Agricultural Technology Transfer Society

Khartoum North, Industrial Area

الجمعية الطوعية لنقل التقانات في المجال الزراعي

الخرطوم بحرى، المنطقة الصناعية

Name of the applicant:	Agricultural Technology Transfer Society (ATTS)
Nationality of the applicant and date of establishment:	ATTS is non-governmental Sudanese organization **(annex 1**) established on January 21st 2009.
Legal status	ATTS is non-governmental organization accredited by the Ministry of Humanitarian Affairs in the Sudan according to the work permit No.2234 dated January 21st 2009 (letter attached).
Partner 1:	Skills Building Training Centre in Food Animal Technologies (**annex 2**).
Partner 2:	Animal Resources Authorities, Nahr Al Nil Pastures and forage department, Nahr Al Nil State. Livestock owners in Nahr an Nil localities Forestry department in Nahr an Nil state. .

Applicant's contact details for the purpose of this action	
Postal address:	P.O. Box 1577, Khartoum North 13113, Sudan.
Mobile: Country code + number	00249122127139
Contact person for this action :	Prof. Elsamani Elgaili
Contact person's e-mail address :	wadagaili@yahoo.com
E-mail address of the Organization	munamm789@yahoo.com
Title of action	Introduction of cactus (*Opuntia ficus-indica* f. *inermis*) in semi-arid areas of Sudan as a strategic fodder and drought mitigation
Total duration of the action	3 years
Amount ($) of requested funding	**122,262.0**

Overall objective of action

This action intends to grow cactus *(Opuntia ficus-indica* f. *inermis*) in areas of Nahr Al Nil State that are vulnerable to sand encroachment to stop sand movement and at the same time provide an alternative source of feed to livestock and food (cactus fruit) to humans.

Target groups

Small livestock holders in rural and suburban areas of Nahr Al Nil state.

Final beneficiaries

1. Small livestock holders in Nahr Al Nil.
2. Forestry department in Nahr Al Nil Al Nil state.
3. Pasture and Forage department in Nahr Al Nil state.
4. Bodies concerned with desertification and environmental safety in Nahr Al Nil state.
5. Veterinary authority in Nahr Al Nil state.

Relevance of the action

Livestock keeping is a common means of generating income and securing food to families in Nahr Al Nil state. However, it is challenged by acute shortages in feed supplies because the state has poor natural grazing base as it lies in a desert area with less than 100 mm of annual rainfall. The state main agricultural land (3.1 million Feddan), which is the sole supplier of livestock feed, lies along the banks of the River Nile and is subjected to considerable reduction in size because of sand infringement. This action will grow cactus in areas that are continuously threatened by sand movement to stop sand movement and at the same time provide untapped feed source (cactus parts) for feeding livestock. Cactus fruit may be consumed by humans and may be sold to provide extra income to small livestock owners in Nahr Al Nil State.

1-Description of the action

1-a. Background

Nahr Al Nil State is situated in northern Sudan between latitudes 16^o and 22^o N and longitudes 25^o and 35^o E Kassala and the red sea states lies in the east of Nahr Al Nil state, Egypt to the north; the northern state to the west and Khartoum and Elgadarif states to the south. Nahr Al Nil State covers an area of about 124000 km^2 and is made up of six localities namely; Atbra, Eldamer, Barber, Shendi, Elmatama and Abuhamed. The major towns of Nahr Al Nil State are Atbra, Aldamer, Barber, Shendi, Abohamed and Elmatama. Nahr Al Nil state is arid and the southern part has semi-arid climate. Aridity decreases gradually with movement towards the south. This diverse climates endowed the state with multiple animal and agricultural resources The state is characterized by long winter season when the temperatures range 8 – 12^oC, in summer the temperature increases from 40 – 45^oC. The long winter season gives the state the characteristic of low incidence of biting flies and epidemics.

The economy of Nahr Al Nil state depends on horticultural crops, cereal and legume crops, pulses and forage production along the banks of the River Nile. Livestock keeping is a common means of generating income and securing food to families. However, the state is challenged by acute shortages in feed supplies because of the poor natural grazing base as it lies in a desert area with less than 100 mm of annual rainfall. The area of natural grazing land is 48000 km^2 restricted to the valleys and rivulets in the southern part of the state. The total area of land suitable for agriculture in is 3.1 million Feddans (1.380,000 ha), of which only 700 thousands Feddans (311.11 ha) are used. Most of used agricultural area is fertile lands along the Nile bank and is cultivated seasonally during summer, winter or autumn (Dameerah). Poor smallholders of livestock (notably sheep and goats) who do not own land irrigated from the Nile are compelled to graze their animals in adjacent natural pastures that are very pitiable because of low annual rainfall and poor soil. Cropping along the River Nile is very much threatened by sand encroachment and the reduction in the size of cropped areas in effect. Thus very limited scope is left to increase livestock feed from traditional sources. Some investors have already started digging boreholes to irrigate fields grown with fodders (notably alfalfa) for export or for commercial sheep production. It is a pity that small livestock holders can not implement such methodology to solve the problem of feed shortage because of financial limitations.

Table 1: Livestock distribution in different localities of Nahr Al Nil state.

Locality↓ Species >	Cattle	Sheep	Goats	Camels	Equine {horses & donkeys}	TOTAL
ELDAMER	19797	219875	293676	41306	35495	610149
ATBRA	6598	24431	67398	2504	15213	116144
SHENDI	36080	415625	464011	20653	49253	985622
ELMATAMA	28033	258051	299551	6376	38654	631115
BARBER	7773	172319	157264	5831	38862	382049
ABOHAMED	1948	125706	186483	1470	30341	345948
TOTAL	100229	1216457	1468386	78140	207818	3071027

Source: MAR .Statistical Year Book (2008).

This action will grow cactus in areas where small livestock owners reside and which are continuously threatened by sand encroachment. The aim is to reduce the threat of sand movement on arable river land and concurrently provides untapped feed source (cactus parts) for feeding livestock. Cactus fruit may be consumed by humans and/or marketed to earn extra income to beneficiaries (small livestock owners. in Nahr Al Nil State).

