allaqi. At the height of the water in winter 1996 and again in 1997(see figure 2) all the *Tamarix* was submerged in water creating a shortage of readily available fuelwood, a situation local residents had not faced in approximately two decades. While *Tamarix* has

been considered an inferior fuelwood resource relative to acacia species due to its lower heat values, quick burn, and smoke and fume emissions, it was the most heavily used fuelwood species and sorely missed when it was inundated. In general, *Tamarix,* in spite of its consistently low value ratings (see for example, Briggs and Badri 1997) is of great value to local residents being, when abundant, the most widely used fuelwood, timber, and fodder species in the area. Perhaps because it is a new species for local residents, appearing only after the lake receded in the late 1970's, people have taken some time to learn its uses and appreciate its value. In addition, as a result of its abundance in the recent past, people, perhaps, took it for granted. However, this is now changing.

People adapted to the fuelwood shortage in a number of ways. Some people (women and children) went into the water to collect *Tamarix* but this was difficult as the water reaches its high point in winter and going into the cold water is uncomfortable and unhealthy. Tamarix collected from the water needs two days to dry. Fisherman brought some households, especially those with whom they had trading relations, *Tamarix* they collected from the water and some people said tree branches occasionally just floated up on shore. This occurred after the torrents. Also many women claimed they were cooking less frequently to conserve wood; some would cook only once a day and save food for later.

People also turned to alternative forms of fuel and fuelwood. In 1996-7 we observed very little use of kerosene stoves however some women said they purchased small amounts of kerosene and used it to ignite cold and damp wood. More interesting was the use of woody species that had been identified as potential fuelwood but that we had not observed in use prior. These species, particularly *Aerva javanica* and *Glinnus* , are low bush like plants that are light and lack density. They are best used as kindling, especially their roots, their thickest part. *Aerva javanica* was also being used to build small animal enclosures - structures usually built out of *Tamarix*.

The use of such plants illustrates not only the adaptability and opportunism of Bedouin plant use but also the economic rationality of utilizing less and not more expensive or valuable species for everyday use. Instead of burning more expensive sources of available fuels such as tree branches or charcoal, the Bedouin chose to move down the economic scale and

preserve the more valuable fuel sources for other (commercial) purposes and utilize cheaper, less efficient sources for everyday use.

b. Economic Value of Charcoal Production

Table 10 **Physical characteristics of fuelwood species of Wadi Allaqi**

Species	MC%		DMC%		AC%	D (g/cm^3)	
	air dry	oven dry	air dry	oven dry		air dry	oven dry
A.ehren.	29.536	4.977	70.463	95.031	2.965	0.943	0.922
A.radd.	29.673	5.004	70.327	94.996	4.346	0.890	0.857
B. aegypt.	39.522	5.048	60.478	94.952	6.848	0.806	0.769
T.nilotica	32.976	5.228	67.023	94.772	4.668	0.745	0.729
S.persica	*	5.547	*	94.458	8.350	0.791	0.756

where MC (%) = moisture content

DMC (%) = dry matter content

AC (%) = ash content

D (g/cm3) =specific weight

Table 11 Gross and net heat of combustion (kJ/g) of five fuelwood species of Wadi Allaqi

Species	Hg	Hn
A.ehrenbergiana	20.587	19.253
A.raddiana	18.690	17.348
B. aegypt.	18.478	16.696
T.nilotica	17.553	16.267
S.persica	17.533	16.285

Table 12. **Market Price of Kerosene**

Price (Piastres) per litre 1	Density (kg/litre)	Price per kg	Energy Content (kJ/kg)	Price (Piastres) per Joule
.56	0.824	48.54	46080	1.05

Table 13. **Shadow Price of Fuelwood**

Species	Energy Content kJ/cm^3	Price (Piastres per kg)	Price (LE per m^3)
A.ehren.	17.751	20.27	262.7
A.radd.	15.995	18.27	236.7
B.aegyp.	15.394	17.58	227.8
T.nilot.	14.998	17.12	221.9
S.pers.	15.015	17.15	221.9

Rates of Harvesting are constant at current levels

Commercial valuation shown above represents an annual flow of value from the stocks of *Acacia*. However, the economic value of *Acacia* stocks in terms of charcoal production is represented by not only the current flows, but all future benefits of charcoal which flow from the stock. The introduction of time requires the adoption of a number of assumptions about the growth rate of the stock, rates of harvesting and the value of benefits over time. .
We have calculated a preliminary estimate of the net present value of charcoal production under several assumptions. These results can be refined and evaluated with the addition of survey data on utilization. We expect that economic values in this context will be especially sensitive to information on the changes in utilization which are summarized in the next section.

In project analysis, time horizons of 20 years are customarily adopted. There are several

1 From the market survey .56 +/- .13 LE

reasons to believe that such a short time horizon would be inappropriate in the current case. First, in the absence of protection, 50 years is a widely accepted time span for producing a mature tree. This fact is reflected in the functional form chosen for the growth function. Second, study of current harvesting patterns suggests that it would take 270 years to deplete the current stock of *Acacia*, **assuming ZERO growth** in the stock. Finally, the calculation reflects the nature of the actual benefit stream: current harvesting practices strongly prohibit harvesting live *Acacia* for charcoal production. We do not yet have data to indicate whether the dynamic changes in resource relationships, discussed in the next section, will affect these harvesting practices.

Further, the present value of net benefits is critically dependent upon the choice of discount rates; a subject of much controversy. One school of thought holds that the discount rate should be equal to the risk-free market rate of interest: this rate is thought to reflect social preferences and the opportunity cost of government projects. Alternatively, it is argued that the social discount rate should be lower than market rates of interest to reflect the fact that individuals in society may have shorter time horizons than society as a whole. In this argument, the question of intergenerational equity becomes critical and any positive discount rate is often regarded as being inequitable to future generations. As a compromise between these positions, the discount rate is chosen to reflect both intergenerational issues and production capabilities of the economy over time. In this context, it is possible to argue for a discount rate which reflects the average rate of real growth in GDP (historically between 2 and 3%) as one which reflects maximum social welfare over time.

Finally, the NPV calculation is, manifestly, sensitive to assumptions made about the path of prices over time. It could be fairly argued that the assumption of constant price is, at best, unlikely over the time horizon considered. Absent the extensive empirical research needed to project prices over the long term, a constant price was adopted as the most transparent price assumption capable of reflecting a world of growing resource scarcity. Market survey data generated by this project is expected to allow for reconsideration of the viability of this assumption.

Net Present Value Calculation

The following estimate of Net Present Value (NPV) of *Acacia* stocks as inputs to charcoal production adopts four critical assumptions:

(1) Discount rate of 2% is used
(2) Price of Charcoal is constant at current level
(3) Growth follows a logistic growth function in which average growth is equal to current harvesting rates:

(1) r is the intrinsic growth rate

(2) k is the carrying capacity of the stock

(3) is the stock biomass (converted to trees assuming 250 kg per tree)

(4) Rates of Harvesting are constant at current levels

$$12000 = 48\,250 + x \cdot 50$$

$$48\,250\,1.84\,270 = 5.962\,10^{6}$$

$$240\,50\,.1.84\,270 = 5.962\,10^{6}$$

1) X is the stock biomass (converted to trees assuming 250 kg per tree)

Net Present Value of Acacia Stocks using the Price of Charcoal as the Shadow Price

$$\sum_{t=0}^{270} \frac{(12996 - t \cdot 48) \cdot 250\,1.84}{(1+.02)^{t}} = 2.488\,10^{8}$$

Economic Value of Acacia as Extractable Resource: assuming zero growth rate

$$\sum_{t=0}^{\infty} \frac{(12996) \cdot 250\,1.84}{(1+.02)^{t}} = 11963467$$

Economic Value of Acacia as a Sustainable Resource: assuming growth=harvesting

c. Economic Value of Fuelwood[2]

The Allaqi Research Group has studied fuelwood species indigenous to the region in order to establish both the energy content of fuelwood and its density. This research is critical in the economic valuation of fuelwood species. The process of valuation is relatively straightforward. First, find the energy content of fuelwood and kerosene. Second, estimate the weight of fuelwood in a cubic metre. Third, estimate the *kerosene equivalent* of a cubic

[2]Source: Section 3 in Environmental Management of Fuelwood Resources in Wadi Allaqi (Egypt) Final Report, submitted to IDRC File 92-1001-01, July 1995

metre of fuelwood by multiplying the weight by the ratio of the energy values of fuelwood and kerosene. Finally, multiply this value by the market price of kerosene. The components of this calculation are shown below.

Results in Table 13 above confirm that both *Acacia ehrenbergiana* and *Acacia raddiana* are preferred, whereas *Tamarix nilotica* and *Salvadora persica* are of low efficiency as fuel. This result could be also confirmed by measuring the energy content of these species. This calculation is shown in Table 11, which lists both gross and net energy values for five fuelwood species which are of special interest in the Wadi Allaqi region. In the context of the valuation of *Acacia* estimated here, it is useful to calculate the reference price per unit of energy for charcoal which is the precursor of charcoal. Assuming that charcoal has an energy value of 13000 BTU/lb and costs 1.84 LE per kg, charcoal has a price of approximately 6 piastres per joule. Given relative production and transportation costs, scarcity and non-energy values of charcoal as fuel, the estimated shadow price of fuelwood seems reasonably credible. Household production of charcoal data provides additional data that is useful is forming an estimate of the overall value of fuelwood in the Wadi Allaqi region.

Table 14 **Estimated Total Charcoal Production**

	Charcoal Kentars	Trips	95% Confidence Interval Total Production	95% Confidence Interval Charcoal Prod.(MT)
Avg./trip 1996	9.555556	24	186.7112 - 271.9555	8.402002 - 12.238
(Standard Error)	0.906084			
Avg./trip 1997	35.25	13	309.7343 - 606.7657	13.93804 - 27.30446
(Standard Error)	5.828718			
Avg./trip 96-97	17.46154	37	544.3432 - 747.8107	24.49544 - 33.65148
(Standard Error)	1.402837			

Notice that while these estimates are consistent with the estimates made by Springuel and Mekki(1994), some changing patterns of production may be emerging. In 1997, estimated charcoal production increases dramatically over that of 1996 while the number of trips associated with selling this charcoal decreases. This may indicate that production patterns are leading toward specialisation in charcoal production.

d. Applied Research: Choosing Appropriate Stoves in Wadi Allaqi

The existing situation of stoves in Wadi Allaqi

Prior to developing the stove a thorough understanding of the existing situation was sought in order to design a new (improved) stove that could accommodate as many as possible of the traditional and useful functions of the existing fireplace or stove. This was preferable to introducing a new one, however efficient and inexpensive it may be. Information was obtained from census data, government publications, research, interviews with people from the range of social strata that exists in the community, and from observations.

Open-fire places are used for cooking and heating in Wadi Allaqi. They consist of three stands of brick or stone that are available in the area. The pot is put upon these stands and the fuel is ignited by using small branches of wood. The main problems of these fireplaces are high wood consumption and difficulty of igniting. The solution to these problems is the design of a new stove of an enclosed firebox to prevent heat losses through the stove walls. *Tamarix nilotica* shrubs are the main wood supply for cooking in downstream Wadi Allaqi. People collect the dry branches and sometimes cut green ones and dry them. They do not cut the whole shrub. People in Wadi Allaqi use a local method for meat roasting; the meat is roasted on heated stones. This method involves putting stones on wood and lighting the fire. When the charcoal of this wood is glowing, the meat is roasted on the heated stones. Bread is prepared by two methods. The first is to cook on an iron plate above the fire. The second method is to immerse the bread dough into the charcoal. Fig.4 shows the different methods for meat roasting, cooking, and bread preparation in Wadi Allaqi.

The situation of stove in Wadi Allaqi can be summarized as follows:

- Open fire place is used for cooking and water heating.
- High fuel consumption and difficult igniting are the major problems of the fireplace.
- Release of smoke is not the main problem because the position of fireplace is outdoors.
- Kerosene stoves with wicks are sometimes used and purchased from Aswan town but they do not diffuse the heat.
- The building of open fire-places is very low cost and the construction materials are available.

- *Tamarix nilotica* shrub is the main wood supply for open fire place in the downstrean part.
- The fuel consumption is approximatelly 10 kg in summer and 20 kg in winter per day.

The new improved stove

By analysis of the assessment of the cooking needs of the Bedouin we can introduce a new stove that is suitable for local people. The one-pot chimney-less stove is well insulated and heat loss in the firebox and through the stove walls is minimized.

The population of Wadi Allaqi do not consider themselves to be full settled. Movements are taking place within the Wadi itself involving the re-location of settlements and cultivated plots. These movements are related to changes in the Lake level over the year and related to abundance of fuelwood species. Thus, the stove must be constructed from light materials so that it can be carried easily when people move through the wadi. One-pot chimney-less stoves (also known as shielded fires) are the simplest and smallest of the stove types and seem to be the most direct progression from the three-stone fireplace. The highest constant field performance figures have been obtained from them. They are usually portable, are relatively low cost, and can often operate over a wider variety of power outputs and higher efficiencies than the other types.

The new stove [Fig.5] is simply a cylinder of metal sheet covered by a wire grid and lined with mixture of cement, ash, and powder of brick (1:1:2 by volume) insulation. Air holes are made through it when the mixture is still wet. The medium size is 33 cm wide x 27 cm height, and the weight is 2.0 kg. The medium size stove cost 5 Egyptian pounds. The diameter of stove is the diameter of pot plus 2 cm. The height of the pot from the fire bed is 0.5 x diameter of the pot. The stove does not have a fuel grid. The fuel entrance (without door) is positioned so that long pieces of wood can be inserted into the firebox while resting on the ground.

Efficiency, power, and fuel consumption of the stove

The new stoves were tested with the aim of assessing the efficiency and power. The stove was fired with 200-500 g of *Tamarix* wood, which was ignited using dry leaves. These leaves were ignited easy. The power was calculated over the whole burning period of the stove, as the wood was allowed to burn out completely. Efficiency was calculated as the energy content

of the water plus the energy content of the water vapour divided by the energy content of the wood.

The power and the efficiency are equal to 2.64kw and 12.98% respectively. Assuming an average efficiency of 10% with open fires, then an improvement positive side-effect of improved efficiency is reduced air pollution. The better the combustion, the cleaner the exhaust gasses. Efficiency is a valid criterion from an energy conservation point of view. Useful energy can be calculated as the product of the net heat of combustion of the wood by the stove efficiency and equal to 48.476.

The calculation of the Specific Fuel Consumption (SFC) for water boiling test can be very misleading and needs careful definition. In water boiling test the SFC is equal to 0.345, the task is to boil 905.72 gram of water and requires 333.44 gram of air dry wood to achieve the required time of boiling.