1.b. Growing Cactus

Description:

Cactus has fleshy, multi-jointed stems with triangular humps sprouting spines and dark green in colour. Stems

growing up to three metres long with lengthwise ribs, giving a plaited rope like appearance. Stems can develop roots wherever they contact the ground and broken stems can grow into new plants. Leaves are absent and modified into the spines which helps the plant reduce moisture loss. Without true leaves, Moon cactus relies on its green stems to photosynthesise. Flowers are large, usually 150-200 mm in length, and are short lived, withering in the morning. Cactus flowers are white and showy, sometimes with a pink tinge around the outermost petals and grow singly from a flower stem. Cactus fruit are round, bright red in colour, 40-50 mm wide and have bumps and spikes similar to those found on the stems. Fruit contain a white fleshy pulp, attractive to birds, mammals and ants. Each fruit contains between 400 and 1000 small black seeds, held in the white pulp. Over a period of several weeks in late spring and early summer, each pad produces several three-to-four-inch wide flowers that bloom in an array of colours, depending on the variety, from subtle to brilliant tones of yellows and oranges, pinks and reds. When the blooms fade, the edible fruits form. The fruits split open when ripe, encouraging the seed and pulp to be eaten by animals, aiding spread. Cactus can produce seed at just six months of age and can fruit nearly all year round. Cactus has two root distinct root types that maximize its drought tolerance, shallow feeder roots that grow horizontally up to two meters and secondary tuberous roots which grow to depths of 150-600 mm, storing energy reserves. The underground tuberous roots have dormant buds; capable of re-shooting when the above-ground growth dies, even following herbicide treatment. Like most plants that thrive in a wide variety of areas, the prickly pear is tolerant of varied soils, temperatures, and moisture levels. The plants grow best in a sunny position in well-drained sandy loam with some protection from cold winter winds. Plants benefit from applications of a balanced fertilizer during their spring-through-fall growing period and, with excellent drainage, can tolerate almost as much water as any other cultivated plant. They are, however, drought tolerant once established. The pads are actually rapidly-growing flattened stems. Depending on the variety, the pads will grow from four to 16 inches long, nine inches wide, and three-quarters of an inch thick. They may be elliptical to oblong in shape, bright green to blue-gray in colour, and have a smooth skin. Most of the cultivated ones are spineless, but some have single inch-long white spines. Smaller stickers (glochids), cloaked in deceptively soft-looking fuzzy patches, will penetrate the skin at the slightest touch. If you grow the prickly pear for its pads, feed with a high-nitrogen fertilizer. In warm climates, well-tended plants may be harvested of pads up to six times a year, and established plants may yield 20 to 40 one-half pound pads at each harvest. Remove the pads by carefully cutting them from their supporting pads. The best time of day to harvest the pads is from mid-morning to mid-afternoon, when the acid content in the pads is at its lowest. If you prefer more flowers and fruits, give the plants a no-nitrogen fertilizer such as 0-10-10 once a month, even through the winter. During this dormant period, the plants require a bright situation and enough water only to keep the pads from shrivelling. The cactus will bloom and set fruit from early spring through the summer, depending on the variety. Each pad can support numerous flowers, each yielding one fruit. Up to 30 blooms have been counted on mature pads, but 8 to 16 is a good number to allow for development of good-sized fruits. The fruits are ripe enough to harvest when the glochids fall off. Twist, rather than pull, the fruit from the pad to avoid tearing it. If the fruits are harvested unripe, the peel colour will change some, but some of the sugar in the fruit will be lost.

Propagation

spread under conditions of scarce and erratic rainfall and high temperatures and can play an important role in the protection of local fauna. What's needed is a very course rocky mix with only very small amounts of sand and organic matter for potted cactus plants. So a compose of 1 part peat, ¼ part of sharp sand or grit and ¼ part of broken crock pieces place in a terracotta pots type with a heavy base and at least one drainage hole in the base, these pots should be located inside the nursery, put in your consideration sunlight direction. One planted seed can produce a plant of 1-5 spineless pads.

Watering: The plants should be kept almost completely dry during the winter months, only water them to prevent the roots from completely drying out, once a month should be fine. When the plant begins to grow watering should be increased gradually until the plant shall be in full growth.

The most intensively used parts of the plant are the pads and the fruits. The pads-technically the flattened stem which grows quickly--protrude from the plant at odd angles. Clinging to each pad are small clusters of tiny stickers. After trimming these stickers and spines away, the pad can then be peeled and prepared for cooking as any vegetable would. Popular techniques include boiling or sauteing the pad, or chopping it raw and adding it to soups and salads. Once heated, the pectin-rich pads tend to become gooey, acquiring a texture similar to okra. The spiny red fruits, also known as "tunas," are cylindrical in shape and about the size of a child's hand. The crimson fruits were once popular for making red dye. They are often used to make jelly, juice, and pickles. In Mexico the fruits are the basis of a jelly, as well as sweet syrup that is used like honey or hardened into taffy. Cactus pear cheese is a delicacy made by cooking and cooling the fruits. This native species has also become a popular landscaping plant (it's colourful and attracts birds). The fresh pads are commonly eaten by animals for nourishment; in times of drought, range animals rely on the cactus pads for food and water. In parts of Africa, the sap from the pads has long been used to repel mosquitoes.

Health Benefits

Traditional healers have used the prickly pear in many ways. The gooey gel (sap) extracted from its pads can be applied much as aloe Vera gel is, namely, spread on minor cuts, sunburns, or skin irritations to promote healing and

soothe any Inflammation. Folk healers have been known to warm up the pads for use as heating "pads," applying them to aching backs as well as chests rattled by the congestion of a common cold. Traditional sources also claim that pureeing the young pads produces an effective laxative. In addition, specially prepared extracts of the prickly pear cactus have been developed in recent years, and are being touted for treating hangovers and boosting recovery from vigorous exercise, among other uses. The Extract is usually made from *Opuntia ficus indica*.