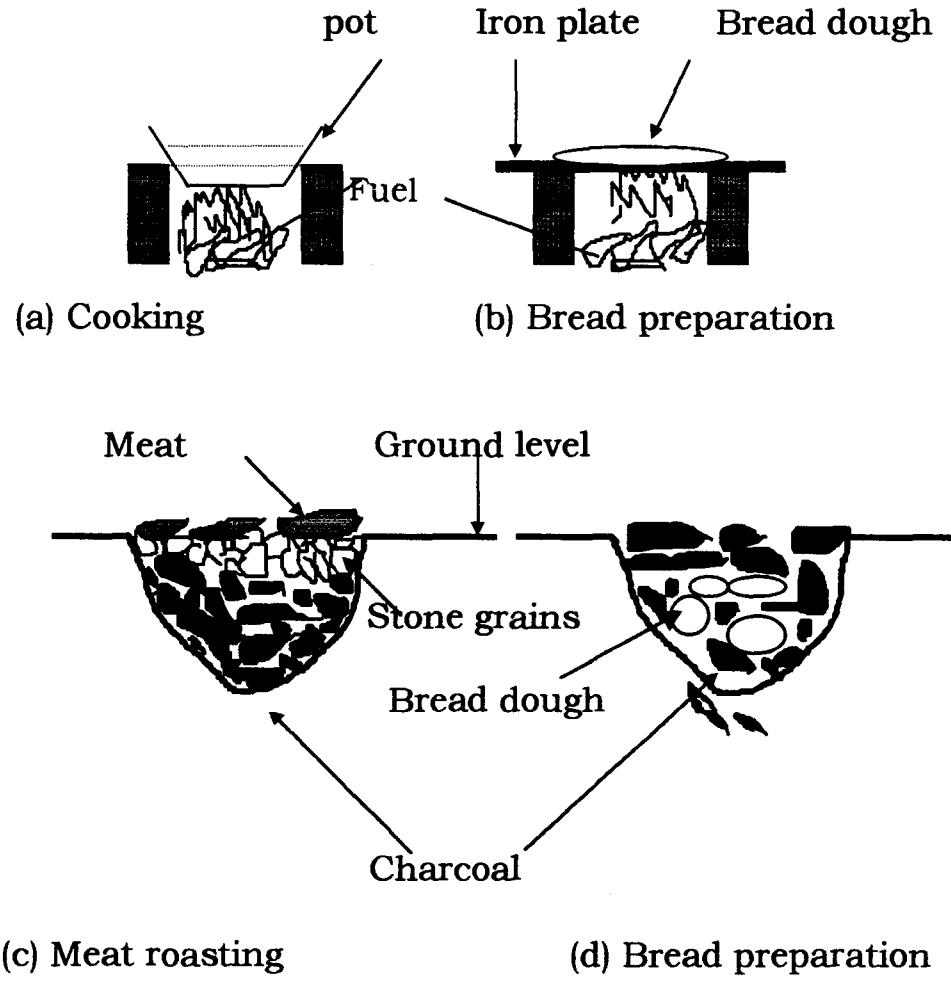


Fig. 4 Stoves used by Bedouins in Wadi Allaqi

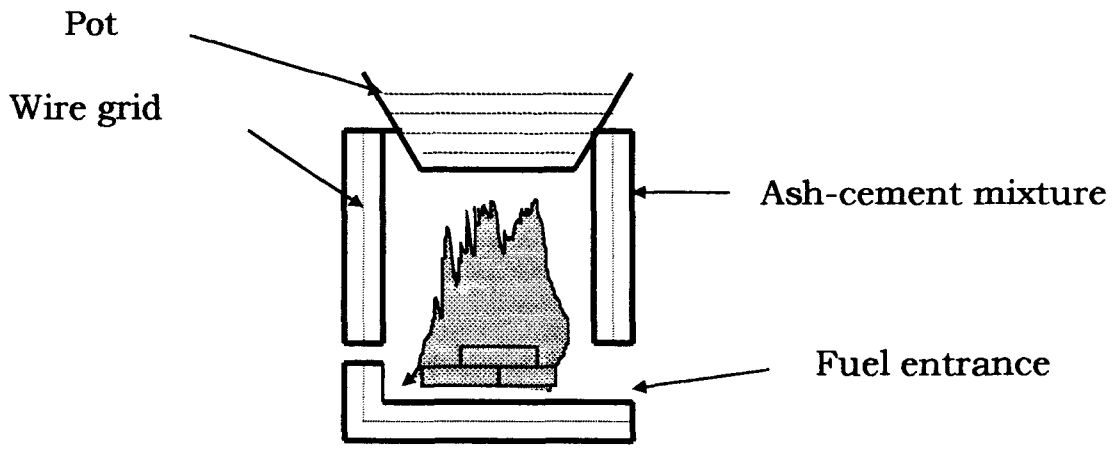


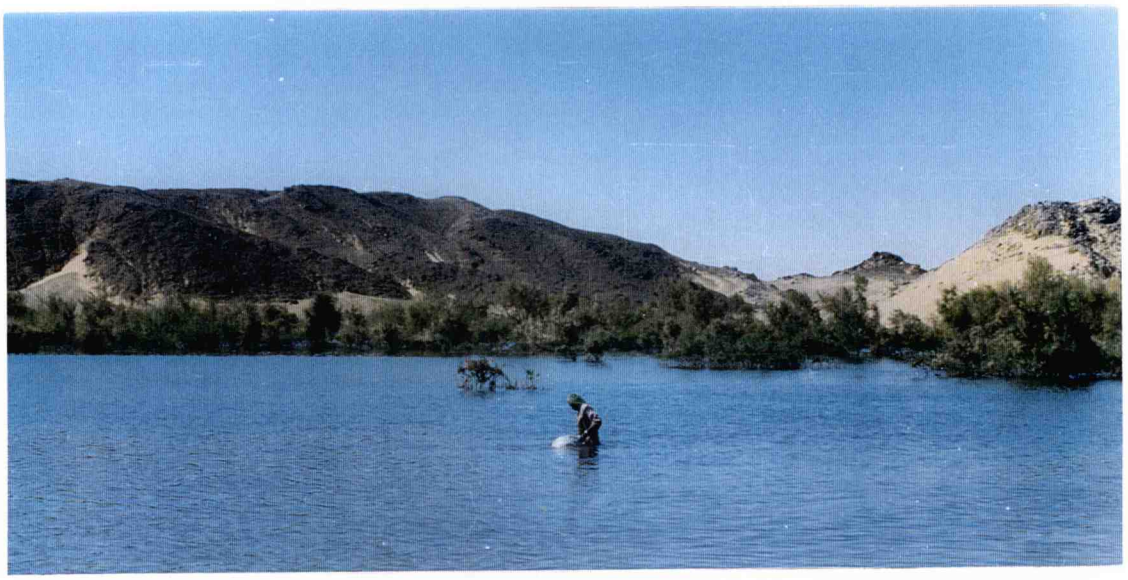
Fig.5 The new stove

People in Wadi Allaqi

Ababda and Bishariin (in center) and project driver (right) in Wadi Allaqi

Ababda worker irrigating plants at research station

Women's work in Wadi Allaqi



Collecting fodder in water

Three women carrying *Tamarix* fuelwood

Collecting water

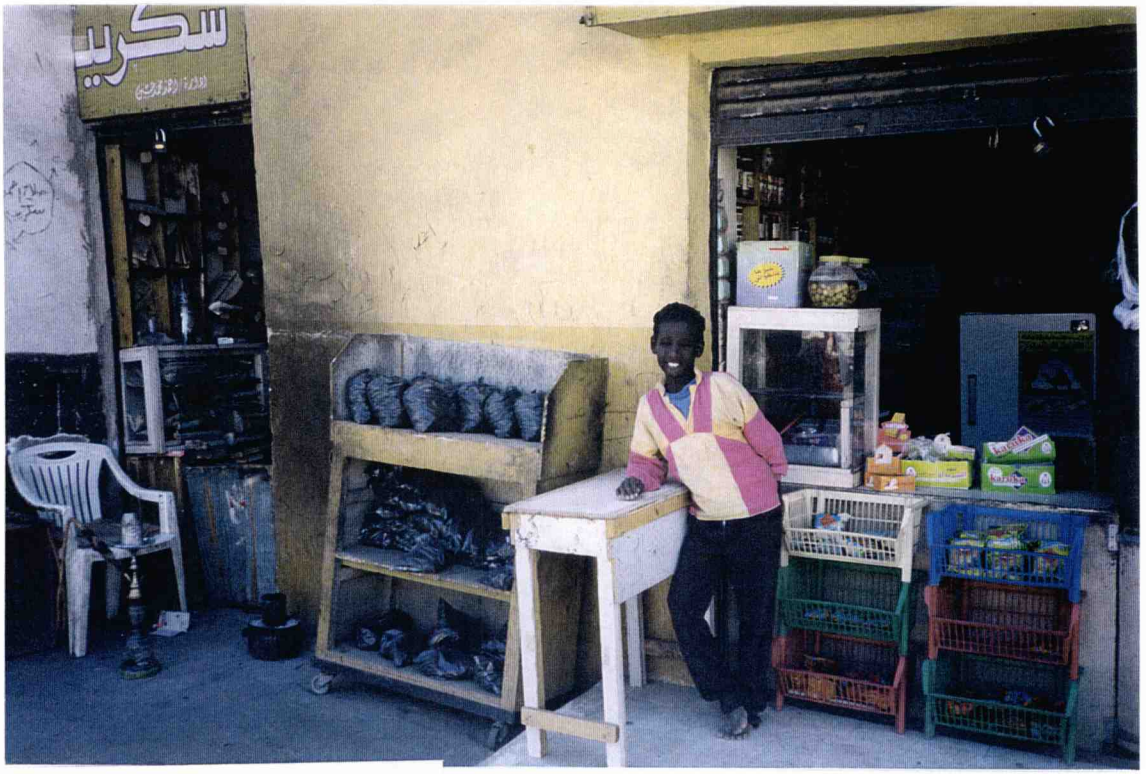
Encampment showing tent with veranda, shade and storage canopy, and small animal enclosure (above)

Bedouin domestic life

New tent constructed of *Tamarix* and goat and sheep wool blankets (shamla) (above)

Tent interior showing *Tamarix* tent poles, hanging sheepskin containers decorated with cowrie shells, and goat and sheep wool blankets as tent walls and for sleeping (right)

Aswan market for desert products



Front of shop showing small bags of charcoal for sale (above)

Shop interior showing herbs and medicinal plants for sale (right)

Sacks of charcoal in front of shop (below)

Bags of *Tamarix* collecte from water (above)

Camels grazing inundated *Tamarix*

Fodder

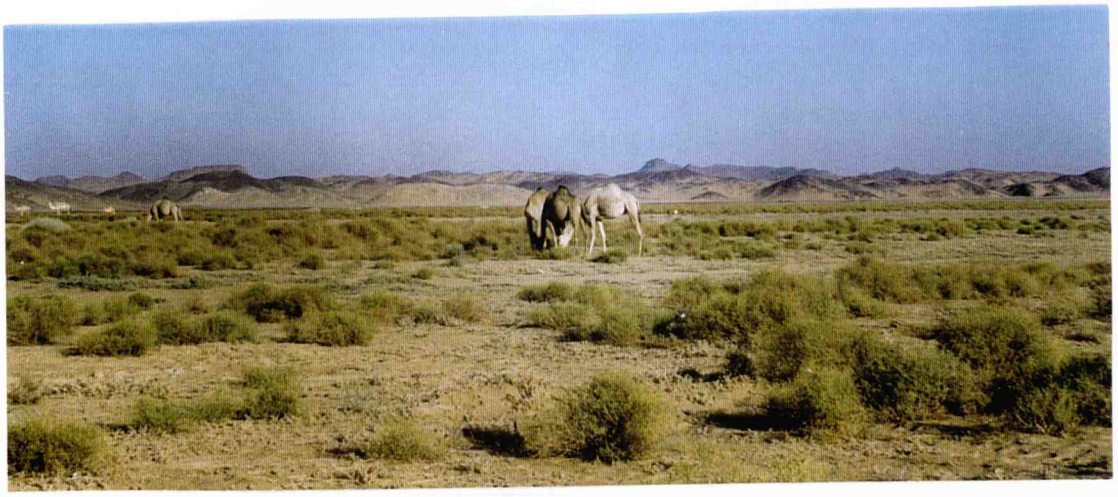
Donkeys eating *Tamarix* and sheep eating *Najas*

Local Bedouin and researcher with *Najas* collected from lakeshore (left)

Camels

Dabuka camels

Teben as fodder for dabuka camels in Allaqi

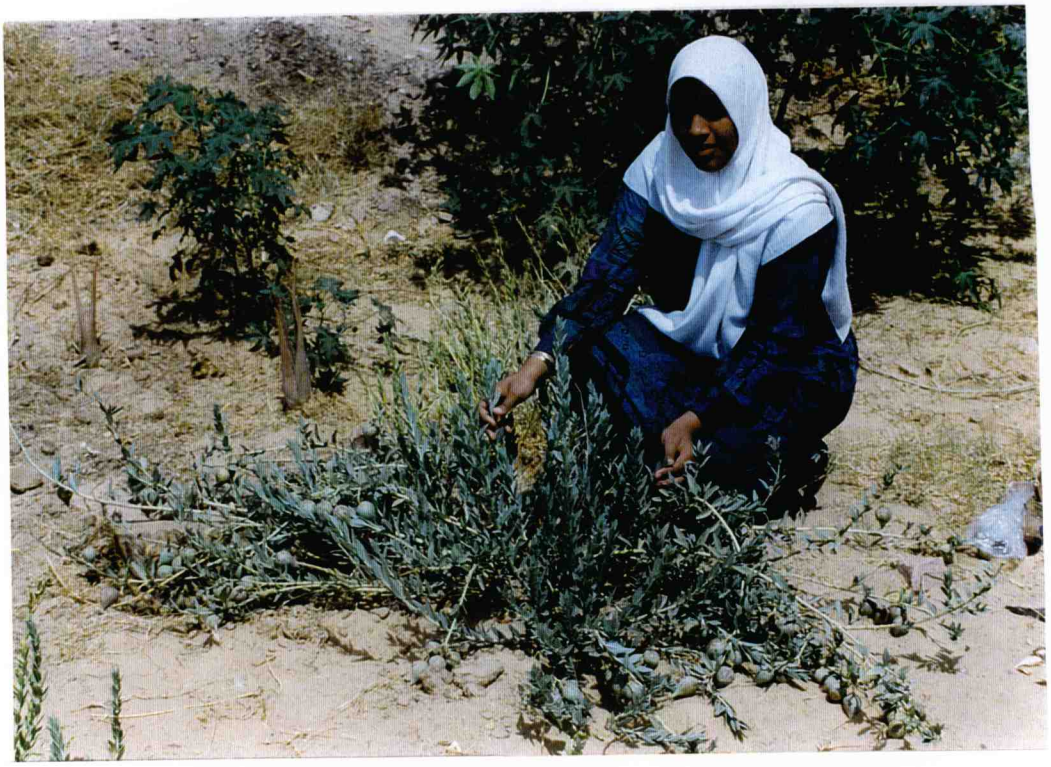


Camels grazing on shoreline pasture

Cultivation of medicinal plants

***Cymbopogon proximus*, 'halfa barr', at Wadi Allaqi research station** (above)

***Cymbopogon proximus*, 'halfa barr', flooded by lake at Wadi Allaqi EEAA administration building** (right)



***Solenostamma arghel*, 'hargel', at South Valley University**

Balanites aegyptiaca farm in Wadi Allaqi

Balanites aegyptiaca

Visit from Joachim Voss and Eglal Rached to Allaqi research station. Cultivated *Balanites aegyptiaca* and date palm in foreground

Aerva javanica

Dried *Aerva javanica* being used for fence

Aerva javanica collected for fuel and fodder

Fuelwood research

Fuel – dried *Tamarix* (5 kg)
(right)

Stove research and construction (above)

Stove in use with *Tamarix* as fuel at EEAA administration building in Wadi Allaqi

Part III

1. CONSERVATION EDUCATION FOR THE WADI ALLAQI PROTECTED AREA

An important part of the conservation function of a protected area to protect its rich natural resources and its diversified environmental elements as well as to educate visitors about the environment, ecology, human populations and their activities and conservation needs of that area. The Allaqi Man and Biosphere Reserve, as part of the development of its wider educational objective, will build a visitor centre, or museum and associated garden and trail in Wadi Um Ushira. The education function associated with the MAB programme includes a wide range of objectives from formal educational programmes related to primary, secondary and tertiary (higher/ further) education to general or informal education. This means that .visitors to the protected area will require different educational experiences. Some visitors will have good knowledge of the area and its conservation, while others, generally the majority, will not. Thus, although some specialist knowledge may be presented, the main purpose is to explain directly and clearly, in language which can be understood by all people, the major elements listed in the first sentence of this section. In devising ways of providing educational resources it is important to start from the perspective that whilst all visitors will be interested in the area, most know little about it. In this case the visitor centre or museum at Wadi Allaqi, will provide the location for educational media and resources for the protected area and its visitors. Some issues relating to the educational objectives of a visitor centre, and ways in which educational information at the visitor centre can be presented are considered below.

a) Visitor center

The story

It is important to present information in an attractive, imaginative and coherent way. This can be done by making the information into a ***story***, with the media at the visitor centre becoming the story teller. This is a more attractive way of telling people about the area, than regarding the resources of the visitor centre as an encyclopaedia. The story is to guide people; most people will be intimidated if they apparently have to chose their own information from a mass of material. The story should not be the complete sum of knowledge for the area.. The most important elements in the environment, ecology, human

use and conservation of the area should be chosen (by the EEAA team), and illustrated in an attractive way. The story needs a theme or "message". For example, in the Allaqi area the theme could be that this is a harsh physical environment in which only the most skilful and cunning organisms can survive, but is also an area which has provided a home to people who have come to know and love this harsh land. The peoples' use of, and relationships with, the landscape could be described as a "typical" day for an imaginary family. An important conservation message could come at the end of the day when the choices must be made for tomorrow. These choices are the changes which have been and can be made to the area (development) and the good (sustainable development) and bad (environmental impacts) which may result from the choices made.

A story for Allaqi

The choice and composition of the story should be done by the EEAA Allaqi team. There are lots of possibilities, but the most interesting could be the interaction between people and the environment. This interaction includes both indigenous people, and modern technology, as well as showing the relationship between humans and an environment and ecology, which is both harsh and beautiful. The story should be set in the context of Egyptian culture and heritage. The desert is a quintessential part of Egyptian existence through the ages, and Egypt is the oldest civilisation on the planet. Use the story to make Egyptians aware and proud of their heritage, and inform foreign visitors of its importance and distinctiveness.

Telling the story

There are different media available. Media are the means of communication and include, written text, photos, maps, diagrams (all of which can be in the form of booklets or on public boards), audio and video tapes, direct experience ("hands on"), narration by a guide or warden, role playing - people ("actors" who are usually local people) who do something to convey a message etc. No single form of media will attain all goals, so the visitor centre should supply several.

Design of media is a professional skill, and should be entrusted to specialists in environmental interpretation with a record of carrying out such work successfully.

b) Natural History Museum

Objectives:

1 - Preserve the cultural heritage of the local inhabitants, (Ababda and Bisharin tribes) and protecting the various elements of the environment.