Specifically, prickly pear cactus may help to:

- **Treat adult-onset (type 2) diabetes.** One of the plant's most compelling traditional uses is for managing diabetes, a chronic condition commonly caused by obesity. With diabetes, the body loses its ability to effectively use glucose, the blood sugar that the body's cells need for energy. The high blood sugar that results can cause many health complications. According to lore of the Valley of Mexico, the Aztecs and other locals consumed prickly pear cactus in various forms to control or actually cure this type of diabetes as long ago as the 15th and 16th centuries. Prickly pear cactus continues to be a traditional treatment of diabetes in Mexico and other Latin American countries. Formal research studies done so far confirm that this ancient approach is sound. Results indicate that high doses of cooked pads can indeed reduce blood sugar levels. It's still not clear exactly how prickly pear works, however, and how much is needed to have an effect. One theory is that the high soluble fiber from the pad's gooey pectin absorbs sugar in the body, and then enables the body to very slowly release sugar through the course of the day. Animal studies done in the 1990s indicate that extracts of the prickly pear at lower doses than traditionally used can reduce blood sugar levels as well, raising hopes that easy-to-use extracts may some day be effective for use in humans.
- **Boost muscle and tissue recovery following vigorous exercise.** A very recent use for prickly pear cactus involves an extract specially drawn from the skin of the fruit. Attracted to the ability of this plant to survive in some of the harshest desert environments on earth, manufacturers of the extract contend that it can accelerate the ability of the human body to withstand physical stresses as well. The claim is that the extract can do this by speeding up the synthesis of natural restorative compounds in the body called Heat Shock Proteins (HSPs), hence protecting the body against excessive exercise-induced muscle and tissue injury. Under normal conditions, it takes the body two to three hours following physical stress to elevate its natural supply of HSPs. By taking the extract before exercise, HSP levels should be ready to rise as soon as 15 minutes after a workout begins. Whether HSP levels actually rise after taking this extract, and whether this property will in turn actually raise energy, speed healing, or increase stamina in an athlete remains to be seen. The prickly pear extract marketed as PrepairTM appears to bethe most widely studied so far. However, human studies to date have been very small, and none has been published in a medical journal.

As Food for Humans

Cacti in general and the fruits in particular are considered staple foods for some poorer residents of Latin America, including Mexico, and in many South European and Mediterranean countries. For as much as two months of the year, they can be the main article of edible food. The fruits are appetizing and are often eaten raw. Cactus fruit is high in vitamin C, low in fat, and high in sugars, where about 1/3 of the sugar content is fructose. A "Cactus Cookbook" is available. Throughout Latin America, local cottage industries have developed to sell fruits collected wild from more than 40 species of cacti in 15 genera. In Mexico and the United States, the cacti most commonly used for food are the prickly pear species of *Opuntia*, some columnar species of *Cereus* and the barrel cacti, *Ferocactus* and *Echinocactus.* The fruits or tunas of prickly pears are commonly sold in the markets of Mexico and in parts of the United States along the US-Mexico border as well as in South European and in Mediterranian countries. The hybridization of prickly pear is common and new strains or cultivars arise frequently, producing tunas in many sizes, colors and flavors. Now very often available in grocery stores throughout Canada, these "Tunas" have been popular and sometimes important in most Mediterranean and other countries where Opuntias have been natural ized and are cultivated on farms and plantations. The **glochids** of prickly pears, minute, barbed spines, must be brushed off first before eating, either by rolling the fruits on the ground or in a bag woven from Agave fibre, swatting the fruits with large leaves and branches, wiping the fruit with a moist towel or commercially by using mechanical brushes. The tunas are eaten as fresh fruit, dried fruit or used for prepared foods where special varieties can be made into pickles, jams, candy, stews to make the popular taffy *miel de tuna*and fermented drinks such as Colonche wine and brandy. In extreme cases, seeds of some genera, e.g., *Myrtillocactus*, have been used as a food source, even when collected as a second harvest from human feces. The recovered, washed seeds are first roasted then eaten, or dried in the sun and ground into a flour-like meal to be used for cooking. The fruits from the columnar cacti and barrel, "candy" cacti are also collected for human consumption although they are less well known than the fruits of the prickly pear cacti. These fruits are mainly eaten raw but can also be prepared to make the equivalents of the prickly pear *miel de tuna,* Colonche and wine.

As Food for Livestock and Other Native Animals

Cactus plants provide water and some nutritional value and are an important source of food for livestock and native animals. Various species of cacti can be used as fodder. Fodder refers to the coarse plant material that is cut up and fed to the livestock. The large **barrel cacti** of the genus *Ferocactus*can be used as fodder by simply cutting open the stem and exposing the pulp. The stems of most columnar cacti are generally chopped up to reveal the pulp.

Harvesting naturally occurring cacti can be ecologically damaging, especially when such cacti tend to propagate infrequently and are very slow growing. However, the most commonly harvested cacti used for fodder are the cultivated **platyopuntias**. Ranchers in the United States have long known how to make use of some species of prickly pear as fodder. However more recently many ranchers have planted platyopuntias on a limited basis, mainly as a water source for their cattle during periods of drought. *Opuntias*can also be the principal diet of the white-tailed deer. Quail, wild turkey, various rodents. Some turtles and tortoises also depend on the cacti as a food source. For desert animals such as pack rats, gophers and rabbits, the barrel cacti can be a principal source of water.

A Variety of Uses

Around the turn of the century, the plant scientist Luther Burbank researched many uses of the prickly pear cactus. Bob Hornback of Santa Rosa, California, has worked with the Luther Burbank collection for many years and done much to relocate and save specimens of these varieties. He has compiled a list of prickly pear uses from Burbank's research notes, circa 1914.

Prickly pear cacti can be grown into hedges and fences by planting them a foot or so apart. Within several years, the plants will grow together to form a wall of the spiny pads protruding at all angles (a barrier that will repel any intruder larger than a rabbit. Plantings can also be made for erosion control in deforested areas. In time, cacti plants such as *Opuntia ficus-indica* may grow into freely-branching trees from 10 to 20 feet tall.

The sap from the pads can be used in first aid similar to the aloe vera plant. Simply cut-off a portion of a pad, crush it, and squeeze the juice onto a cut, burn, or bruise. The sap will soothe the wound. Ground or pureed young pads are used as a laxative and also as a remedy for diabetes. According to Marita Cantwellde-Trejo, Extension Vegetable Post harvest Specialist at the University of California, Davis, the Mexican Institute of Nutrition in Mexico City is researching the hypoglycaemic effect of cactus consumed by humans.

In Central Africa, the sap from the pads served as a mosquito repellent. In 1911, Burbank noted in Scientific American, that when spread on water, it smothers mosquito larvae, and the effect lasts up to a year.