2 - Display aspects of the life of the local inhabitants and their long history of accommodating their life-style to their environment.

3 - Promote and support the self-identity of the people and create a connection between the successive generations through keeping their cultural heritage intact, authentic and well displayed.

4 - Assist in empowering the inhabitants, especially children, in the educational and cultural fields, through the different activities of the museum.

5 - Develop the economic capabilities of inhabitants, especially women, by encouraging and reviving some of their traditional arts and hand-crafts, and marketing these through the museum shop.

6 - Encourage sustainable environmental tourism in Egypt, through holding scientific conferences and organizing safari trips.

7 - Facilitate the collection and documentation by the local people of their oral heritage, e.g. oral history, songs, folk stories.

The main target groups:

1 - The local inhabitants – both semi-settled and regular visitors to the area, such as the herdsmen who lead the *dabuka* (camel trains).

2 - Professional groups, e.g. ecologists, social scientists, interested experts, who come to the conservation area, from throughout the world.

3 - Environmental tourists:
Organized-specialized groups; individual visitors.

Description:

Within the idea and the objectives of the museum, together with our awareness of the important role museums can play, especially those of ethnography and natural history, in a country like Egypt with its cultural diversity, we can summarize our conception of the role of Wadi Allaqi natural history museum in two aspects :

1 - Its main role as a place to keep and exhibit selected symbols, showing to the visitors the aspects of interaction and continuity between people and their environment in this particular area.

2 - Its dynamic role as a cultural and scientific establishment where experts from Egypt and the world can carry out their research in different fields, in addition to its educational role, especially for children, and promoting the social and economical conditions for women.

In all these cases, some considerations must be studied before setting up this museum, such as:

1 - The location.
2 - Its architectural style.
3 - The interior layout.
4 - The exhibition design criteria

The museum location:

Wadi Um Ushira is the most suitable area for this establishment, because of the following reasons:

A - It is situated near the centre of Wadi Allaqi, thus all the nomads, who live in different areas can reach the museum easily and participate in its activities.

B - It is close to the main paved road, which enable all Egyptian and international visitors to reach it from Aswan.

C - Being slightly elevated, it protects the area from destructive dangers such as torrents, which can flow at the beginning of the autumn.

D - This area is large and bare, enabling new buildings to be added in the future.

The museum architectural style:

It is important that the building architectural style reflects the local features of the area, so that the visitor feels in harmony with the surrounding environment, and emotionally and intellectually stimulated.

The interior partition:

In natural history museums in particular, gardens can be used as open-air exhibitions, such as different styles of houses, wells, medical herb gardens. Moreover a green belt of trees round the museum buildings, will play an effective role as a natural filter -preventing dust, also stabilizing the humidity in the atmosphere, hence keeping the objects in a good condition.

The museum buildings should comprise the following sections:

1 - Main interior exhibition hall.
2 - Temporary exhibition hall.
3 - Medical herbs room.
4 - Library.
5 - Office.
6 - Auditorium.
7 - Education room.
8 - Meeting room.
9 - Restoration/conservation room.
10 - Laboratory for physics/chemistry.
11 - Photo laboratory.
12 - Store.
14 - Cafeteria/Restaurant.
15 – Guesthouse.
16 - Museum shop.
17 - Car park.
18 - Information kiosk.

The exhibition design criteria:

Museum objects consist of:

The main material culture articles which the local inhabitants use in their daily life, such as tents and shelters, costumes, jewellery, utensils, working tools, childrens' toys, various amulets.

Various samples of vegetation, fauna, which characterize the conservation area, Wadi Allaqi, as well as the species which have become extinct, totally together with those threatened with the same fate, in addition to geological fossils and pictorial representations of wildlife.

The main task of the museum is to exhibit all these objects in an attractive and interesting way, and within a social context, in order to offer the visitor a chance for a better understanding and a deeper comprehension of the human cultural history in its relationship with the environment.

This can be realized by the use of the latest contemporary technological methods, which have been recently developed in the museum fields.

From our point of view, in the case of a museum like this, we expect differences in the educational levels and interests of the visitors for whom we need to cater.

There should be a simple, direct, clear and attractive presentation of the ideas, which can be realized by the designer in using many methods to make the presentation lively and interesting, such as using dioramas, and sound effects of birds and animals. The designer can also attract visitors through effective use of colour and light, and offer more detailed and inter-related information for specialized visitors.

Also, texts and labels should be clearly and simply designed, with more details for professionals in Arabic, French and English, and signs to lead visitors to the displays in an appropriate sequence to achieve an enhanced understanding and enjoyment of the whole story-line of the museum.

Outputs:

The following outputs are expected from this proposal:

1 - The museum itself, as a place for preserving and representing the artifacts related to the environment and local inhabitants, and as a tool for cultural pluralism and national development.

2 - A catalogue containing various documents and details about the area.

3 - An educational unit for the local inhabitants, especially children.

4 - A workshop for reviving and marketing the traditional local handicrafts.

Plan:

The process of setting up the Museum can be divided into three main stages :

-Preparatory stage
· Field Research
· Writing the Museum Concept
· Architectural design
· Time schedule

II. Production Stage
- Constructing the museum building.
- Collecting the objects.
- Display.
- Catalogue.
- Texts and labels.

III. Final stage
- Programmes for main activities.
- Training for the staff.
- Opening to the public.

3. WORKSHOPS

During the implementation of the second phase of the project (1996-1998), the UESD organised several national and international workshops and seminars related to the project objectives. Environmental economics, sustainable development, conservation issues and environmental education were the main topics discussed and evaluated by the working groups. Funds for holding the workshops were raised from different national and international organisations: South Valley University, EEAA, UNESCO, the British Council, CEDARE, DANIDA, International Academy of Environment, etc.

The UESD is organising a workshop in October 1998 for local organisations and institutions working in the Wadi Allaqi area in order to co-ordinate different development activities (agriculture, mining, fisheries, quarries etc) and prepare a management programme for sustainable use of natural resources in Wadi Allaqi Biosphere Reserve in accordance with environmental law N4, 1994.

A brief description of the workshops and seminar are given below.

a) Regional Workshop on Environmental Economics for Sustainable Development (14-24 April 1996)

To help further the integration of environmental and economic issues in a sustainable development framework in the Arab and Mediterranean region, a regional workshop on Environmental Economics for Sustainable Development was held in Aswan, Egypt from 15 to 24 April 1996. The workshop was sponsored by the International Academy of the Environment, METAB, UNESCO Cairo Office, CEDARE, UNDP and hosted by UESD, South Valley University. Twenty-two participants from Egypt, Arab countries, Europe and Canada attended the Workshop.

A primary objective of the workshop was the initiation of the environmental economics network to establish and maintain communication and information flow between environmentalists and economists within the region and between countries, organisations, disciplines and participants.

Four senior researchers of the IDRC Project, from UESD, S.V. University, Egypt (Drs. A.Belal and I. Springuel) and Trent University, Canada (Drs. J..Solway and B. Lenth) worked as experts in this workshop. The junior researchers of the IDRC project together with staff of the UESD and the staff of Wadi Allaqi Biosphere Reserve provided on-site support for the sessions and organised a two days field trip to the Wadi Allaqi. Issues central to the IDRC Wadi Allaqi project were presented and discussed and their formed the basis for an evaluation exercise for the participants.

b) Local seminar on the cultivation of medicinal plants in Wadi Allaqi (1st May 1997)

A seminar on the cultivation and uses of indigenous medicinal plants was held in Aswan on 1st May 1997. The one-day seminar was organised by UESD and supported by South Valley and Assiut Universities which was followed by a field excursion to the Wadi Allaqi field station. The main objectives of the workshop were:

- To evaluate the project activities.
- To present the results of research work in Wadi Allaqi as an example of sustainable development, the use of resources in arid lands, and particularly the areas around Lake Nasser in Upper Egypt. The research includes the study of natural resources (vegetation, water, soil, fauna, geology, etc.), medicinal plants, conservation and the socio-economic patterns of resource use in the region.
- To discuss, with experts, the research results and development initiatives of the Wadi Allaqi Biosphere Reserve in the light of the concept of sustainable development and to formulate recommendations for subsequent development.
- To heighten the awareness of decision makers and officials of the possible negative environmental consequences which could result from inappropriate policy in the region.

About 30 participants working in the Wadi Allaqi project attended the seminar. The seminar was successful and generated much heated discussion at its end.

c) International workshop on Ecotechnie and the Development of Environmental Education in Arab Universities (November 23-26, 1997)

A workshop on Ecotechnie and the Development of Environmental Education in Arab Universities was organized in the context of the creation of the UNESCO-Cousteau Ecotechnie Chair at the Unit for Environmental Studies and Development at the South Valley University in Aswan and of the Arab Regional Ecotechnie Network.

The Ecotechnie programme is a sustainable development initiative that seeks to promote integrated, multi-disciplinary approaches to education, research and policy making that combine ecology, economics, the social sciences and technology. A key focus of the programme is on providing support to universities and research centers active in such areas, including, but not limited to, Ecological Economics, Human Ecology and Ecotechnology. The Ecotechnie Programme also seeks to support networking among universities in these fields. One instrument developed by the programme for this purpose, is the UNESCO-Cousteau Ecotechnie Chairs.

The workshop was held in Aswan in November 1997 and attended by over 60 participants from eight Arab countries, as well as academics and consultants from Great-Britain, Canada, Denmark, France, Germany and representatives of the organizing bodies and international organizations, such as the Arab League and UNDP. It was sponsored by UNESCO, the British Council, CEDARE, DANIDA and hosted by South Valley University (SVU) and the Egyptian Environment Affairs Agency (EEAA).

During the workshop there was a signing ceremony by UNESCO and South Valley University for the establishment of a UNESCO-Cousteau Chair at the Aswan Unit for Environmental Studies and Development. The workshop was addressed by Dr F. Mayor, Director-General of UNESCO, H. E. Prof. M. Shihab, Minister of Higher Education, Professor Arafat M. Kamel, President of South Valley University and Professor A.E. Belal, Director of UESD. During the workshop nine working groups were formed. A summary of recommendations by all working groups follows:

- Universities should favourably consider establishment of environmental education programmes at both under- and post-graduate levels.
- Establishing institutions (units, centres etc.) related to environmental

education and multidisciplinary research and sustainable development within universities.

- Specific funding should be allocated in the university budget for environmental institutions as well as encouraging additional funding from different funding agencies.
- UNESCO should initiate a programme to establish UNESCO Ecotechnie Chairs in universities of different Arab countries.
- Establish and encourage a regional networking programme of environmental institutions including Ecotechnie Chairs and set up a system of communications, e.g. a "home page" on the Internet, a newsletter, to redress current lack of information related to environmental education and sustainable development.
- An Arab regional environmental education and sustainable development network should develop links with other regions.
- Funding for all research projects addressing social needs should comply with certain expressed principles, such as improving the environment, abating pollution and utilizing resources appropriately.
- Projects concerned with women and biodiversity should be developed to integrate bio-ecological, socio-economic and cultural elements.
- Ecotechnie Chair research projects should actively involve the community and utilize local knowledge at all stages from initial identification of research needs to application and implementation.
- Further research into potential uses of indigenous plants, e.g. medicinal, should be carried out to assist poorer societies in raising their standard of living and health status.

In addition to the above recommendations reached by the working groups, one major landmark of the workshop was the consolidation and finalization of an Ecotechnie Programme in South Valley University and initiation of work on an implementation action plan, to be presented to UNESCO in due course. The participants also recommended the creation of a regional network for multidisciplinary environmental education, field research projects and studies in policy making for sustainable development.

Part IV

Conclusions and recommendations

1. Conclusions

Desert resources provide the basis for meeting the majority of the livelihood needs (subsistence and commercial) for the local population. Directly and indirectly, they also fulfil many social and symbolic needs. In addition, we have identified many plants with potential, but currently unexploited, value.

In order to assess the value of local resources we have relied upon many sources of information and types of analyses. We have consulted the local people themselves for their assessment of resources and we have observed the manner in which local resources are used in the desert. We have conducted literature reviews, laboratory analysis, market research, and have carried out experiments to identify alternative ways to efficiently utilize local resources. Central to our research is economic analysis utilizing statistical methods and comparative regional data from international public sources such as FAO to determine the economic value of critical desert resources.

The combination of these multi-disciplinary approaches in evaluating local resources has led us to appreciate the importance of bio-diversity for the local Bedouin population. Bedouin livelihood is based primarily upon the subsistence strategies of pastoralism, charcoal production, and especially for those living in upstream Wadi Allaqi, medicinal plant collection. These pursuits are land extensive and require the opportunistic exploitation of a large variety of resources in different ecological zones. The availability of these resources and their manner of exploitation vary widely yearly, seasonally and spatially. Bedouin subsistence strategies such as transhumance and property relations that enable reciprocal access to different territories reflects this variation. Given the extreme variations in the desert habitat of Wadi Allaqi and the environment's importance to Bedouin livelihood, it is of utmost importance to conserve and promote biodiversity in the region.

The Bedouin have a deep knowledge and profound appreciation of their desert habitat and have utilized it in a sustainable manner. Current threats to the local environment derive

largely from (1) the increased presence of transients in Wadi Allaqi who generally lack the Bedouin's knowledge and appreciation of the environment and (2) the greater pressure being exerted on local resources in downstream Wadi Allaqi as a consequence of increased sedentarization.

Our research reveals that the economically important plant diversity present in Wadi Allaqi is high. Out of all the recorded species, 74% are known to be of potential value and 35% are known to be useful in more than one context. Plants with multi-uses have a high importance value compared to the plants that use are only in one context.

For the purpose of this research we have examined three categories of plants. They were selected because of their high subsistence and/or commercial value for local inhabitants and are (1) pasture plants, (2) medicinal plants, and (3) fuelwood species.

A. Pasture Plants:

Animals, both domestic and wild, can graze and browse on 58 (over half) of the species growing in Wadi Allaqi.
According to availability, desert pasture plants are split into three groups. The first group comprises perennial plants (trees and shrubs) that form the permanent but limited source of fodder for livestock.
The second group is perennials whose life- span is in accordance with water availability stored in the wadi- fill deposits after rain events. Most have a low palatability
The third group is composed of annual and ephemeral plants that provide temporal (a few months) but abundant (high biomass and high nutrition) pasture for livestock. These emerge after rain events which do not necessarily occur every year.
Both the permanent and annual/ephemeral pasture are critical to Bedouin pastoralism. They complement each other in order to form a fodder base that is available at different times, in different locations, and under constantly changing ecological conditions.

Pastoralism is the dominant economic activity in Wadi Allaqi. Animals are sold, their products (milk, meat, hides, and hair) are consumed locally and are transformed into products, they provide transport, and are critical in the social and symbolic life of the Bedouin.

B. Medicinal plants:

Nearly half of all recorded species in Wadi Allaqi (56), are of known medicinal value or are under investigation for medicinal compounds. In our studies we estimated the value of medicinal plants (10 species) which are collected by the Bedouin and are sold in shops. The price of these plants range according to species but all have a market value and their sale is an important source of income for the Bedouin, particularly of upstream Wadi Allaqi. Also many other species are collected for local use by the Bedouin and many are purchased.

Some species are used in the pharmacological industry; an example is *Cymbopogon* and we have calculated its value. It is interesting to note that the value, in Egypt, of ***Cymbopogon proximus*** as a dry plant exceeds the market value of the processed extract. This illustrates the effect of state-controlled pharmaceutical industries in the country.

C. Fuel-wood plants:

In the present study we describe some of the recent changes in fuelwood use patterns as result of inundation and hence the low availability of the main fuelwood species (*Tamarix*). We observed that in the absence of *Tamarix* people moved down the economic scale, utilizing less valuable species rather than moving up and utilizing more expensive species. Our data also indicates that *Tamarix*, a multi-purpose species, only available since inundation, is becoming increasingly acknowledged as valuable by the Bedouin. This shows adaptation to changing conditions in local knowledge systems.

Our research confirms that both *Acacia ehrenbergiana* and *Acacia raddiana* have higher economic values than *Tamarix nilotica* and *Salvadora persica* in terms of their efficiency as fuelwood and as charcoal. We have estimated the average production of charcoal in 1996-1997 from Wadi Allaqi to be approximately 18 tons and its value to be approximately LE 32,400.

We designed and tested in the field an inexpensive, efficient, and suitable stove.

2. Recommendations

A. Recommendations for management of natural resources:

The area of a biosphere reserve needs to be large and to consist of units of complementary importance, spatially and temporally, in order to support the traditional rangeland activities.

The management of natural resources should be based on traditional and scientific knowledge. Bedouin have managed the resources in a sustainable manner but this system is now under threat largely as a result of the growing number of transients in the area and as a result of increased sedentarization. Thus the following management recommendations are made.

A management plan needs to be constructed to conserve the area's vegetation. This must be developed in collaboration with the Bedouin. Such a management plan should control the type of development that occurs in the Biosphere reserve in order to insure that plans are sustainable and will not degrade the environment.