The stickiness of the sap makes it useful in formulating various products. It can be extracted to make chewing gum and candles, and is used as a stiffening agent for cotton cloth. A common use in rural areas of Mexico is to boil it down into a concentrate and mix it with whitewash and mortar to increase the durability of buildings.

Fresh pads provide a dependable source of food and drink for livestock and poultry. From 1906 to 1915, Burbank developed and promoted some 35 varieties of "spineless" cactus for this purpose. Charles E. Russell, of Texas A&I University, has studied some of these and other varieties as animal fodder in arid regions of Texas, Mexico, and Chile. Russell points out that the pads, when supplemented with a portion of cottonseed meal, offer all the moisture and nutrition an animal needs. Cantwell-de-Trejo adds that while there is a maximum amount of cactus pads that animals can eat (if pads make up over 50% of their diet, they will develop diarrhoea), the pads may be the only source of food and water for range animals during times of drought or hardship. A wide variety of other animals has been successfully raised on the cactus pads. These include sheep, pigs, horses, ostriches (grown for their feather plumes), and at least one circus elephant.

According to Russell, the pads are a highly-prized commodity in the dairy industry of Mexico. When fed to dairy stock, the pads impart a distinctive flavour to the milk and butter, and these products are highly desired locally. A mutually beneficial barter system between cacti and dairy producers provides all the manure the cactus can use in return for all the pads the dairy stock can eat.

Other parts of the cactus also are useful. The pads can be pounded and dried, and the strong fibers woven into mats, baskets, fans, and fabrics. Pressed fibers can be used in making paper. The large spines are used as toothpicks, needles, and pins. Even the woody skeletons left after the fleshy tissues is dried can be used(in the construction of houses, rustic furniture, and assorted trinkets.

Before commercial dependence on synthetic dyes, cactus plantations were planted for the production of red pigments. The red-colored fruit of Opuntia streptacantha contain betacyanins (similar to anthocyanins) that are used for food colouring. Carminic acid ("cochineal" (is produced by the cochineal insect that feeds on the pads and fruit, and is used in botanical stains and as a cloth dye. In the 16th century, the export of cochineal from Mexico was second in importance and monetary value only to silver. According to Cantwell-de-Trejo, there is a resurgence of interest in these natural pigments. Also, some Indian groups dry the pads, flower buds, and fruits for later boiling and eating. Young flower buds can be baked and eaten. The prickly pear cactus is an underappreciated plant species, and they optimistically anticipate the development of future economic uses for both the pads and the fruit. Some possible uses, include adapting the natural mucilage in pads as a soup thickener similar to agar, using the fruit's juice in various flavorings, and fermenting the juice into vinegar and wine (the distillate retains a wonderfully fruity aroma.

1.c. Effect on performance of feeding cactus to livestock

An interesting challenge for scientists in the field of animal nutrition is the introduction of alternative feedstuffs that could overcome the problems of environmental harshness and production costs. Several studies have shown that the exploitation of some drought-tolerant shrubs represents an effective strategy for livestock feeding (Ben Salem *et al*., 2002). The studies have demonstrated that cactus (*Opuntia ficus-indica* f. *inermis*) cladodes (Ben Salem *et al*., 1996;

Misra *et al.*, 2006) or fruits (Ben Salem *et al*., 2003) have a good nutritional value, when used as supplements in small ruminant diets. Cactus cladodes are low in protein content, but contain high percentages of soluble carbohydrates. Cactus pear (*Opuntia ficus-indica* L. Miller) constitutes a potential water and food source for animals during the dry season (Tegegne *et al*., 2007), and may reduce the negative effects of drought on animal performance. Cactus pear has been traditionally used for livestock feeding in Brazilian semi-arid region and has been studied in many countries (Wanderley *et al*., 2002; Melo *et al*., 2003; Ben Salem *et al.*, 2004; Misra *et al*., 2006; Tegegne *et al.*, 2007) where it represents the main forage source during the dry season. This type of forage is adapted to semi-arid and is able to yield great amounts of fresh water per cultivated surface because of its high moisture and mucilage-rich composition. Cactus pear has low levels of dry matter (DM) (10–14%), crude protein (4–6%) and neutral detergent fiber (26.8%) (Melo *et al*., 2003). On the other hand, it is an excellent energy source, rich in nonfibrous carbohydrates (61.7%) and presents high dry matter digestibility coefficient (Wanderley *et al*., 2002). Besides, cactus pear contains significant levels of calcium, potassium and magnesium (Santos *et al*., 1997). The high water level in cactus pear represents an important alternative to supply water requirements of animals in arid and semi-arid regions, where water may be a limiting factor for animal production. Nevertheless, animals fed exclusively with cactus pear may present weight loss, decreased milk fat (Santos *et al*., 1990) and also digestive disturbances such as diarrhoea and distended tympanic abdomen (Tegegne *et al*., 2005). Cactus pear associated with other fibre sources increases DM levels in diet and keeps normal conditions in the rumen, thus preventing such undesired effects (Mattos *et al*., 2000). Supplementation with cactus pear did not reduce rumen pH, since the high mucilage and mineral levels stimulated saliva production and pH buffering (Ben Salem *et al*., 1996). Cactus pear was shown to be an important resource for reducing water intake in lactating goats.

Cactus is a xerphytic plant and an emergent crop, which evolved commercially during the second half of the XX century. The plant probably originated in Central Mexico, the region presenting the widest germplasm variability as well as the larger number of uses. The species of the Opuntia spp. Subgenus have developed phonological, physiological and structural adaptations favourable to their development in arid environments, in which water are the main factor limiting the development of most plant species. Among these adaptations stand out its asynchronous reproduction, and its metabolism, which combined with structural adaptations such as succulence, allow this plant to continue assimilation of carbon dioxide during long periods of drought and in this way reach acceptable productivity levels even in years of severe drought. The physiological features conferring cactus pear drought tolerance, its adaptability and its utilization as human food and animal feed, as well as its suitability for recovery for degraded lands of semiarid tropics, have raised global interest and driven the most recent trend of dispersal. Nowadays, the domesticated cactus is found in North America and South America and may countries of Africa, Asia and Middle East. The establishment of sustainable production systems based on cactus may contribute to the food security of populations in agriculturally marginalized areas and to soil improvement. Cacti are some of the best plants for the reforestation of arid and semiarid areas because they can resist scarce and erratic rainfall and high temperatures.