A management plan is necessary to control the manner in which the transient population impacts upon natural resources. For example, visitors to the desert do not always respect the Bedouin's rule of only using dead branches of trees for fuel. Traffiic in the desert should be controlled and encouraged to stay on certain paths in order not to damage the seed bank lying dormant in the soil. A dramatic example of transient over-exploitation of the environment (and consequent need for a management plan) is illustrated by the following example:

> Dabuka have maintained a long-standing relationship with the inhabitants of the Allaqi region, sustainably transporting large number of camels through the region without endangering indigenous fodder stocks. However, recent experiences have demonstrated that this balance is fragile and it is worthwhile examining the implied cost of transient livestock populations in the region.

Energy requirements(kg) per camel/day	6.30
Implicit fodder price(LE) per camel/day	2.93

While 2.93 LE/day appears to be a relatively trivial cost, typical transient camel herds can exceed 100,000 annually. Thus the potential cost for detaining each dabbuka for merely one day could exceed 293000 LE. This translates into a total fodder requirement of 630 MT DM/yr, an amount that could seriously jeopardize local fodder stocks.

The management plan should encourage alternative uses of natural resources that will benefit the local society and decrease the pressure on the natural ecosystem. For example, the cultivation of economically important indigenous plants for medicinal, fodder, timber and fuelwood uses should be encouraged and facilitated. Especially important for local residents is the improvement of local fodder supply. The Allaqi team has already established experimental plots of several valuable indigenous plants.

Women manage the domestic unit and provide the most care for small stock when they are in downstream Allaqi. They are the most dependent upon local resources. Therefore it is important to consult with women as well as men in the development of a management plan.

A. Recommendations for further research

Wadi Allaqi is a dynamic system with unprecedented developments. Our research has shown that Bedouin local knowledge evolves with the changing circumstances. Subsequent research should entail the recording of indigenous knowledge and the manner in which it is transforming.

This project represents an innovative, perhaps even unique collaboration between the physical and natural sciences, sociology and economics. As such, it is an example of successful integration of research methods and applications at an interdisciplinary level which can serve as a model for future interdisciplinary research projects. As with any pioneering work, the research process itself has highlighted many areas where this collaboration could be usefully extended. For example, economic valuation of medicinal plants focussed on the actual market value of the plants when traded and local collection/uses of the plants. In one case, *Cymbopogon proximas*, we could extend the

analysis to economic valuation using the market value of the drug for which *Cymbopogon proximas* is the source material. This analysis could be extended to other indigenous medicinal plants. This would require extensive collection of data on pharmaceutical applications, biological properties and local and world market prices. Such an extension would provide important data for estimating the value of conservation in the Allaqi region. Moreover, this type of valuation could be critical in the analysis of development proposals for the Allaqi region.

In addition, the economic valuation of fodder species could be extended to provide more refined estimates based on amplified measurement criteria of the fodder characteristics of these plants. Thus, valuation of climatic, geographic and biological variability within species would offer a more exact valuation of plants within the region. At the same time, more extensive research on fodder collection and use by households in the region would allow for a more accurate calculation of the fodder use value of the species.

Finally, the valuation of fuel-wood species could be extended to encompass species which are emerging as important fuel-wood sources. Moreover, many of the plant species studied within the current project have emerged as medicinal, fodder and fuel sources and a natural extension of the current project would be to integrate this valuations so that it would be possible to compare directly the relative values in each application. This type of exercise would be especially useful in constructing long-term conservation and development proposals.

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Annex 1

Table 1 Economically Important Plants in Wadi Allaqi Conservation Area, Egypt

Importance values as follows: **M** = Medicinal use, **T** = Timber, **G** = Grazing, **H** = Human food, **F** = Fuelwood, **C** = Charcoal, **O** = Other uses, **TIV** = *Total importance value*

Species	M	T	G	H	F	C	O	TIV
Abutilon pannosum								
Acacia ehrenbergiana	-	-	8	-	6	6	-	35
Acacia nilotica	6	6	6	-	6	6	6	64
Acacia raddiana	7	8	8	-	8	8	6	80
Acacia tortilis	7	7	8	-	8	8	6	86
Aerva javanica	5	-	5	-	-	-	-	17
Aizoon canariense	-	-	-	4	-	-	-	7
Alhagi graecorum	6	-	7	6	6	-	-	44
Amaranthus graecizans	4	-	-	-	-	-	-	7
subs. proximus	-	-	5	-	-	-	-	9
Aristida adscensionis	-	-	6	-	-	-	-	11
Aristida funiculata	-	-	6	-	-	-	-	11
Aristida mutabilis	-	-	6	-	-	-	-	11
Arnebia hispidissima	4	-	7	-	-	-	-	19
Asphodelus tenuifolius	5	-	-	5	-	-	-	17
Astragalus eremophilus	-	-	6	-	-	-	-	11
Astragalus vogelii	-	-	6	-	-	-	-	11
Balanites aegyptiaca	8	8	7	8	8	6	8	94
Boerhavia coccinea	4	-	-	-	-	-	-	7
Calotropis procera	7	-	-	-	7	-	7	37
Capparis decidua	7	-	-	5	6	-	-	32
Cassia italica	7	-	-	-	6	-	-	23
Caylusea hexagyna	-	-	6	-	-	-	-	11
Citrullus colocynthis	8	-	-	-	-	-	-	14
Cistanche phelypaea	4	-	-	4	-	-	-	14
Chenopodium murale	-	-	4	-	-	-	-	7
Chrozophora obliqua	-	-	-	-	-	-	6	11
Cleome amblyocarpa	6	-	-	-	-	-	-	11
Cleome droserifolia	8	-	-	-	-	-	-	14
Cocculus pendulus	5	-	-	5	5	-	-	27
Convolvulus prostratus	4	-	-	-	-	-	-	7
Cornulaca monacantha	5	-	-	-	-	-	-	9
Cotula cineria	5	-	6	-	-	-	5	28
Crypsis schoenoides	-	-	6	-	-	-	-	11
Crotalaria aegyptiaca	5	-	5	-	-	-	-	17
Cucumis prophetarum	7	-	-	-	-	-	-	12
Cymbopogon proximus	7	-	6	7	-	-	-	36
Cynodon dactylon	6	-	6	-	-	-	-	21
Cyperus pygmaeus	-	-	5	-	-	-	-	9
Dipterygium glaucum	-	-	-	-	5	-	-	9
Dichanthium foevulatum	-	-	5	-	-	-	-	9
Eragrostis aegyptiaca	-	-	6	-	-	-	-	11
Eragrostis ciliaris	-	-	6	-	-	-	-	11
Euphorbia granulata	4	-	-	-	-	-	-	7

Species	M	T	G	H	F	C	O	TIV
Fagonia bruguieri	4	-	4	-	-	-	-	14
Fagonia glutinosa	-	-	4	-	-	-	-	7
Fagonia indica	-	-	6	-	-	-	-	11
Farsetia aegyptia	-	-	5	-	-	-	-	9
Fimbristylis bis-umbellata	-	-	5	-	-	-	-	9
Glinus lotoides	5	-	4	-	-	-	-	16
Haplophyllum tuberculatum	5	-	-	-	-	-	-	9
Heliotropium bacciferum	5	-	-	-	-	-	-	9
Heliotropium supinum	4	-	-	-	-	-	-	7
Hyoscyamus muticus	8	-	-	-	-	-	-	14
Hyphaene thebaica	6	7	-	7	-	-	7	48
Indigofera argentea	-	-	6	-	-	-	-	10
Indigofera hochstetteri	-	-	6	-	-	-	-	10
Imperata cylindrica	6	-	4	-	-	-	6	28
Infloga spicata	-	-	4	-	-	-	-	7
Launaea capitata	-	-	-	6	-	-	-	10
Launaea mucronata	4	-	-	-	-	-	-	7
Leptadenia pyrotechnica	6	-	6	6	7	-	6	55
Lotononis platycarpa	-	-	7	-	-	-	-	12
Lupinus varius ssp. orientalis	-	-	-	6	-	-	6	21
Lycium shawii	-	-	-	-	5	-	-	9
Maerua crassifolia	5	6	5	-	6	-	-	39
Morettia philaeana	-	-	6	-	-	-	-	11
Panicum turgidum	6	-	8	7	-	-	-	37
Pergularia tomentosa	6	-	-	6	-	-	-	21
Phragmites australis	6	-	6	6	-	-	6	42
Polycarpaea repens	5	-	-	-	-	-	-	9
Polygala erioptera	6	-	-	-	-	-	-	11
Portulaca oleracea	4	-	4	5	-	-	-	23
Psoralea plicata	5	-	8	-	-	-	-	23
Pulicaria crispa	6	-	6	-	6	-	-	32
Pulicaria incisa	7	-	-	7	-	-	-	25
Ricinus communis	7	-	-	5	7	-	7	46
Rumex cyprius	-	-	-	4	-	-	-	7
Rumex vesicarius	4	-	-	4	-	-	-	14
Salsola baryosma	-	-	-	-	6	-	-	11
Salvadora persica	8	6	6	6	6	-	6	68
Schouwia purpurea	-	-	6	4	-	-	-	18
Senna alexandrina	8	-	-	-	6	-	-	25
Sesamum alatum	-	-	-	5	-	-	-	9
Sesbania sesban	6	5	6	-	6	-	5	50
Solenostemma oleifolium	8	-	-	-	-	-	-	14
Stipagrostis plumosa	-	-	6	-	-	-	-	11
Tamarix nilotica	7	-	7	-	8	-	7	51
Tephrosia apollinea	-	-	5	-	-	-	-	9
Tragus berteronianus	-	-	5	-	-	-	-	9
Trianthema crystallina	-	-	6	-	-	-	-	11
Tribulus mollis	-	-	4	-	-	-	-	7
Tribulus pentandrus	-	-	4	-	-	-	-	7
Tribulus terrestris	4	-	4	4	-	-	-	21
Zilla spinosa	5	-	6	-	5	-	-	28
Ziziphus spina-christi	6	6	6	6	6	-	6	64
Zygophyllum simplex	-	-	4	-	-	-	-	7

Annex 2

Table 1 In Vitra Dry Matter (DMD)% & Organic Matter Disappearance (OMD) %

Tamarix nilotica

Date	DMD			OMD		
Dec-94	44.3	43.1	44.1	41.2	38.4	37.1
Jan-95	42.3	40.2	42.2	39.3	36.5	35.2
Feb-95	44.6	43.4	42.9	40.9	38.3	36.8
Mar-95	42.6	41.5	41.1	39.7	37.9	36.7
Apr-95	42.9	42.1	39.9	39.2	37.1	36.1
May-95	43.7	42.1	40.8	40.8	38.2	37.3
Jun-95	39.6	39.1	38.3	36.4	34.4	32.1
Jul-95	40.7	39.9	38.9	37.6	35.3	33.8
Aug-95	38.8	39.1	39.2	35.4	33.8	32.9
Sep-95	38.7	38.9	37.9	34.9	32.5	30.5
Oct-95	40.6	41.1	39.8	38.6	35.9	34.8
Nov-95	40.8	39.2	38.3	37.9	30.8	34.2
Dec-95	38.6	37.1	36.2	34.6	33.1	32.1

Hyoscyamus muticus

Date	DMD			OMD		
Jan-95	43.5	41.2	42.1	41.2	39.5	40
Feb-95	40.5	39.5	39.3	39.8	38.6	37.2
Mar-95	40.6	39	40.8	39.7	38.8	37.4
Apr-95	40.2	38.4	41.5	38.2	37.8	36.9
May-95	38.3	36.6	39.7	36.3	35.9	34.7
Jun-95	37.9	35.4	36.5	33.5	32.8	32
Aug-95	40.3	38.2	39.8	38.1	37.2	37.5
Oct-95	41.4	39.9	40	37.2	35.9	36.2

Najas sp.

Date	DMD			OMD		
Feb-95	39.5	37.2	38.5	36.7	34.2	34
Mar-95	35.4	34.3	35.1	32.1	30	29.1
Apr-95	35.2	33.5	34.4	31.9	29.3	28.3
May-95	32.4	30.5	31.5	30.1	28.1	30
Jun-95	31.7	30.1	30.5	28.6	27.4	28.9
Jul-95	33.6	32.5	32.8	29.2	28.1	27.6
Aug-95	35.1	34.2	34.8	32.8	30.4	30.5
Oct-95	37.3	35.3	36.1	33.7	31.5	32.1

Acacia raddiana

Date	DMD			OMD		
Dec-94	42.5	40.1	39.2	39.7	38.1	35.9
Jan-95	35.1	33.5	33.9	30.8	28.8	27.1
Feb-95	37.2	35	36.1	34.1	32.5	29.3
Mar-95	34.9	33.1	34.1	30.7	28.1	27.3
Apr-95	35.1	34.2	34.9	31.8	30.1	28.6
May-95	38.2	37	36.8	35.3	34	32.8
Jun-95	37.5	35.6	34.8	33.7	31.5	29.7
Jul-95	36.2	34.9	35.1	32.9	30.9	28.9
Aug-95	34.3	32.8	33.1	31.4	30.1	29.1
Sep-95	35.4	35	33.8	33.8	32.5	29.8
Oct-95	33.9	31.8	30.7	31.8	30.05	28.1
Nov-95	31.2	30	29.1	30.1	20.9	27.2
Dec-95	30.3	29.5	27.9	28.4	25.1	26.1

Acacia ehrenbergiana

Date	DMD			OMD		
Dec-94	43.6	41.4	40.3	41.2	39.6	38.1
Jan-95	41.2	38.9	40.1	28.5	36.1	36.6
Feb-95	43.4	41.1	42.2	40.4	38.2	38
Mar-95	41.9	39.4	40.5	38.6	36.4	35.9
Apr-95	41.8	39.6	40.6	38.5	36.9	35.3
May-95	42.8	39.9	41.3	40.2	38.5	35.1
Jun-95	39.5	37.5	37.9	36.5	34.1	33.1
Jul-95	40.5	38.2	39.1	37.5	35.1	34.3
Aug-95	38.2	36.4	37.8	35.2	33.4	33.1
Sep-95	38.5	36.4	37.2	36.7	34.1	33.9
Oct-95	39.9	37.4	38.8	38.2	35.9	35.1
Nov-95	39.8	38.5	37.9	37.1	35.2	34.8
Dec-95	38.7	36.1	37.1	35.6	33.2	32.8

Senna alexandrina

Date	DMD			OMD		
Jan-95	41.5	42.1	41	38.9	36.8	37.1
Feb-95	36.7	37.3	36.5	32.8	31.2	30.6
Mar-95	38.2	39.1	37.9	37.1	35.9	34.6
Apr-95	39.4	39.5	38.3	38.3	36.8	37.1
May-95	39.6	40.1	37.8	35.2	34.2	33.9
Jun-95	37.3	38.2	36.9	35.4	33.8	34.2
Aug-95	38.5	39.5	37.1	36.2	35	34.8
Sep-95	39.4	40.1	39.2	36.8	34.2	35.1
Oct-95	38.1	39.5	38.2	35.9	34.8	34.6
Nov-95	38.2	39.6	37.9	34.6	33.8	33
Dec-95	35.6	36.7	35.4	33.1	31.5	30.8

Aerva javanica

Date	DMD			OMD		
Dec-94	40.1	39.2	41.3	38.6	36.5	35.1
Feb-95	38.4	37.8	39.5	35.7	34.2	33.2
Mar-95	38.1	36.9	39.7	35.4	33.1	32.5
Apr-95	31.4	30.2	33.5	30.2	28.9	28.1
May-95	35.3	36.1	37.2	33.9	31.2	30
Jun-95	32.4	33.5	34.5	30.5	29.5	28.1
Jul-95	30.7	31.3	32.2	28.7	26.4	26.3
Aug-95	32.4	33.2	33.9	29.8	27.7	28.1
Sep-95	34.6	35.1	36.1	31.9	30.5	29.3
Oct-95	32.5	33.9	34.1	30.7	238.5	27.8
Nov-95	30.4	31.5	31.7	27.9	26.1	26.3
Dec-95	30.2	31.6	31.9	28.2	26.5	25.9

Pulicaria crispa

Date	DMD			OMD		
Dec-94	38.2	39.6	36.3	35.2	34.3	29.4
Jan-95	34.9	35.6	31.7	31.3	30.9	28.3
Feb-95	36.8	37.9	33.5	31.8	31	28.4
Mar-95	33.7	35.1	31.8	32.4	31.2	29.9
Apr-95	34.3	36.9	32.1	31.9	30.5	28.9
May-95	33.8	35.2	31.7	30.7	30	29.2
Jun-95	32.9	34.2	30.2	30.1	31	28.1
Jul-95	35.2	37.1	33.8	33.5	31.8	32
Aug-95	35.2	36.3	32.5	32.9	31.2	29.5
Sep-95	34.2	35.4	33.1	30.9	29.4	28.6
Oct-95	31.8	33.2	30	28.2	27	29.1
Nov-95	35.9	37	34.3	29.1	28	29.2
Dec-95	35.1	37.3	33.5	30.9	28.4	29.4