Cactus belongs to the family *Cactaceae*. The family *Cactaceae* contains about 130 genera and the prickly pear cactus (*Opuntia ficus-indica*) belongs to the genus *Opuntia* (Russell and Felker, 1987). Cactus withstands water shortage, high temperature and poor soil fertility (Barbera, 1995), and thus adapted to the arid and semi-arid zones of the world. Ben Salem *et al*. (1996) also noted the increased importance of cactus as livestock feed in arid and semiarid zones due to its drought resistance, high biomass yield, high palatability and tolerance to salinity. In many arid areas, farmers use cactus extensively as an emergency forage that is harvested from both wild and cultivated stands to prevent the disastrous consequences of frequent and severe droughts. Worldwide about 900,000 ha of cactus are cultivated for forage production (FAO, 2001). Cactus is highly palatable and in conjunction with conventional roughage sources can maintain adult sheep during scarcity of feeds (Sirohi *et al.*, 1997). Moreover, the succulent pads of cactus serve as source of water for livestock in dry areas. In arid and semi-arid areas of Ethiopia, cactus serves to bridge the gap of feed shortage during the dry season. Cactus cladodes are extensively used under extreme droughts in arid and semi arid areas of Tunisia as low-cost nutrients and water resources for livestock. Cladodes of spineless cactus (*Opuntia ficus indica* f. *inermis*) are rich in water, sugar and calcium, but low in crude protein (CP) and fiber (Ben Salem *et al*., 1996). Cladodes of spiny cactus (*Opuntia amyclae*) should be burned for using them in livestock feeding which represent a risk for rangeland degradation and is time consuming. The appropriate use of spineless cactus could be an alternative although the opinions about the benefit from feeding spiny or spineless cactus cladodes are controversial (Cordier, 1947; Hanselka and Paschal, 1990) although the content of some nutrients (*i.e.* water, mucilage and ADFom) changed with season, gas production from spineless and spiny cactus cladodes fermentation, either fromwinter or summer, was similar. Diets based on spineless or spiny cactus promoted similar VFA and bacterial N production and efficiencies. Spineless cactus (*Opuntia f ´ıcus-indica* Mill and *Nopallea cochenillifera* Salm and Dyck) is an important feed for ruminants in north-east of Brazil especially, during the dry season (Dubeux *et al*., 2006). There is an estimated 400,000 ha under cactus cultivation in north-east Brazil and the most cultivated species are *Opuntia ficus-indica* and *Nopalia cochenillifera* (Santos and Albuquerque, 2002). Unlike other forages, cactus contains high levels of water soluble and non-fiber carbohydrates (NFC), and low concentrations of cell wall fibers and crude protein (CP). On average spineless cactus contains (dry matter basis, DM) 168 g/kg ash, 62 g/kg CP, 278 g/kg neutral detergent fiber (aNDF), 479 g/kg NFC and 74 g/kg galactorunic acid

(Batista et al., 2003). Due to its high NFC and low fiber concentrations, cactus is characterized by rapid ruminal degradation (Ben Salem et al., 2002a,b; Batista et al., 2003). In the north-east region of Brazil, high levels of cactus are usually fed to ruminants during the dry season due to the lack of other forages. However, due to its high ruminal degradability and laxative effect, feeding high levels may result in digestive problems and eventually reduce animal performance (Nefzaoui and Ben Salem, 2001). A recent study reported digestive disturbances, such as bloat and diarrhoea when high levels of cactus (600 g/kg of the diet DM) was fed to sheep (Gebremariam et al., 2006). Inclusion of a non-bloat forage can be an effective strategy to reduce the incidence of digestive disturbances when high levels of cactus are fed.

Spineless cactus had a high water content of 880 g/kg fresh weight (Table 1). The cactus pads had high ash (mineral content), especially calcium (45 g/kg DM), but the phosphorus concentration nwas 2.6 g/kg DM, making the ratio of calcium to phosphorus 17:1. The soluble carbohydrate of cactus was over 251 g/kg DM, whereas itwas only 130 g/kgDMin the basal diet. Also the CP content of cactus (83 g/kg DM) was higher compared to that of tef straw (76 g/kg DM). However, high contents of NDF and ADF were determined in tef straw compared to that in cactus pads. Cactus was readily consumed and the animals preferred it to tef straw. Consumption of cactus dry matter intake (DMI) increased with increasing level of cactus inclusion. Tef straw DMI decreased ($P<0.05$) as the proportion of cactus offered increased. Total DMI was least ($P<0.05$) in animals offered the highest level of cactus DM inclusion compared to the other treatments. Offering tef straw without cactus inclusion (T1) also promoted lower ($P<0.05$) DMI than T2. In T3 and T4, cactus DMI was 0.43 and 0.6 of the total DMI, respectively, indicating that the animals preferred it to tef straw. Feeding animals on cactus may satisfy the water requirement of animals and thus serve to mitigate water problems in the dry season and during drought. Moreover, cactus may improve the nutritive value of poor quality roughage due to its high content of soluble carbohydrates. It may promote reasonable live weight gain in sheep fed on tef straw provided that a small quantity of CP source is also included in the die

Created in early 90s, today the FAO International Technical Cooperation Network on Cactus (FAO-Cactusnet) includes more than 50 countries from all continents and aims actively to: (i) collect and disseminate information on production and planting, trade and markets, crop research, post harvest and processing and cochinilla on cactus pear; (ii) cooperate in the collection, conservation, exchange, evaluation and utilization of germplasm and monitor progress and usefulness of such exchanges; (iii) promote the ecological and social benefits of cactus pear; (iv) develop new food and carminic acid uses; and (v) exchange expertise and organize training courses, workshops and meetings of experts in order to improve technical capability of collaborating institutions. The network has regional representatives, country focal points, and scientific working groups that include, biology, fruit production, forage and rangelands, cochineal, plant genetic resources collection, conservation and evaluation and agro industries and post harvest physiology. In addition, the Network is closely collaborating with FAO to disseminate and use cactus in new emerging countries through the development of technical cooperation projects

1.d. Specific objectives of the action

Objectives

- To reduce negative environmental and social impacts
- To enhance sustainability of agro-ecosystems
- To enhance sustainability of rural communities
- To combat rural poverty
- To ensure food security
- Ecological management of productive resources
- Empowerment of rural communities
- To improve efficiency of farm systems

1- **Assessment of drought threatened areas and livestock feed shortage in Nahr Al Nil state** .This deals with the identification of sites threatened by sand movement, monthly distribution of livestock, estimation of annual livestock feed shortage, current feed resources, quantities utilized and sale price

2-**Identification of beneficiaries** (livestock owners in the drought threatened areas) and their **organization** into beneficiary groups on regional basis. **Initiation of meetings** with members of each beneficiary group to elect 10 of its members to attend training in cactus cultivation and harvesting, feed processing technologies and animal nutrition.