Astragalus vogelii

Date	DMD			OMD		
Feb-95	40.9	39.6	40.1	37.3	36.4	37.1
Mar-95	39.6	38.4	36.7	35.1	34.5	35.1
Apr-95	39.8	37.9	38.8	35.5	34.9	34.5
May-95	35.2	36.1	35.1	32.1	31.1	31.9
Jul-95	36.6	36.1	35.8	33.2	32.8	33

Glinus lotoides

Date	DMD			OMD		
Jan-95	41.2	42.3	40.5	39.4	36.8	35.8
Feb-95	42.4	43.2	41.4	40.9	37.1	37.9
Mar-95	40.3	41.4	40.5	38.7	36.3	35.2
Apr-95	38.6	39.4	40.2	38.2	36.1	34.9
May-95	41.5	42.3	40.9	39.6	38.2	36.3
Jun-95	41.2	42.5	39.9	36.3	35.4	34.3
Jul-95	39.7	40.2	38.7	35.8	33.2	34.1
Aug-95	36.8	37.5	39.5	35.7	34.3	32.8
Sep-95	38.3	39.6	36.4	36.2	35.3	34.1
Oct-95	35.9	36.8	34.2	35.3	34.1	32.8

Table 2 Chemical composition of plant samples % (n=4)

Hyoscyamus muticus

Date	CP1	CP2	CP3	CP4
Jan-95	17.06	17	16.7	15.2
Feb-95	14.42	13.9	14.5	13.5
Mar-95	12.5	12	14.7	13.1
Apr-95	9.46	10.2	13.6	12.8
May-95	9.49	10.5	11.4	11.2
Jun-95	6.63	8.7	11.1	10.3
Aug-95	8.25	8.4	10.2	9.5
Oct-95	8.62	9.1	10.3	9.21

Date	CF1	CF2	CF3	CF4
Jan-95	48	40.9	44.2	42.9
Feb-95	30	32.2	40.5	38.6
Mar-95	39.4	41.3	38.7	39.4
Apr-95	45.3	38.9	40.35	42.15
May-95	39.7	41.4	41.5	45.4
Jun-95	45.3	44.3	44.2	46.65
Aug-95	47.7	45.61	45.8	46.7
Oct-95	49.2	45.9	48.4	49.3

Date	EE1	EE2	EE3	EE4
Jan-95	3.61	3.1	3.5	3.25
Feb-95	3.5	3.4	3.25	3.19
Mar-95	3.41	3.25	3.11	3.1
Apr-95	3.39	3.22	3.1	2.96
May-95	3.4	3.15	2.97	3.64
Jun-95	3.4	3.2	2.85	2.61
Aug-95	3.4	2.9	2.61	2.55
Oct-95	3.29	2.99	2.45	2.49

Date	Ash1	Ash2	Ash3	Ash4
Jan-95	8.4	9.1	8.9	9.3
Feb-95	8.6	8.9	8.5	9.45
Mar-95	8.75	8.7	8.82	9.5
Apr-95	8.92	8.85	8.99	9.62
May-95	9.3	9.13	9.07	9.75
Jun-95	9.4	9.14	9.15	9.9
Aug-95	9.55	9.22	9.4	9.89
Oct-95	9.71	9.8	9.9	10.3

Najas sp.

Date	CP1	CP2	CP3	CP4
Feb-95	9.94	10.5	10.4	10.6
Mar-95	9.25	10.3	10.2	9.52
Apr-95	9.01	9.85	9.92	8.73
May-95	6.89	9.6	9.5	5.66
Jun-95	8.1	8.4	8.9	7.85
Jul-95	8.2	7.91	8.2	7.96
Aug-95	8.9	7.95	8.1	9.65
Oct-95	9.4	8.31	8.32	9.9
Nov-95	9.95	8.01	8.1	10.2

Date	CF1	CF2	CF3	CF4
Feb-95	50.5	49.3	50.3	53.2
Mar-95	48.6	52.2	49.5	46.55
Apr-95	57.7	54.43	53.5	69.7
May-95	61.8	56.7	60.8	76.26
Jun-95	59.4	57.04	58.9	61.6
Jul-95	62.5	60.2	61.75	63.05
Aug-95	63.6	61.32	61.42	6.05
Oct-95	60.7	61.7	60.05	61.5
Nov-95	61.8	61.53	61	61.9

Date	EE1	EE2	EE3	EE4
Feb-95	3.2	3.3	2.95	3.1
Mar-95	3.16	3.15	2.99	2.95
Apr-95	3	2.95	3.01	2.89
May-95	2.95	2.85	2.99	2.91
Jun-95	2.89	2.79	2.8	2.95
Jul-95	2.7	2.8	2.8	2.85
Aug-95	2.55	2.65	2.6	2.67
Oct-95	2.4	2.49	2.51	2.59
Nov-95	2.4	2.4	2.6	2.5

Date	Ash1	Ash2	Ash3	Ash4
Feb-95	16.1	16.2	15.9	15.9
Mar-95	15.8	15.93	15.75	15.95
Apr-95	15.9	16.33	15.8	16.3
May-95	16.3	16.5	16.05	16.49
Jun-95	16.5	16.7	16.3	16.7
Jul-95	16.7	16.8	16.55	16.82
Aug-95	18.1	17.4	17.2	17.1
Oct-95	18.3	17.85	17.9	17.39
Nov-95	18.4	17.96	17.9	17.5

Acacia raddiana

Date	CP1	CP2	CP3	CP4
Dec-94	12.36	12.2	11.2	4.9
Jan-95	7.02	10.1	8.5	9.1
Feb-95	9.9	9.9	8.9	8.7
Mar-95	11.98	9.82	9.56	9.3
Apr-95	7.81	9.65	8.6	9.1
May-95	9.09	9.15	9.01	8.81
Jun-95	8.58	8.72	8.8	8.7
Jul-95	7.42	8.5	8.7	8.52
Aug-95	7.85	7.3	8.51	8.32
Sep-95	8.07	7.1	8.12	8.1
Oct-95	7.88	7.05	7.41	7.9
Nov-95	5.95	6.1	6.95	7.41
Dec-95		5.92	6.41	6.5

Date	CF1	CF2	CF3	CF4
Dec-94	28.7	31.7	30.25	31.1
Jan-95	50.1	30.9	49.3	44.3
Feb-95	32.2	32.4	41.2	42.4
Mar-95	54.7	40.5	44.5	45.5
Apr-95	48.7	43.3	46.6	46.3
May-95	35.7	40.5	45.9	46.9
Jun-95	42.7	40.6	48.7	48.2
Jul-95	48.5	44.8	49.3	49.53
Aug-95	51.2	46.9	49.5	50.3
Sep-95	46.5	49.3	49.92	51.55
Oct-95	53.4	51.01	50.51	52.41
Nov-95	54.5	54.3	53.6	54.2
Dec-95	57.2	55.9	58.5	54.6

Date	EE1	EE2	EE3	EE4
Dec-94	3.5	3.45	3.6	3.35
Jan-95	3.6	3.52	3.4	3.3
Feb-95	3.81	3.8	3.8	3.71
Mar-95	3.87	3.81	4.01	3.99
Apr-95	4.2	3.42	4.21	4.02
May-95	4.35	4.3	3.95	4.22
Jun-95	4.6	4.4	3.8	4.1
Jul-95	4.6	4.52	3.75	3.89
Aug-95	4.2	4.17	3.68	3.7
Sep-95	4.01	4.1	3.7	3.54
Oct-95	3.8	3.9	3.69	3.34
Nov-95	3.72	3.81	3.58	3.42
Dec-95	3.7	3.6	3.7	3.2

Date	Ash1	Ash2	Ash3	Ash4
Dec-94	7.5	7.2	7.3	7.4
Jan-95	7.79	7.56	7.8	7.9
Feb-95	7.82	7.74	7.9	7.95
Mar-95	7.9	7.81	8.51	8.2
Apr-95	7.97	7.9	8.4	8.35
May-95	8.1	8	8.65	8.5
Jun-95	7.9	7.89	8.72	8.65
Jul-95	8.2	8.2	8.63	8.7
Aug-95	7.99	8.39	8.8	8.9
Sep-95	8.31	8.4	8.95	8.9
Oct-95	8.52	8.5	9.11	9.2
Nov-95	8.6	8.62	9.22	9.3
Dec-95	8.71	8.72	8.9	9.4

Acacia ehrenbergiana

Date	CP1	CP2	CP3	CP4
Dec-94	12.36	13.1	12.5	12.9
Jan-95	9.93	11.9	9.4	9.9
Feb-95	9.91	11	9.85	9.8
Mar-95	11.48	12.2	11.3	10.4
Apr-95	7.81	9.92	8.2	10.1
May-95	4.09	8.94	8.9	8.2
Jun-95	8.58	8.67	9.3	8.1
Jul-95	7.42	8.32	8.2	8.05
Aug-95	6.04	7.2	6.09	7.4
Sep-95	5.42	6.5	6.2	7.15
Oct-95	6.34	6.15	6.95	6.9
Nov-95	5.97	5.92	6.1	6.72
Dec-95	5.53	5.4	5.82	5.35

Date	CF1	CF2	CF3	CF4
Dec-94	28.7	27.4	27.25	28.2
Jan-95	37.5	32.1	34.2	32.15
Feb-95	32.2	34.56	30.25	33.4
Mar-95	54.7	39.75	49.67	34.9
Apr-95	48.4	40.45	47.67	38.9
May-95	35.7	44.5	39.52	40.1
Jun-95	42.7	46.57	40.52	43.5
Jul-95	48.5	47.4	39.92	44.59
Aug-95	42.8	47.5	44.6	45.4
Sep-95	50.4	52.3	47.41	46.7
Oct-95	47.5	53.1	49.3	48.95
Nov-95	56.2	55.4	49.5	49.41
Dec-95	49.9	51.9	50.1	52.3

Date	EE1	EE2	EE3	EE4
Dec-94	3.2	3.14	3.1	2.99
Jan-95	3.05	3	3	3
Feb-95	3.1	2.99	2.9	2.9
Mar-95	3.01	2.9	2.93	2.89
Apr-95	2.9	2.84	2.85	2.81
May-95	2.8	2.75	2.74	2.8
Jun-95	2.8	2.7	2.71	2.74
Jul-95	2.95	2.7	2.9	2.8
Aug-95	3.1	2.94	3.05	2.9
Sep-95	3.2	3.1	3.1	3.1
Oct-95	3.4	3.2	2.99	2.91
Nov-95	3.41	3.3	3.1	3.01
Dec-95	3.5	3.4	3.15	3.1

Date	Ash1	Ash2	Ash3	Ash4
Dec-94	17	16.9	17.7	17.3
Jan-95	17.3	17.2	16.95	16.9
Feb-95	16.9	17.1	16.49	16.54
Mar-95	17.2	16.98	16.82	16.8
Apr-95	17.3	17.3	16.99	16.9
May-95	16.9	17.1	17.11	17.15
Jun-95	17.5	17.3	17.28	17.32
Jul-95	17.5	17.52	17.4	17.5
Aug-95	17.7	17.61	17.54	17.5
Sep-95	17.8	17.73	17.62	17.81
Oct-95	18.2	17.95	17.9	17.95
Nov-95	18.3	18.1	17.85	18.2
Dec-95	18.2	18.4	18.2	18.16

Cassia senna

Date	CP1	CP2	CP3	CP4
Jan-95	16.01	15.9	9.7	12.4
Feb-95	5.69	10.5	8.4	10.2
Mar-95	9.32	9.95	8.9	9.9
Apr-95	11.35	9.9	10.5	10.1
May-95	11.88	9.8	11.2	9.95
Jun-95	7.28	9.61	9.4	9.75
Aug-95	11.05	9.45	10.9	9.82
Sep-95	12.01	9.9	11.5	10.4
Oct-95	11.75	10.1	11.6	10.8
Nov-95	11.64	10.3	11.7	11.2
Dec-95	10.33	11.2	11.2	11.5

Date	CF1	CF2	CF3	CF4
Jan-95	24.8	25.9	32.5	29.9
Feb-95	40.5	39.1	37.2	33.2
Mar-95	32.8	33.1	35.4	33.1
Apr-95	25.9	28.8	33.1	34.2
May-95	34.1	32.7	29.9	30.9
Jun-95	31.4	34.1	28.6	29.9
Aug-95	31.7	32.15	27.7	31.1
Sep-95	29.5	30.6	28.4	30
Oct-95	25.8	28.2	27.5	27.9
Nov-95	27.8	26.9	26.8	26.95
Dec-95	29.1	26.7	28.5	28.2

Date	EE1	EE2	EE3	EE4
Jan-95	4.4	4.2	4.25	4.16
Feb-95	4.21	4.1	4.1	4.1
Mar-95	4.34	4.25	4.3	3.99
Apr-95	4.23	4.3	4.25	4.25
May-95	4.29	4.31	4.15	4.15
Jun-95	4.2	4.15	3.95	4.19
Aug-95	4.11	3.95	3.99	3.95
Sep-95	4.05	4.1	3.6	3.89
Oct-95	4	4	3.45	3.67
Nov-95	3.82	3.6	3.4	3.59
Dec-95	3.81	3.92	3.25	3.8

Date	Ash1	Ash2	Ash3	Ash4
Jan-95	17.9	17.41	17.9	17.78
Feb-95	47.9	16.1	17.85	47.9
Mar-95	18.2	17.9	17.99	47.89
Apr-95	18.6	18.2	18.5	17.95
May-95	18.7	18.1	18.21	18.17
Jun-95	18.9	18.3	18.4	18.5
Aug-95	18.9	18.55	18.65	18.65
Sep-95	19	18.8	18.79	18.8
Oct-95	19.2	19.1	19.2	18.94
Nov-95	19.4	19.21	19.44	19.3
Dec-95	19.5	19.5	19.65	19.5

Aerva javanica

Date	CP1	CP2	CP3	CP4
Dec-94	13.89	13.2	13	13
Feb-95	8.88	10.1	9.5	9.4
Mar-95	8.66	9.1	9.13	9.3
Apr-95	5.05	7.82	8.81	8.85
May-95	8.01	7.9	7.5	8.71
Jun-95	5.14	7.45	6.8	7.9
Jul-95	5.69	6.2	6.52	6.3
Aug-95	9.12	6.1	6.3	6.1
Sep-95	5.95	5.94	6.1	5.81
Oct-95	8.53	5.62	5.93	5.62
Nov-95	4.44	4.91	4.85	5.15
Dec-95	4.03	4.8	4.6	4.9

Date	CF1	CF2	CF3	CF4
Dec-94	49.7	47.1	48.6	48.9
Feb-95	49.4	47.2	46.1	48.1
Mar-95	38.1	40.5	45.3	43.9
Apr-95	40.8	41.61	44.1	41.5
May-95	42.6	43.3	45.9	44.5
Jun-95	42.5	45.5	47.62	45.7
Jul-95	40.1	46.7	49.51	45.9
Aug-95	47.7	47.4	50.32	49.46
Sep-95	46.4	48.5	51.42	52.3
Oct-95	42.8	49.2	52.59	52.4
Nov-95	67.4	52.3	56.6	55.6
Dec-95	60.9	55.7	58.8	56.3

Date	EE1	EE2	EE3	EE4
Dec-94	4.9	4.8	4.5	4.2
Feb-95	4.81	4.7	4.2	4.3
Mar-95	4.75	4.65	3.92	4.1
Apr-95	4.72	4.55	3.81	3.95
May-95	4.71	4.5	3.7	3.8
Jun-95	4	4.42	3.52	3.6
Jul-95	4.52	4.4	3.59	3.45
Aug-95	3.9	3.9	3.44	3.4
Sep-95	3.84	3.82	3.5	3.2
Oct-95	3.6	3.71	3.8	3.1
Nov-95	3.7	3.55	3.9	2.99
Dec-95	3.61	3.5	3.85	2.95

Date	Ash1	Ash2	Ash3	Ash4
Dec-94	9.2	8.8	8.9	8.9
Feb-95	8.8	8.71	8.2	8.15
Mar-95	7.7	8.4	8.43	8.3
Apr-95	7.9	8.2	8.78	8.42
May-95	8.4	8.5	8.9	8.55
Jun-95	8.7	8.67	9.35	8.75
Jul-95	8.9	8.75	9.8	8.95
Aug-95	9.4	8.9	9.46	9.14
Sep-95	9.3	9.2	9.66	9.3
Oct-95	9.2	9.25	9.83	9.52
Nov-95	9.5	9.3	9.9	9.8
Dec-95	9.5	9.4	10.1	9.93

Pulicaria crispa

Date	CP1	CP2	CP3	CP4
Dec-94	15.25	14.3	12.8	13.5
Jan-95	9.76	10.5	10.7	10.2
Feb-95	9.38	10.1	10.2	10.1
Mar-95	8.44	9.9	9.81	10
Apr-95	7.85	9.8	9.6	9.8
May-95	6.98	9.92	9.43	9.62
Jun-95	5.4	8.9	8.9	8.79
Jul-95	7.42	8.6	8.55	8.7
Aug-95	8.95	8.4	8.2	8.45
Sep-95	6.45	8.1	8.16	8.04
Oct-95	5.95	7.9	7.4	7.99
Nov-95	12.5	7.2	6.6	7.1
Dec-95	12.1	6.9	6.5	6.72