3- **Conduct training for elected members of beneficiary** groups in cactus cultivation and harvesting, technologies used to treat cactus cladodes as animal feed to upgrade their nutritional value and palatability.

4. **Organize demonstrations** for practical cultivation and harvesting of cactus and feeding of treated cactus to ruminants.

5- **Visit** the beneficiaries **and respond** to their remarks on cactus cultivation, feed processing technologies and livestock performance on treated cactus in order to improve methodologies and maximize benefits from the action.

1-c: Means of realizing objectives

Item	Methodology	Duration	Professional staff	Assistant staff	Outcome
1- **Assessment of drought threatened areas and livestock feed shortage in Nahr Al Nil state**.	Field trips will be made to all localities of Nahr Al Nil state in order to identify the sand movement threatened areas and quantify livestock feed in each locality and regions inside each locality. A questionnaire will be used (see Annex1)	4 months	1.Project co-ordinator 2. A staff member of the veterinary authority in Nahr Al Nil. 3- A staff member of the forestry department in Nahr Al Nil. 4- A staff member of the horticultural department in Nahr Al Nil. 5. A staff member of the pasture and forage department in Nahr Al Nil. 6.Facilittors	1. Enumerators. 2-Facilitators. 3-Technicians.	Assessment report.
2- Identification & organization of beneficiaries	a. Organization of beneficiaries (livestock owners) inside localities into groups according to their settlements. b. Election of 10 livestock owners by members of each beneficiary group to attend training	1 month	1.Project co-ordinator 2. A staff member of the pasture and forage department in Nahr Al Nil. 3. A staff member of the veterinary authority in Nahr Al Nil. 4.Community mobilization specialist	1-Facilitators.	1-Beneficiaries at community level organized into groups. 2-Ten freely elected individuals in each beneficiary group to attend training.
3- Training in cactus cultivation and harvesting	a. Training of elected members of beneficiary groups on cactus cultivation and harvesting	2 months	1. Horticulture specialist	1- Facilitators. 2-Technician.	300 elected members of beneficiary groups trained the basics of cactus cultivation and harvesting
3-Training in the basics of animal nutrition	a. Training of elected members of beneficiary groups on the basics of animal nutrition, feed conservation and storage.	2 months	1.Animal Nutrition specialist	1- Facilitators. 2-Technician.	300 elected members of beneficiary groups trained the basics of animal nutrition and feed conservation..

3- Training in technologies used to upgrade the nutritional value of cactus.	a. Training of elected members from beneficiary groups (Details of technologies are given in Annex II).	3 months	1.Feed technology specialist	1- Facilitators. 2-Technician.	300 elected members of beneficiary groups trained in technologies to upgrade nutritional value of cactus
4-Demonstrations in planting, harvesting and feeding treated cactus to livestock	Demonstration of feeding treated cactus to livestock	1 month	1.Animal Nutrition specialist	1- Facilitators. 2-Technician.	300 elected members of beneficiary groups shown demonstrations in feeding cactus to livestock.
5-Visits to beneficiary groups	Visits to all beneficiary groups to discuss and listen to comments on the performance of livestock on treated cactus	2 months	1-Co-ordinator 2.Animal Nutrition specialist	1- Facilitators.	Remarks and comment collected and feedback to comments made.

e. Methodology

There will be participatory involvement of members of the community in the inception, planning and implementation process because this will ensure that relatively complete, accurate, detailed information on livelihood strategies are captured. For the process to be effective, the stakeholders must be intimately aware of the ATTS process, their respective roles and responsibilities. The participatory process contributes to the building of awareness and most importantly catalyzes and creates a sense of ownership.

First phase of training for personnel in relevant government, NGOs and farmers (2010 - 2011)

Initially, the emphasis on conducting training in the field around the participatory training development (PTD) processes of cactus plantation. From the second year onwards, training of the trainer (ToT) programs in for government officials in the relevant institutions (animal resources authorities, pastures and forage department, livestock owners locality, forestry department in the state), and farmers with proven training capacity.

Training consists of:

- A long training process starting in year 1 and continuing in years 2 and 3
- Strategic workshops for NGOs (closely involved in field-level implementation) farmers and government personnel from year 1
- ToT process for government and NGOs trainers and farmer trainers who after three years take over the management and implementation of cactus plantation

Men-women participation in training program will be considered, a minimum should be 30% women. To enable women to participate, flexibility regarding training timing and venue will be considered. Participation of men and women will be closely monitored during the season. Reasons for dropout will be recorded.

Modules for the season-long training

- Participatory training concepts and approach
- Identifying problems and possible solution
- Gender mainstreaming in the participatory approach
- Step-wise field-based training with focus on the technical aspects of the problems identified and technologies being tested
- Monitoring of the participatory approach development (PTD) process
- Evaluating the results of the experiments and the process of experimentation

Second phase: scaling up, with emphasis on strategic linkages, ToT and monitoring

After three years the trained NGOs, government personnel and core group of farmer trainers are expected to be able to carry on by themselves. ATTS continues to support, but at different level:

- ATTS monitors field-level training and participatory training development activities implemented by the stakeholders (NGOs, government personnel and farmer trainers)
- ATTS shifts the emphasis of its work to creating a conductive environment for farmer groups and NGOs to take cactus technologies processes further

- Meetings with beneficiary group discussion and elections of individuals who will undergo training.
- Theoretical lessons.
- Practical hand-on-work training in cultivation, harvesting and treatment of cactus to upgrade its nutritional value and palatability.
- Illustrations and films.
- Group discussion.
- Demonstrations

Sustainability

- **Sharing between farmers, NGOs and government officials and ATTS**

Sharing between the primary stakeholders in this process takes place in several ways: during the weekly field visits of the NGO, during training conducted by ATTS, at the monthly review meetings between ATTS and the NGOs and at a meeting with farmers and the NGOs to evaluate the results of the action.

- **Involvement of researchers in field-level experiments**

Researchers and government extension staff will be invited to join at important stage of participatory training development process. In the participatory stage researchers are asked to share their knowledge about suitable technologies. Once the experiment has started, they are invited at regular intervals and to give inputs into the season long training. Again at the end of the season, they are invited to join in evaluation of the experiment. Specific field days will be organized where researchers, government officials, farmer groups from neighbouring villages and the local press are invited to visit the cactus plantations and have discussion with the experimenting farmers

- **Shifting role in implementation**

Gradually the NGOs assumes greater responsibilities taking over some of the ATTS roles. They will start facilitating participatory training development processes on their own.

Risks and constraints
For the transfer of responsibilities to be successful turnover of staff should be minimal, also the facilitating processes requires considerable experience and sensitivity. Not all NGOs are strong enough to anchor such processes; some might feel the process is time consuming. The inherent limitation of PTD is that it requires quality inputs (process-wise, technically, socially and strategically). Also its impact should be measured in qualitative rather than quantitative terms. In ToTs not everyone might become good facilitator, but at least they should communicate clearly with farmers about the proven technologies. Models of institutionalization that can be replicated and taken further to scale by others need to be evolved

e. Potential added value

The action will demonstrate to livestock owners' methods of cactus cultivation and harvesting. This will increase their awareness about using cactus as a barrier against sand movement.

The action will select and train some livestock owners on basic animal nutrition and technologies to upgrade quality of cactus .This will encourage the use of farmer-to-farmer extension model to enhance the spread of good nutritional management and cactus treatment technologies among other livestock keepers in the community.

	Unit Cost US $	Unit Quantity	Unit Type	Year 1	Year 2	Year 3	Total
Project Support Costs							
Professional Project Staff							
Project Manager	4000	36	month	48,000	48,000	48,000	144,000
Field inspector	2000	3	month	6,000	-	-	6,000
Nursery technicians	2000	2	month	4,000	-	-	4,000
Skilled labours	2000	2	month	4,000	-	-	4,000
Propagation trainer	2000	3	month	6,000	-	-	6,000
Harvesting trainer	2000	3	month	6,000	-	-	6,000
Feed processing specialist	2000	3	month	2,000	2,000	2,000	6,000
Horticulture specialist	2000	3	month	2,000	2,000	2,000	6,000
Veterinarian	700	28	month	8,400	8,400	8,400	25,200
Subtotal				**86,400**	**60,400**	**60,400**	**207,200**
Supplies							
Seeds &/ or pads			Package	12500	7500	5000	25000
Cultivation tools			Set	5000	3000	2000	10000
Shed for planting nursery			Shed	3750	2250	1500	7500
Land preparation				42750	25650	17100	85500
Fertilizers & peat moss			sac	120000	72000	48000	240000
Feed processing tools			Set	5000	3000	2000	10000
Subtotal				**189000**	**113400**	**75600**	**378000**
National Support Staff							
Secretary	500	36	month	6,000	6,000	6,000	18,000
Accountant	700	36	month	8,400	8,400	8,400	25,200
Facilitator	700	36	month	8,400	8,400	8,400	25,200
Enumerator	400	5	month	2,000	-	-	2,000
Guard	200	36	month	720	720	720	21,600
Cleaner	200	36	month	720	720	720	21,600
Car driver	500	36	month	6,000	6,000	6,000	18,000
Subtotal				**32,240**	**30,240**	**30,240**	**131,600**
Transportation							
Khartoum-Shendi return travels	100	18	Ticket	1800	1800	1800	5400
Shipment of seeds	1000	3	Trip	1000	1,000	1000	3000
Subtotal				**2800**	**2800**	**2800**	**8400**
Vehicle and Running Costs							
Vehicle rentals	4500	36	month	54,000	54,000	54,000	108,000
Vehicle running costs & fuel	1500	36	month	18,000	18,000	18,000	54,000
Subtotal				**72,000**	**72,000**	**72,000**	
Other Office Costs							
Office Rental	1200	36	office	14,400	14,400	14,400	43,200
Utilities (water and electricity)	1300	36	bill	15,600	15,600	15,600	46,800
Telephone / fax	1000	36	month	12,000	12,000	12,000	36,000
Postage / Courier	200	36	month	2,400	2,400	2,400	7,200
Stationary / Supplies	1000	36	month	12,000	12,000	12,000	36,000
Maintenance	1000	36	month	12,000	12,000	12,000	36,000
Documentation / Reporting	1000	36	month	12,000	12,000	12,000	36,000
Advertising / Visibility	1000	36	month	12,000	12,000	12,000	36,000

Planning timetable:

Activity↓ Month→												36
Field survey												
Identification & organization of beneficiaries												
Training basic cactus cultivation, harvesting and animal nutrition & management												
Cactus cultivation and harvesting demonstrations												
Cactus feeding demonstrations												
Follow up visits to beneficiary groups												

Expected output

- Training is a way to get more skilled livestock owners in animal nutrition and feeding at times of feed scarcity. Thus they manage their animals in the best way in the dry season and reduce the side effects of feed shortage.
- The success of this action will encourage other states of the same desertification problems and facing feed shortage to quote it.

outcomes

- ❖ Stakeholder analysis and local organization process
- ❖ Better understanding of ago-ecological market potential and trade-offs
- ❖ Better understanding of constraints and opportunities
- ❖ Assessment of the effects of the intervention
- ❖ Intermediate outcomes, economic, social and environmental
- ❖ Demand for land-use management options
- ❖ Increased awareness and collaboration
- ❖ Sustainable land-use management
- ❖ Adoption of technology and food security
- ❖ Poverty alleviation
- ❖ Well-being and capabilities improved

BIBLIOGRAPHY

Batista, A.M.V., Mustafa, A.F., Santos, G.R.A., Carvalho, F.F.R., Dubeux Jr., J.C.B., Lira, M.A., Barbosa, S.B.P., 2003. Chemical composition and ruminal dry matter and crude protein degradability of spineless cactus. Short communication. J. Agron. Crop Sci. 189, 123–126.