Date	CF1	CF2	CF3	CF4
Dec-94	34.7	34.89	34.75	35.9
Jan-95	33.6	33.1	34.45	34.5
Feb-95	35.9	34.5	31.9	35.6
Mar-95	37.2	36.15	39.9	36.8
Apr-95	38.1	36.92	42.2	37.9
May-95	38.3	38.5	39.05	37.99
Jun-95	38.7	38.9	43.4	38.33
Jul-95	38.8	38.45	39.5	38.51
Aug-95	39.2	38.45	38.35	39.4
Sep-95	39.6	39.2	39.6	39.6
Oct-95	39.9	39.5	37.15	39.75
Nov-95	39.9	39.75	37.8	39.9
Dec-95	38.1	37.6	37.05	39.8

Date	EE1	EE2	EE3	EE4
Dec-94	3.4	3.3	3.5	3.6
Jan-95	3.45	3.29	3.6	3.45
Feb-95	3.34	3.25	3.42	3.4
Mar-95	3.4	3.15	3.5	3.35
Apr-95	3.3	3.1	3.41	3.1
May-95	3.29	3	3.39	3.01
Jun-95	3.1	2.9	3.29	2.89
Jul-95	3.1	2.85	3.3	2.7
Aug-95	3.05	2.9	2.89	2.61
Sep-95	2.9	2.81	2.85	2.45
Oct-95	2.7	2.8	2.82	2.8
Nov-95	2.64	2.71	2.8	2.74
Dec-95	2.6	2.66	2.89	2.5

Date	Ash1	Ash2	Ash3	Ash4
Dec-94	15.3	14.9	15.2	16.3
Jan-95	14.8	14.75	14.9	15.5
Feb-95	15	14.65	14.95	15.75
Mar-95	15	14.8	15.2	15.92
Apr-95	15.2	15.2	15.3	15.9
May-95	15.3	15.19	15.1	16.25
Jun-95	15.3	15.4	14.95	16.34
Jul-95	14.5	15.41	15.3	16.55
Aug-95	15.6	15.49	15.35	16.7
Sep-95	15.6	15.55	15.4	16.85
Oct-95	15.8	15.71	15.45	16.93
Nov-95	15.9	15.83	15.61	17.25
Dec-95	15.9	15.82	15.61	17.5

Glinus lotoides

Date	CP1	CP2	CP3	CP4
Jan-95	13.56	13.1	12.6	12.9
Feb-95	13.5	13.1	13.3	13
Mar-95	15.95	14.9	11.2	13.9
Apr-95	8.68	11.4	9.95	10.4
May-95	13.13	12.9	9.24	10.1
Jun-95	12.38	12.3	9.01	11.4
Jul-95	11.29	11.1	8.8	10.5
Aug-95	7.04	10.4	8.82	9.4
Sep-95	8.29	9.95	7.95	8.9
Oct-95	7.22	8.72	7.3	8.2

Date	CF1	CF2	CF3	CF4
Jan-95	37.1	38.02	38.9	38.1
Feb-95	27	33.4	36.65	31.6
Mar-95	25	32.6	35.2	33.9
Apr-95	43	35.6	33.4	34.6
May-95	31.5	36.7	36.6	36.1
Jun-95	33.1	38	37.7	36.9
Jul-95	37.7	38.4	38.2	37.9
Aug-95	33.8	38.9	39.4	38.75
Sep-95	38.1	39.7	39.9	38.9
Oct-95	36.7	39.9	40.1	39.4

Date	EE1	EE2	EE3	EE4
Jan-95	3.1	3.1	3.3	2.99
Feb-95	3.4	3.3	3.2	3.1
Mar-95	3.25	3.02	3.5	3.25
Apr-95	3.51	3.4	2.89	3.15
May-95	3.49	3.2	2.7	2.99
Jun-95	3.5	3.1	2.65	3.11
Jul-95	3.4	2.89	2.54	2.79
Aug-95	3.38	2.79	2.49	2.18
Sep-95	3.2	2.7	2.4	2.59
Oct-95	3.1	2.7	2.35	2.4

Date	Ash1	Ash2	Ash3	Ash4
Jan-95	6.9	7.1	7.3	7.05
Feb-95	7.9	7.75	7.59	7.6
Mar-95	7.25	7.4	7.65	7.4
Apr-95	7.8	7.8	8.2	8.1
May-95	7.82	7.72	8.29	8.3
Jun-95	7.9	7.82	8.45	7.99
Jul-95	8.2	8.1	8.75	8.8
Aug-95	8.31	8.29	8.9	8.9
Sep-95	8.45	8.41	9.2	9.1
Oct-95	9.2	8.9	9.25	9.3

Tamarix nilotica

Date	CP1	CP2	CP3	CP4
Dec-94	14.46	14.1	13.5	13.9
Jan-95	11.76	12.8	12.3	12.8
Feb-95	16.34	15.3	14.5	14.3
Mar-95	15.31	15.2	12.5	13.6
Apr-95	12.84	13.9	13.2	13.1
May-95	14.07	14	14.4	12.5
Jun-95	9.99	10.2	10.2	10.1
Jul-95	10.85	10.7	9.51	10
Aug-95	8.68	9.92	9.2	8.8
Sep-95	8.58	9.25	8.87	8.2
Oct-95	9.23	9.13	8.6	8.9
Nov-95	9.34	8.75	8.2	8.3
Dec-95	8.29	9.1	8.21	8.1

Date	CF1	CF2	CF3	CF4
Dec-94	29.4	29.5	31.5	30.8
Jan-95	22.9	24.6	28.9	29.2
Feb-95	28.5	27.9	30.59	29.6
Mar-95	30.2	28.9	35.4	33.3
Apr-95	26.2	27.3	35.6	34.2
May-95	35.8	30.4	37.5	35.6
Jun-95	30.5	30.4	38	37.81
Jul-95	32.1	32.9	37.9	37.2
Aug-95	28.9	29.85	36.55	34.9
Sep-95	37.8	35.7	36.3	35.8
Oct-95	35.6	34.5	34.7	34.1
Nov-95	30.1	29.9	35.2	35.25
Dec-95	30.6	30.02	36.7	35.9

Date	EE1	EE2	EE3	EE4
Dec-94	2.95	3.01	2.99	2.9
Jan-95	3.11	3.1	3.2	3.15
Feb-95	2.95	3.1	3.01	3
Mar-95	2.9	3.12	2.8	2.92
Apr-95	2.79	2.98	2.77	2.8
May-95	2.8	2.9	2.69	2.9
Jun-95	3.15	3.1	2.7	3.05
Jul-95	2.9	2.91	2.65	2.8
Aug-95	2.75	2.7	2.6	2.62
Sep-95	2.74	2.67	2.6	2.7
Oct-95	2.75	2.71	2.54	2.65
Nov-95	2.71	2.6	2.45	2.6
Dec-95	2.69	2.55	2.39	2.54

Date	Ash1	Ash2	Ash3	Ash4
Dec-94	15.3	15.9	16.2	16
Jan-95	15.2	15.7	15.15	15.9
Feb-95	15.1	15.2	15.39	15.2
Mar-95	14.9	15.05	15.5	15.1
Apr-95	14.8	14.9	15.71	14.9
May-95	14.5	14.85	14.82	15.2
Jun-95	14.4	14.5	15.99	15.8
Jul-95	14.5	14.4	16.2	15.2
Aug-95	14.3	14.3	15.9	14.8
Sep-95	14.9	14.65	16.35	15.3
Oct-95	15	14.82	16.29	16.2
Nov-95	15.1	15.02	16.35	15.8
Dec-95	15.2	15.1	16.4	15.7

Astragalus vogelii

Date	CP1	CP2	CP3	CP4
Feb-95	16.41	13.5	15.9	14.5
Mar-95	14.11	12.1	15.5	13.4
Apr-95	14.88	13.1	14.3	13
May-95	5.66	11.5	12.6	11.1
Jul-95	11.99	12.9	11.9	11.3

Date	CF1	CF2	CF3	CF4
Feb-95	40.9	39.8	39.5	41.5
Mar-95	41.1	40.2	40.2	42.3
Apr-95	35.4	38.2	41.1	39.3
May-95	46.3	50.2	43.35	42.9
Jul-95	35	40.2	44.5	43.1

Date	EE1	EE2	EE3	EE4
Feb-95	4.11	3.49	3.95	3.9
Mar-95	3.92	3.82	3.8	3.8
Apr-95	3.81	3.75	3.79	3.71
May-95	3.75	3.62	3.5	3.62
Jul-95	3.55	3.5	3.4	3.49

Date	Ash1	Ash2	Ash3	Ash4
Feb-95	10.3	10.5	10.3	10.4
Mar-95	10.5	10.6	10.65	10.5
Apr-95	11.2	11.1	11.1	11.2
May-95	10.3	10.4	11.5	10.9
Jul-95	11.5	10.99	11.5	11.2

Table 3 Mineral content of plant samples collected from Wadi Allaqi area (expressed in % dry weight) May 1997

Species	P %	K%	Na %	Ca %	Mg %	Cl %
Crypsis schoenoides	0.18±0.03	1.31±0.20	0.43±0.06	0.28±0.05	0.31±0.05	0.89±0.12
Fimbrystlis bisumbellata	0.18±0.03	1.41±0.24	0.27±0.05	0.60±0.10	0.54±0.09	1.07±0.15
Eragrostis aegyptiaca	0.21±0.03	1.12±0.20	0.37±0.07	0.70±0.10	0.54±0.10	0.36±0.06
Tamarix nilotica	0.28±0.04	2.01±0.28	1.68±0.29	1.60±0.29	1.44±0.20	2.66±0.37
Psoralea plicata	0.26±0.03	2.50±0.43	0.19±0.03	0.60±0.08	0.42±0.05	0.53±0.09
Citrullus colocynthis	0.23±0.03	2.01±0.34	0.19±0.04	3.70±0.63	0.66±0.09	0.89±0.13
Euphorbia granulata	0.20±0.03	1.51±0.29	0.21±0.04	0.50±0.09	0.42±0.07	0.53±0.10
Astragalus vogelii	0.27±0.05	1.81±0.27	0.18±0.03	1.00±0.15	0.84±0.14	0.53±0.08
Balanites aegyptiaca (shoot)	0.12±0.02	1.75±0.30	1.50±0.20	1.40±0.27	0.54±0.10	2.13±0.36
Balanites aegyptiaca (fruit)	0.13±0.02	1.41±0.18	0.18±0.03	0.10±0.02	0.24±0.04	0.71±0.09
Acacia raddiana (shoot)	0.20±0.04	0.92±0.13	0.16±0.03	0.80±0.14	0.42±0.05	0.53±0.10
Acacia raddiana (Fruit)	0.15±0.03	0.92±0.16	0.13±0.02	1.00±0.13	0.48±0.08	0.71±0.10

Table 4 The nutritional composition of plant samples collected from Wadi Allaqi area (expressed in % dry weight) May 1997.

Species	Moist %	Ash %	Protein %	Carb. %	Fibre %	Fat %
Crypsis schoenoides	70.13±9.8	11.53±1.5	9.4±1.4	8.62±1.1	25.76±3.4	1.73±0.29
Fimbrystlis bisumbellata	78.12±14.1	20.25±2.8	9.9±1.5	12.19±2.1	27.38±4.7	0.83±0.15
Eragrostis aegyptiaca	71.00±9.9	13.15±2.2	12.3±1.6	10.44±1.5	40.37±5.7	0.63±0.11
Tamarix nilotica	78.29±13.3	23.13±3.2	18.4±3.1	6.75±1.0	10.07±1.8	1.50±0.21
Psoralea plicata	77.45±13.9	8.71±1.5	17.80±2.7	8.20±1.1	39.22±5.1	1.33±0.17
Citrullus colocynthis	78.74±15.0	22.30±3.4	10.70±1.8	8.59±1.2	18.88±3.2	1.13±0.19
Euphorbia granulata	61.26±10.4	6.55±1.2	11.40±1.5	10.33±1.8	36.60±6.2	2.33±0.30
Astragalus vogelii	78.11±11.7	18.72±3.2	19.80±3.0	7.45±1.3	33.31±4.3	0.83±0.15
Balanites aegyptiaca (shoot)	65.78±8.6	9.60±1.6	12.90±1.9	9.33±1.7	31.08±5.3	0.97±0.13
Balanites aegyptiaca (fruit)	13.10±1.8	7.59±1.0	8.80±1.1	26.64±4.5	24.22±4.1	5.10±0.66
Acacia raddiana (shoot)	58.44±9.9	9.09±1.3	14.20±2.1	6.69±0.9	46.49±7.90	1.23±0.21
Acacia raddiana (Fruit)	59.20±8.9	5.90±0.8	21.20±3.6	11.89±2.0	34.93±4.5	1.37±0.18

Annex 3

Household Survey

Date	Name	Dabuka	Clan	Head	Number	Wealth
28/05/96	Makki & El-Soghir	0		Idris	5	1
28/05/96	Makki & El-Soghir		Hamedab	Ali Seleman	4	3
28/05/96	Makki & El-Soghir	0		Jar El Nabi	0	3
28/05/96	Makki & El-Soghir	0		Ali Hadaya	0	2
07/10/96	Makki & El-Soghir	10	Beduin	Mahmod Salah	6	1
07/10/96	Makki & El-Soghir	10	Beduim	Gar Al Nabi (son-El-Nor)	6	3
07/10/96	Makki & El-Soghir	10	Bushari	Karar El- Wakeel	4	2
07/10/96	Makki & El-Soghir	10	Bashari	Hamed Assia Nasr	5	2
07/10/96	Makki & El-Soghir	10	Budin	Salah Abo Khidary	5	2
11/12/96	Makki & El-Soghir	1	Malake	Karar El Wakel	5	2
11/12/96	Makki & El-Soghir	1	Fashagabe	Gar Al Nabi (son-Mohamed Ahamed)	7	3
11/12/96	Makki & El-Soghir	0	Hamedabe	Awade Abo Easi	6	3
11/12/96	Makki & El-Soghir	1	Sadenab	Mohamed Al0i Salah	3	1
11/12/96	Makki & El-Soghir	0	Omorab	Mohamed Karar	4	1
07/04/97	Makki & El-Soghir		Fashegab- Beduin	Mossa Gar El-Nabi	4	2
07/04/97	Makki & El-Soghir	0	Omrab- Bushari	Mohamed Karar	4	1
07/04/97	Makki & El-Soghir		Sadenab	Ali Salah	2	1
07/04/97	Makki & El-Soghir	0	Omrab- Bushara	Taher Nasr	4	1
07/04/97	Makki & El-Soghir	0	Sadenab	Nafai Hassan El-Nor	2	1
07/04/97	Makki & El-Soghir	0	Beduin- Agebab	Salah Abo khedry	6	3
30/06/97	Makki & El-Soghir	0	Bedouin- Sedanb	Ahmed El Noor	2	1
30/06/97	Makki & El-Soghir	0	Bedouin- Sedanb	Nafai Hassan El Noor	2	1
30/06/97	Makki & El-Soghir	0	Bedouin	Mohamed Ali Salah	2	1

30/06/97	Makki & El-Soghir	1	Bedouin- Sedanb	Ali Salah	3	1
30/06/97	Makki & El-Soghir		Bedouin- Sedanb	Hassan Ahmed El Noor	2	1
01/09/97	Makki & El-Soghir	10	Bedouin-Hamidabe	Ewad Abo Aissa	3	2
01/09/97	Makki & El-Soghir	10	Besharia- Malak	Karar El Wakeel	3	2
01/09/97	Makki & El-Soghir	10	Hemidabe-Bedouin	Ali Mohamed Seleman	5	3
01/09/97	Makki & El-Soghir	10	Bedouin-Fashegab	Gar El Nabye	2	3
01/09/97	Makki & El-Soghir	10	Besharia-Omarabe	Ali Aissa Nasser	4	2

owned Camel	owned Sheep	owned Goat	% allaqi Camel	% allaqi Sheep	% allaqi Goat	%local fodder	%aswan fodder	How often
1	1	1	4	4	4	1	1	3
3	3	3	1	1	1	0	1	1
3	3	3	1	4	4	4	3	2
3	3	3	1	1	1	0	0	4
1	1	0	4	4	4	0	0	4
3	3	3	4	4	4		1	3
2	2	2	1	1	1	0	0	4
2	2	2	1	1	1	0	0	4
2	2	2	4	4	4	0	0	4
2	2	2	1	1	1	1	1	3
3	3	3	1	1	1	3	3	2
3	3	3	1	1	1	3	3	
1	1	0	1	1	1	0	0	4
1	1	0	4	4	4	0	0	4
2	2	3	4	4	4	0	0	4
1	1	0	4	4	4	0	0	4
0	1	0	4	4	4	0	0	4
1	1	0	3	4	4	0	0	4
1	0	0	4	4	4	0	0	
3	3	3	4	4	4	0	0	4
1	1	0	1	1	0	0	0	4
1	0	0	1	1	1	0	0	4
1	1	1	1	1	1	0	0	4
0	1	0	1	1	0	0	0	4
1	1	1	1	1	1	0	0	4
3	3	3	1	4	4	3	3	3
3	3	3	1	1	1	0	0	4
3	3	3	4	4	4	0	4	3
3	3	3	4	4	4	4	4	3
3	3	3	1	1	1	0	0	4

died Camel	died Sheep	died Goats	sold Camel	sold Sheep	sold Goats	slaught Camel	slaught Sheep	slaught Goats	goat milk	sheep milk	pwdered milk
0	4	4	0	0	0	0	1	1	3	3	0
0	0	0	1	3	3	0	3	3	3	3	0
	20	50	0	0	0	0	2	2	2	2	1
0	0	0	0	1	1	0	2	2	3	3	0
0	0	0	0	0	0	0	0	0	1	1	1
1	0	0	3	3	3	0	2	2	3	3	0
1	0	0	1	1	1	1	1	1	2	2	0
0	0	0	1	1	1	1	1	1	2	2	0
0	0	0	1	1	1	0	2	2	2	2	0
0	0	0	1	1	1	0	1	1	3	3	0
1	2	2	3	3	3	0	3	3	3	3	0
1	5	5	3	3	3	0	3	3	3	3	0
0	0	0	0	0	0	0	0	0	2	1	0
0	0	0	0	0	0	0	0	0	2	2	0
0	2	2	2	1	1	0	2	2	3	3	0
0	0	0	0	0	0	0	0	0	2	2	0
0	0	0	0	0	0	0	0	0	2	0	0
0	0	0	0	0	0	0	0	0	2	2	0
0	0	0	0	0	0	0	0	0	2	2	0
0	20	25	3	3	3	0	3	3	3	3	0
			0	0	0	0	0	0	3		0
1			0	0	0	0	0	0	3	2	0
			0	0	0	0	0	0	3	1	0
			0	0	0	0	0	0	3	0	0
			1	0	0	0	0	2	3	1	0
			3	3	3	0	3	3	3	3	0
							1	1	3	3	0
1	2	3	3	3	3	0	3	3	3	3	0
			3	3	3	0	3	3	3	3	0
			0	0	0	3	3	2	3	3	0

charcoal	transport	Method	Season	Grazing	Tamarix
10	3	0	1	0	1
75	3	0	1	1	1
0	0	0	1	0	1
10	3	0	1	0	1
5	1	0	1	0	0
20	2	0	1	0	0
0	0	2	0	0	0
0	0	2	1	0	0
0	0	2	0	0	0
0	0	2	0	1	0
50	3	0	0	1	0
0	0	2	0	1	0
50	3	0	0	1	0
5	1	0	0	1	0
0	0	2	0	1	0
0	0	2	0	1	0
0	0	2	0	1	0
0	0	2	0	1	0
5	5	1	0	1	0
0	0	2	0	1	0
2	2	2	0	0	0
0	0	2	0	1	1
0	0	2	0	1	1
0	0	2	0	0	0
0	0	0	0	1	1
200	5	0	0	1	1
100	2	0	0	1	1
200	4	0	0	0	0
0	0	2	0	1	1
0	0	2	0	1	1

Citrullus	Balanities	Cassia Senna	Cleome	Cymbopogon	Haploph.	Hyoscyam.	Pulicaria	Salvadora	Solenostemma
0	0	1	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
1	0	1	0	1	0	0	0	1	1
0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	1	0	1	0	0	0	0	1
0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	1	0	1	0	0	0	0	1

Livestock Survey

Date	Location	Goat	Camel	Sheep	CamelPrice	Over 600kg	Age C	Sex C	Goat Price	Over 25kg	Age G	Sex G	Sheep Price	Over 35kg	Age S	Sex S
22/05/97	Aswan	35	0	20		0		0	65	1	1.5	0	165	0	1	0
27/05/97	Daraw	0	15	0	2300	1	3	0	73	1	1.5	0	235	1	2	0
26/06/97	Aswan	24	1	15	800	0	2.5	0	55	0	1	0	140	1	3	1
24/06/97	Daraw	0	350	0	2050	0	2.5	0	80	0	2	0	210	0	2	0
31/07/97	Aswan	20	0	15		0	0	0	125	1	2	1	280	1	2	0
29/07/97	Daraw	0	15	0	2420	1	3	0	90	1	1.5	0	187	1	2	1
21/08/97	Aswan	5	0	7		0	0	0	75	0	1.399999976	0	155	1	2	1
19/08/97	Daraw	0	0	0	1875	0	2	0	43	0	0.75	0	290	1	2	0

Cost Camel	Weight (Over 600kg)	Age (c)	Sex (c)	Cost Goat	Weigh t(Over 25kg)	Age (g)	Sex (F)	CostSheep	Weight (Over35kg)	Age(s)	Sex(s)
	0	0	0	$70.00	-1	1.5	0	$172.00	0	1	0
$2,475. 00	-1	3	0	$42.00	0	0.8	0	$160.00	0	1	0
	0	0	0		0	0	0	$175.00	0	1.5	0
	0	0	0	$65.00	-1	1.5	-1	$165.00	0	1	0
	0	0	0	$65.00	-1	1.5	0	$145.00	0	1.5	0
	0	0	0	$60.00	0	1	0	$175.00	0	1.2	0
$2,210. 00	0	2.5	0	$70.00	0	1.5	0	$165.00	0	2	-1
	0	0	0	$82.00	0	1.4	0		0	0	0
	0	0	0	$57.00	0	0.98	0	$245.00	-1	3	-1

Market Survey

Fodder

Teben1	Teben2	Sorghum1	Sorghum2	Other1	Other2
LE0.40	LE0.50	LE1.00	LE1.25	LE1.00	LE1.00
LE0.50	LE0.50	LE1.00	LE1.50	LE1.00	LE1.00
LE0.40	LE0.50	LE1.50	LE1.00	LE1.00	LE1.25
LE0.40	LE0.45	LE1.25	LE1.50	LE1.00	LE1.25
LE0.45	LE0.50	LE1.25	LE1.50	LE1.00	LE1.25
LE0.40	LE0.45	LE1.50	LE1.50	LE1.00	LE1.25
LE0.40	LE0.45	LE1.50	LE1.25	LE1.00	LE1.25
LE0.40	LE0.40	LE1.25	LE1.25	LE1.00	LE1.25
LE0.40	LE0.45	LE1.25	LE1.50	LE1.25	LE1.25
LE0.45	LE0.50	LE1.25	LE1.25	LE1.00	LE1.25
LE0.50	LE0.40	LE1.10	LE1.10	LE1.00	LE1.10
LE0.50	LE0.40	LE1.10	LE1.10	LE1.00	LE1.10
LE0.50	LE0.40	LE1.10	LE1.10	LE1.00	LE1.10
LE0.50	LE0.40	LE1.10	LE1.10	LE1.00	LE1.10
LE0.50	LE0.40	LE1.10	LE1.10	LE1.00	LE1.10
LE0.50	LE0.40	LE1.25	LE1.25	LE1.00	LE1.10
LE0.50	LE0.40	LE1.25	LE1.25	LE1.50	LE1.50
LE0.50	LE0.40	LE1.25	LE1.25	LE1.50	LE1.50
LE0.50	LE0.40	LE1.25	LE1.25	LE1.50	LE1.50
LE0.00	LE0.00	LE0.00	LE0.00	LE1.00	LE0.60
LE0.00	LE0.00	LE0.00	LE0.00	LE1.00	LE0.60
LE0.00	LE0.00	LE0.00	LE0.00	LE1.00	LE0.60
LE0.00	LE0.00	LE0.00	LE0.00	LE1.00	LE0.60
LE0.00	LE0.00	LE0.00	LE0.00	LE0.50	LE0.50
LE0.00	LE0.00	LE0.00	LE0.00	LE0.50	LE0.50
LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00
LE0.00	LE0.00	LE0.00	LE0.00	LE0.50	LE0.50
LE0.00	LE0.00	LE0.00	LE0.00	LE0.50	LE0.50
LE0.00	LE0.00	LE0.00	LE0.00	LE0.50	LE0.50
LE0.00	LE0.00	LE0.00	LE0.00	LE0.50	LE0.50
LE0.00	LE0.00	LE0.00	LE0.00	LE0.50	LE0.50
LE0.00	LE0.00	LE0.00	LE0.00	LE0.50	LE0.00
LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00
LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00
LE0.50	LE0.45	LE1.25	LE1.25	LE1.50	LE1.50
LE0.50	LE0.45	LE1.25	LE1.25	LE1.50	LE1.50
LE0.50	LE0.45	LE1.25	LE1.25	LE1.50	LE1.50
LE0.50	LE0.45	LE1.25	LE1.25	LE1.50	LE1.50
LE0.50	LE0.50	LE1.25	LE1.25	LE1.50	LE1.50
LE0.50	LE0.50	LE1.25	LE1.25	LE1.50	LE1.50
LE0.50	LE0.50	LE1.25	LE1.25	LE1.50	LE1.50
LE0.50	LE0.50	LE1.25	LE1.25	LE1.50	LE1.50
LE0.60	LE0.60	LE1.25	LE1.25	LE0.00	LE1.50
LE0.60	LE0.60	LE1.25	LE1.25	LE1.50	LE1.50
LE0.00	LE0.00	LE1.25	LE1.25	LE0.50	LE0.50
LE0.00	LE0.00	LE1.25	LE1.25	LE0.50	LE0.50

LE0.00	LE0.00	LE1.20	LE1.20	LE1.00	LE0.60
LE0.00	LE0.00	LE1.25	LE1.00	LE0.60	LE0.50
LE0.00	LE0.00	LE1.25	LE1.25	LE0.80	LE0.50
LE0.00	LE0.00	LE1.25	LE1.25	LE1.00	LE0.60
LE0.00	LE0.00	LE1.25	LE1.25	LE1.00	LE0.60
LE0.00	LE0.00	LE1.00	LE1.00	LE1.00	LE0.60
LE0.25	LE0.25	LE0.60	LE0.60	LE0.70	LE0.70
LE0.30	LE0.25	LE0.60	LE0.60	LE0.70	LE0.70
LE0.30	LE0.25	LE0.60	LE0.60	LE0.80	LE0.60
LE0.25	LE0.30	LE0.50	LE0.60	LE0.70	LE0.75
LE0.25	LE0.25	LE0.50	LE0.60	LE0.70	LE0.75
LE0.25	LE0.25	LE0.50	LE0.60	LE0.70	LE0.75
LE0.25	LE0.25	LE0.60	LE0.60	LE0.70	LE0.75
LE0.25	LE0.25	LE0.60	LE0.60	LE0.70	LE0.75
LE0.70	LE0.70	LE1.25	LE1.25	LE1.50	LE1.50
LE0.70	LE0.70	LE1.25	LE1.25	LE1.50	LE1.50
LE0.70	LE0.70	LE1.25	LE1.25	LE1.50	LE1.50
LE0.70	LE0.70	LE1.25	LE1.25	LE1.50	LE1.50
LE0.70	LE0.70	LE1.25	LE1.25	LE1.50	LE1.50
LE0.70	LE0.70	LE1.25	LE1.25	LE1.50	LE1.50
LE0.70	LE0.70	LE1.25	LE1.25	LE1.50	LE1.50
LE0.00	LE0.00	LE1.00	LE1.00	LE1.00	LE0.60
LE0.00	LE0.00	LE1.00	LE1.00	LE1.00	LE0.60
LE0.00	LE0.00	LE1.00	LE1.00	LE1.00	LE0.60
LE0.00	LE0.00	LE1.00	LE1.00	LE1.00	LE0.50
LE0.00	LE0.00	LE1.00	LE1.00	LE1.00	LE0.50
LE0.00	LE0.00	LE1.00	LE1.00	LE1.00	LE0.50
LE0.00	LE0.00	LE1.00	LE1.00	LE1.00	LE0.50

Food

Ppwder milk1	Ppwder milk2	Pgoatmil k1	Pgoatmil k2	Pbutter1	Pbutter2	pgoatme at1	Pgoatm eat2	Psheep meat1	Psheep meat2	Pcamel meat1	Pcamel meat2
LE10.00	LE10.00	LE2.00	LE1.50	LE9.00	LE8.00	LE12.00	LE13.00	LE14.00	LE14.00	LE10.00	LE9.00
LE10.00	LE10.00	LE2.00	LE2.00	LE9.00	LE10.00	LE13.00	LE13.00	LE14.00	LE14.00	LE10.00	LE10.00
LE10.00	LE10.00	LE2.00	LE1.50	LE10.00	LE10.00	LE13.00	LE13.00	LE14.00	LE14.00	LE10.00	LE10.00
LE14.00	LE15.00	LE2.00	LE1.50	LE10.00	LE10.00	LE13.00	LE13.00	LE14.00	LE14.00	LE9.00	LE10.00
LE14.00	LE15.00	LE2.00	LE1.50	LE10.00	LE10.00	LE13.00	LE13.00	LE14.00	LE14.00	LE9.00	LE10.00
LE15.00	LE15.00	LE2.00	LE1.50	LE10.00	LE10.00	LE13.00	LE13.00	LE14.00	LE14.00	LE10.00	LE10.00
LE15.00	LE15.00	LE2.00	LE1.50	LE10.00	LE10.00	LE13.00	LE13.00	LE14.00	LE15.00	LE9.00	LE10.00
LE15.00	LE15.00	LE2.00	LE2.00	LE10.00	LE10.00	LE13.00	LE13.00	LE14.00	LE14.00	LE9.00	LE10.00
LE15.00	LE15.00	LE0.00	LE0.00	LE10.00	LE10.00	LE14.00	LE14.00	LE14.00	LE14.00	LE10.00	LE10.00
LE15.00	LE14.00	LE0.00	LE0.00	LE10.00	LE11.00	LE14.00	LE14.00	LE14.00	LE14.00	LE10.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE10.00	LE12.00	LE11.00	LE11.00	LE14.00	LE15.00	LE9.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE10.00	LE12.00	LE11.00	LE11.00	LE14.00	LE15.00	LE9.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE10.00	LE12.00	LE11.00	LE11.00	LE14.00	LE15.00	LE9.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE10.00	LE12.00	LE11.00	LE11.00	LE14.00	LE15.00	LE9.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE10.00	LE12.00	LE11.00	LE11.00	LE14.00	LE15.00	LE9.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE10.00	LE12.00	LE11.00	LE11.00	LE14.00	LE15.00	LE9.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE10.00	LE12.00	LE11.00	LE11.00	LE14.00	LE15.00	LE9.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE10.00	LE12.00	LE12.00	LE12.00	LE14.00	LE15.00	LE9.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE10.00	LE12.00	LE12.00	LE12.00	LE14.00	LE15.00	LE9.00	LE10.00
LE7.50	LE1.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE15.00	LE15.00	LE10.00	LE10.00
LE7.50	LE1.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE15.00	LE15.00	LE10.00	LE10.00
LE7.50	LE1.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE15.00	LE15.00	LE10.00	LE10.00
LE7.50	LE1.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE15.00	LE15.00	LE10.00	LE10.00
LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE14.00	LE14.00	LE9.00	LE9.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE14.00	LE14.00	LE9.00	LE9.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE14.00	LE14.00	LE9.00	LE9.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE14.00	LE14.00	LE9.00	LE9.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE14.00	LE14.00	LE9.00	LE9.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE14.00	LE14.00	LE0.00	LE0.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE15.00	LE9.00	LE0.00	LE0.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE15.00	LE9.00	LE0.00	LE0.00
LE7.50		LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE14.00	LE0.00	LE9.00	LE0.00
LE7.50		LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE14.00		LE9.00	LE0.00
LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00
LE15.00	LE7.50	LE0.00	LE0.00	LE11.00	LE12.00	LE12.00	LE12.00	LE15.00	LE15.00	LE10.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE11.00	LE12.00	LE12.00	LE12.00	LE15.00	LE15.00	LE10.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE11.00	LE12.00	LE12.00	LE12.00	LE15.00	LE15.00	LE10.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE11.00	LE12.00	LE12.00	LE12.00	LE15.00	LE15.00	LE10.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE11.00	LE12.00	LE12.00	LE12.00	LE15.00	LE15.00	LE10.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE11.00	LE12.00	LE12.00	LE12.00	LE15.00	LE15.00	LE10.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE11.00	LE12.00	LE12.00	LE12.00	LE15.00	LE15.00	LE10.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE11.00	LE12.00	LE12.00	LE12.00	LE15.00	LE15.00	LE10.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE10.00	LE12.00	LE12.00	LE12.00	LE15.00	LE15.00	LE10.00	LE10.00
LE15.00	LE7.50	LE0.00	LE0.00	LE10.00	LE12.00	LE12.00	LE12.00	LE15.00	LE15.00	LE10.00	LE10.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE15.00	LE9.00	LE0.00	LE0.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE15.00	LE9.00	LE0.00	LE0.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE15.00	LE9.00	LE0.00	LE0.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE15.00	LE10.00	LE0.00	LE0.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE14.00	LE10.00	LE0.00	LE0.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE14.00	LE10.00	LE0.00	LE0.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE14.00	LE10.00	LE0.00	LE0.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE14.00	LE9.00	LE0.00	LE0.00
LE12.00	LE12.00	LE2.00	LE2.00	LE8.00	LE8.00	LE14.00	LE14.00	LE14.00	LE14.00	LE8.00	LE8.00
LE12.00	LE12.00	LE2.00	LE2.00	LE9.00	LE9.00	LE14.00	LE14.00	LE14.00	LE14.00	LE8.00	LE8.00
LE12.00	LE12.00	LE2.00	LE2.00	LE8.00	LE8.00	LE14.00	LE14.00	LE14.00	LE14.00	LE8.00	LE8.00
LE12.00	LE12.00	LE2.00	LE2.00	LE8.00	LE8.00	LE14.00	LE14.00	LE14.00	LE14.00	LE8.00	LE9.00
LE12.00	LE12.00	LE2.00	LE2.00	LE8.00	LE8.00	LE14.00	LE14.00	LE14.00	LE14.00	LE8.00	LE8.00
LE12.00	LE12.00	LE2.00	LE2.00	LE8.00	LE8.00	LE14.00	LE14.00	LE14.00	LE14.00	LE8.00	LE8.00
LE12.00	LE12.00	LE2.00	LE2.00	LE8.00	LE8.00	LE14.00	LE14.00	LE14.00	LE14.00	LE8.00	LE8.00
LE12.00	LE12.00	LE2.00	LE2.00	LE8.00	LE8.00	LE14.00	LE14.00	LE14.00	LE14.00	LE8.00	LE8.00
LE15.00	LE7.50	LE0.00	LE0.00	LE12.00	LE12.00	LE12.00	LE12.00	LE16.00	LE16.00	LE11.00	LE11.00

LE15.00	LE7.50	LE0.00	LE0.00	LE12.00	LE12.00	LE12.00	LE12.00	LE16.00	LE16.00	LE11.00	LE11.00
LE15.00	LE7.50	LE0.00	LE0.00	LE12.00	LE12.00	LE12.00	LE12.00	LE16.00	LE16.00	LE11.00	LE11.00
LE15.00	LE7.50	LE0.00	LE0.00	LE12.00	LE12.00	LE12.00	LE12.00	LE16.00	LE16.00	LE11.00	LE11.00
LE15.00	LE7.50	LE0.00	LE0.00	LE12.00	LE12.00	LE12.00	LE12.00	LE16.00	LE16.00	LE11.00	LE11.00
LE15.00	LE7.50	LE0.00	LE0.00	LE12.00	LE12.00	LE12.00	LE12.00	LE16.00	LE16.00	LE11.00	LE11.00
LE15.00	LE7.50	LE0.00	LE0.00	LE12.00	LE12.00	LE12.00	LE12.00	LE16.00	LE16.00	LE11.00	LE11.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE14.00	LE9.00	LE0.00	LE0.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE14.00	LE9.00	LE0.00	LE0.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE14.00	LE9.00	LE0.00	LE0.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE14.00	LE9.00	LE0.00	LE0.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE15.00	LE8.00	LE0.00	LE0.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE15.00	LE9.00	LE0.00	LE0.00
LE7.50	LE7.50	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE0.00	LE15.00	LE8.00	LE0.00	LE0.00

Products

Mats1	Mats2	Wool(sh)1	Wool(sh)2	Wool(g)1	Wool(g)2	Blanket1	Blanket2	Container1	Container2	Rope1	Rope2	Other1	Other2
LE 35.00	LE 40.00	LE 20.00	LE 20.00	LE 20.00	LE 20.00	LE 45.00	LE 45.00	LE 15.00	LE 10.00	LE 3.00	LE 4.00	LE 0.00	LE 0.00
LE 35.00	LE 40.00	LE 20.00	LE 20.00	LE 20.00	LE 20.00	LE 45.00	LE 45.00	LE 15.00	LE 12.00	LE 3.00	LE 3.00	LE 0.00	LE 0.00
LE 30.00	LE 35.00	LE 20.00	LE 25.00	LE 20.00	LE 20.00	LE 40.00	LE 45.00	LE 10.00	LE 15.00	LE 3.50	LE 3.00	LE 0.00	LE 0.00
LE 30.00	LE 35.00	LE 20.00	LE 25.00	LE 20.00	LE 20.00	LE 40.00	LE 45.00	LE 10.00	LE 15.00	LE 3.50	LE 3.00	LE 0.00	LE 0.00
LE 30.00	LE 35.00	LE 20.00	LE 25.00	LE 20.00	LE 20.00	LE 40.00	LE 45.00	LE 10.00	LE 15.00	LE 3.50	LE 3.00	LE 0.00	LE 0.00
LE 30.00	LE 35.00	LE 20.00	LE 25.00	LE 20.00	LE 25.00	LE 40.00	LE 40.00	LE 10.00	LE 12.00	LE 3.00	LE 3.00	LE 0.00	LE 0.00
LE 30.00	LE 30.00	LE 20.00	LE 20.00	LE 20.00	LE 22.00	LE 40.00	LE 45.00	LE 10.00	LE 15.00	LE 3.00	LE 3.50	LE 0.00	LE 0.00
LE 30.00	LE 30.00	LE 20.00	LE 25.00	LE 20.00	LE 25.00	LE 40.00	LE 45.00	LE 10.00	LE 15.00	LE 3.00	LE 3.50	LE 0.00	LE 0.00
LE 30.00	LE 35.00	LE 20.00	LE 25.00	LE 20.00	LE 25.00	LE 40.00	LE 40.00	LE 10.00	LE 12.00	LE 3.00	LE 3.50	LE 0.00	LE 0.00
LE 35.00	LE 35.00	LE 20.00	LE 25.00	LE 25.00	LE 25.00	LE 40.00	LE 45.00	LE 10.00	LE 12.00	LE 3.00	LE 3.50	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 15.00	LE 10.00	LE 0.00	LE 0.00	LE 250.00	LE 250.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 15.00	LE 10.00	LE 0.00	LE 0.00	LE 250.00	LE 250.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 15.00	LE 10.00	LE 0.00	LE 0.00	LE 250.00	LE 250.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 15.00	LE 10.00	LE 0.00	LE 0.00	LE 250.00	LE 250.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 15.00	LE 10.00	LE 0.00	LE 0.00	LE 250.00	LE 250.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 15.00	LE 10.00	LE 0.00	LE 0.00	LE 250.00	LE 250.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 15.00	LE 10.00	LE 0.00	LE 0.00	LE 250.00	LE 250.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 20.00	LE 10.00	LE 0.00	LE 0.00	LE 250.00	LE 250.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 20.00	LE 15.00	LE 0.00	LE 0.00	LE 250.00	LE 250.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 50.00	LE 0.00	LE 0.00	LE 0.00	LE 20.00	LE 30.00	LE 0.00	LE 0.00	LE 20.00	LE 15.00	LE 4.00	LE 0.00	LE 0.00	LE 0.00
LE 50.00	LE 0.00	LE 0.00	LE 0.00	LE 20.00	LE 30.00	LE 0.00	LE 0.00	LE 20.00	LE 15.00	LE 5.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 15.00	LE 15.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 15.00	LE 20.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00

LE 0.00	LE 0.00	LE 0.00	LE 10.00	LE 0.00	LE 0.00	LE 0.00	LE 25.00	LE 15.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 15.00	LE 30.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 20.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 15.00	LE 30.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 7.00	LE 10.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 10.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 14.00	LE 20.00	LE 0.00	LE 0.00	LE 50.00	LE 0.00
LE 0.00	LE 0.00	LE 30.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 10.00	LE 4.00	LE 50.00	LE 0.00	LE 0.00	LE 90.00	LE 75.00
LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 20.00	LE 15.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 20.00	LE 15.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 20.00	LE 15.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 20.00	LE 15.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 20.00	LE 15.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 20.00	LE 15.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 20.00	LE 15.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 20.00	LE 15.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 20.00	LE 15.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 20.00	LE 15.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 40.00	LE 80.00	LE 0.00	LE 0.00	LE 5.00	LE 8.00
LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 40.00	LE 80.00	LE 0.00	LE 0.00	LE 5.00	LE 80.00
LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 40.00	LE 80.00	LE 0.00	LE 0.00	LE 5.00	LE 80.00
LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 40.00	LE 80.00	LE 0.00	LE 0.00	LE 5.00	LE 80.00
LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 40.00	LE 80.00	LE 0.00	LE 0.00	LE 5.00	LE 80.00
LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 40.00	LE 80.00	LE 0.00	LE 0.00	LE 5.00	LE 80.00

LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 40.00	LE 80.00	LE 0.00	LE 0.00	LE 5.00	LE 80.00
LE 50.00	LE 0.00	LE 75.00	LE 80.00	LE 50.00	LE 60.00	LE 0.00	LE 0.00	LE 8.00	LE 10.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 12.00	LE 12.00	LE 20.00	LE 20.00	LE 15.00	LE 15.00	LE 12.00	LE 12.00	LE 1.00	LE 1.00	LE 3.00	LE 3.00	LE 0.00	LE 0.00
LE 10.00	LE 12.00	LE 20.00	LE 20.00	LE 15.00	LE 14.00	LE 12.00	LE 12.00	LE 1.00	LE 1.50	LE 3.00	LE 3.00	LE 0.00	LE 0.00
LE 12.00	LE 10.00	LE 20.00	LE 20.00	LE 15.00	LE 15.00	LE 12.00	LE 12.00	LE 1.50	LE 1.00	LE 3.00	LE 3.00	LE 0.00	LE 0.00
LE 12.00	LE 12.00	LE 20.00	LE 20.00	LE 15.00	LE 15.00	LE 12.00	LE 12.00	LE 1.00	LE 1.50	LE 30.00	LE 3.00	LE 0.00	LE 0.00
LE 12.00	LE 12.00	LE 20.00	LE 20.00	LE 15.00	LE 15.00	LE 12.00	LE 12.00	LE 1.00	LE 2.00	LE 3.00	LE 3.00	LE 0.00	LE 0.00
LE 12.00	LE 12.00	LE 20.00	LE 20.00	LE 15.00	LE 15.00	LE 12.00	LE 12.00	LE 1.00	LE 1.00	LE 3.00	LE 3.00	LE 0.00	LE 0.00
LE 12.00	LE 12.00	LE 20.00	LE 20.00	LE 15.00	LE 15.00	LE 12.00	LE 12.00	LE 1.00	LE 1.00	LE 3.00	LE 3.00	LE 0.00	LE 0.00
LE 12.00	LE 12.00	LE 20.00	LE 20.00	LE 15.00	LE 15.00	LE 12.00	LE 12.00	LE 1.00	LE 1.00	LE 3.00	LE 3.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 25.00	LE 20.00	LE 250.00	LE 250.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 25.00	LE 20.00	LE 250.00	LE 250.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 25.00	LE 20.00	LE 250.00	LE 250.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 25.00	LE 20.00	LE 250.00	LE 250.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 25.00	LE 20.00	LE 250.00	LE 250.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 25.00	LE 20.00	LE 250.00	LE 250.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00
LE 0.00	LE 0.00	LE 25.00	LE 20.00	LE 250.00	LE 250.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 1.00	LE 0.00
LE 50.00	LE 0.00	LE 85.00	LE 90.00	LE 65.00	LE 70.00	LE 0.00	LE 0.00	LE 7.00	LE 10.00	LE 0.00	LE 0.00	LE 1.00	LE 0.00
LE 70.00	LE 0.00	LE 70.00	LE 60.00	LE 40.00	LE 50.00	LE 0.00	LE 0.00	LE 7.00	LE 8.00	LE 0.00	LE 0.00	LE 1.00	LE 0.00
LE 40.00	LE 0.00	LE 60.00	LE 60.00	LE 40.00	LE 40.00	LE 0.00	LE 0.00	LE 8.00	LE 15.00	LE 0.00	LE 0.00	LE 1.00	LE 0.00
LE 40.00	LE 0.00	LE 60.00	LE 60.00	LE 40.00	LE 40.00	LE 0.00	LE 0.00	LE 15.00	LE 5.00	LE 0.00	LE 0.00	LE 1.00	LE 0.00
LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 15.00	LE 15.00	LE 30.00	LE 30.00	LE 8.00	LE 8.00
LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 22.00	LE 22.00	LE 35.00	LE 35.00	LE 8.00	LE 8.00
LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 0.00	LE 25.00	LE 15.00	LE 40.00	LE 37.00	LE 10.00	LE 8.00

Medicinal Plants

LE Balanites	LE Citrullus	LE Cassia Senna	LE Cleome	LE Cymbopogon	LE Haplophyllum	LE Hyoscyamus	LE Pulicaria	LE Salvadora	LE Solenostemma
1	0.5	5	40	4	5	6	3		
2	2	2.5	2	2	2	2	1	0.3	2.5
2	2	2	2	2	2	2.5	1	0.2	2
2	2	2	2	2	2	2.5	1	0.2	2
2	2	2	2	2	2	2.5	1	0.2	2
2	0.25	2	3	2.5	5	5	8	0.5	4
2	0.25	2.5	3	2.5	5	5	8	0.25	4
2	0.25	3	3	2.5	5	5	8	0.25	4
2	0.2	2	3	2.5	5	5	8	0.5	4
2.5	0.25	2	3	2.5	5	5	8	0.5	4
8	0.25	0	6	3.5	15	0	20	0.5	8
8	0.25	0	6	3.5	15	0	20	0.5	8
8	0.25	0	6	3.5	15	0	20	0.5	8
8	0.25	0	6	3.5	15	0	20	0.5	8
8	0.25	0	6	3.5	15	0	20	0.5	8
8	0.25	0	8	4	15	0	20	0.5	8
8	0.25	0	8	4.5	15	0	25	0.5	8
8	0.25	0	8	4.5	15	0	25	0.5	8
8	0.25	0	8	4.5	15	0	25	0.5	8
8	0.25	15	6	4	20	15	20	0.5	8
8	0.25	15	6	4	20	15	20	0.5	7
14	0.5	8	0	4	12	0	16	0.35	8
14	0.5	8	0	4	12	0	18	0.25	7
8	0.25	0	6	3	15	15	15	0.5	8
8	0.25	0	6	3	15	15	15	0.25	6
8	0.25	0	6	3	15	15	15	0.25	6
4	0.25	0	0	2.5	4	0	15	0.25	6
15	0	0	0	4	0	8	3	1.5	5
15	0	0	0	4	0	0	3	0.5	8
15	0	0	0	4	0	0	3	0.5	8
15	0	0	0	4	0	0	3	0.5	8
15	0.5	0	0	3	7	15	12	0.5	8
15	0.25	8	16	3	15	16	12	0.5	6
0	0	0	0	4	0	0	0	1	6
8	0.35	8	5	16	25	0.5	8	0	4
9	0.35	0	8	5	16	0	25	0.5	8
9	0.35	0	8	5	16	0	25	0.5	8
9	0.35	0	8	5	16	0	25	0.5	8
9	0.35	0	8	5	16	0	25	0.5	8
9	0.35	0	8	5	16	0	25	0.5	8
9	0.35	0	8	5	16	0	25	0.5	8
9	0.35	0	8	5	16	0	25	0.5	8
9	0.35	8	0	4	15	0	25	0.5	8
9	0.35	8	0	4	15	0	25	0.5	8
15	0.25	0	0	4	0	0	3	0.5	8
15	0.25	0	0	4	0	0	3	0.5	8
6	0.25	5	80	5	9	12	11	0.5	6

7	0.25	5	80	5	9	12	9	0.5	5
6	0.4	5	80	3	7	12	7	1	5
7	0.4	6	80	4	9	14	9	0.5	6
7	0.5	6	80	5	10	15	10	1	6
15	0.25	6	7	4	15	12	12	0.5	7
1	2	0.8	40	0.9	6	5	6	0.15	2.5
1	2	0.8	40	1	6	5	6	0.2	2
1	2	0.8	40	3	5	5	6	0.2	2.5
1.5	2	1	40	1	6	5	6	0.2	2
1	2	0.8	40	1	6	5	6	0.25	2
1	2	1	40	0.9	6	5	6	0	20
1	3	0.8	40	1	6	0	6	0.25	2.5
1	3	0.8	40	1	6	0	6	0.25	2.5
9	0.35	8	0	5	15	0	25	0.5	8
9	0.35	8	0	5	15	0	25	0.5	8
9	0.35	8	0	5	15	0	25	0.5	8
9	0.35	8	0	5	15	0	25	0.5	8
9	0.35	8	0	5	15	0	25	0.5	8
9	0.35	8	0	5	15	0	25	0.5	8
9	0.35	8	0	5	15	0	25	0.5	8
15	0.25	6	7	4	15	12	12	0.5	7
15	0.25	6	7	4	15	12	12	0.5	7
15	0.25	8	7	4	15	12	14	0.5	7
15	0.25	8	8	4	15	0	16	0.5	6
15	0.25	12	8	4	15	0	20	0.5	6
15	0.25	12	8	4	15	0	20	0.5	6
15	0.25	12	8	4	15	0	20	0.5	6