Ben Salem, H., Ben Salem, I., Nefzaoui, A., Ben Sa¨ıd, M.S., 2003. Effect of PEG and olive cake feed block supply on feed intake, digestion, and health of goats given kermes oak (*Quercus coccifera* L.) foliage. Anim. Feed Sci. Technol. 110, 45–59.

Ben Salem, H., Nefzaoui, A., Ben Salem, L., 2002a. Supplementing spineless cactus (*Opentia ficus indica* f. inermis) based diets with urea treated straw or oldman saltbush (*Atriplex nummularia* L). Effects on intake, digestion and sheep growth. J. Agric. Sci. 138, 85–92.

Ben Salem, H., Nefzaoui, A., Ben Salem, L., 2002b. Supplementation of acacia Cyanophylla Lindl. Foliage based diets with barley or shrubs from arid areas (Opentia ficus indica f. inermis and Atriplex nummularia L) on digestibility and growth in sheep. Anim. Feed Sci. Technol. 96, 15–30.

Ben Salem, H., Nefzaoui, A., Ben Salem, L., 2004. Spineless cactus (*Opuntia ficus-indica* f. inermis) and oldman saltbush (*Atriplex nummularia* L.) as alternative supplements for growing Barbarine lambs given strawbased diets. Small Rumin. Res. 51, 65–73.

Ben Salem, H.,Nefzaoui,A.,Abdouli, H., Orskov, E.R., 1996. Effect of increasing level of spineless cactus (*Opuntia ficus-indica* var. inermis) on intake and digestion by sheep fed straw-based diets. Anim. Sci. 62, 293–299.

Cordier, G., 1947. De la composition de quelques produits fourragers tunisiens et de leurs valeur pour l'alimentation du mouton. Ann. Serv. Bot. Agron. Tun. 20, 22–108.

Dubeux, J.C., Ferreira dos Santos, M.V., Andrade Lira, M., Cordeiro dos Santos, D., Farias, I., Lima, L.E., Ferreira, R.L.C., 2006. Productivity of *Opuntia ficus-indica* (L) Miller under different N and P fertilization and plant population in north-east Brazil. J. Arid Environ. 67, 357–372.

FAO, 2001. *Opuntia* as Forage. FAO Plant Production and Protection Paper 169, Rome, pp. 1–4.

Gebremariam, T., Melaku, S., Yami, A., 2006. Effect of different levels of cactus (*Opuntia ficus-indica)* inclusion on feed intake, digestibility and body weight gain in tef (*Ergagrostis tef*) straw-based feeding of sheep. Anim. Feed Sci. Technol. 131, 41–52.

Mattos, L.M.E., Ferreira, M.A., Santos, D.C., 2000. Association of cactus pear (*Opuntia ficus indica* Miller) with different fiber sources for feeding 5/8 Holstein/Zebu lactating cows. Rev. Bras. Zootec. 29, 2128–2134.

Melo, A.A.S., Ferreira, M.A., Veras, A.S.C., et al., 2003. Substitution of soybean meal for urea and cactus pear (*Opuntia ficus-indica* Mill.) in diets for lactating cows. I. Performance. Rev. Bras. Zootec. 32, 727–736.

Misra, A., Mishra, k., Tripathi, A.S., Chaturvedi, M.K., Vaithiyanathan, O.H., Prasad, S.R., Jakhmola, R.C., 2006. Intake, digestion and microbial protein synthesis in sheep on hay supplemented with prickly pear cactus [*Opuntia ficus-indica* (L.) Mill.] with or without groundnut meal. Small Rumin. Res. 63, 125–134.

Nefzaoui, A., Ben Salem, H., 2001. Opuntia spp. A strategic fooder and efficient tool to compact desertification in tWANA region. In: Mondrag´on-Jacobo, C., P´erez-Gonz´alez, S. (Eds.), Cactus (Opuntia spp) as Forage, Plant Production and Protection Paper, vol. 169. FAO, Rome, Italy.

Russell, C.E., Felker, P., 1987. The prickly pear (*Opuntia* spp., *Cactaceae*): a source of human and animal food in semi-arid regions. Econ. Bot. 41, 433–445.

Santos, D.C. and Albuquerque, S.G., 2002. Opuntia as fodder in the semi-arid northeast Brazil. In: Mondrag´on-Jacobo, C., P´erez-Gonz´alez, S. (Eds.), Cactus (Opuntia spp) as Forage, Plant Production and Protection Paper, vol. 169. FAO, Rome, Italy, pp. 37–50.

Santos, D.C., Farias, I., Lyra, M.A., Tavares Filho, J.J., Santos, M.V.F., Arruda, G.P., 1997. Cactus pear (*Opuntia ficus-indica* Mill) and (*Nopalea cochenillifera* Salm.Dyck) in Pernambuco: Cultivation and Utilization.Recife, Brasil, Empresa Pernambucana de Pesquisa Agropecuária. Documentos IPA 25, 23.

Santos, M.V.F., Lira, M.A., Farias, I., et al., 1990. Comparative study of cactus pear cultivars gigante, redonda (*Opuntia ficus indica* Mill) and miúda (*Nopalea cochenillifera* Salm-Dyck) for milk production. Rev. Bras. Zootec. 19, 504–511.

Sirohi, S.A., Karim, S.K., Misra, A.K., 1997. Nutrient intake and utilization in sheep fed with prickly cactus. J. Arid Environ. 36, 161–166.

Tegegne, F., Kijora, C., Peters, K.J., 2007. Study on the optimal level of cactus pear (*Opuntia ficus-indica*) supplementation to sheep and its contribution as source of water. Small Rumin. Res. 72, 157–164.

Tegegne, F., Peters, K.J., Kijora, C., 2005. Cactus pear (Opuntia ficus indica): a strategic crop in combating food and feed insecurity and desertification in Tigray, northern Ethiopia. Proc. Sco. Nutr. Physiol. 14, 60.

Wanderley, W.L., Ferreira, M.A., Andrade, D.K.B., Véras, A.S.C., Farias, I., Lima, L.E., Dias, A.M.A., 2002. Replacement of forage cactus (*Opuntia ficus indica* Mill) for sorghum silage (*Sorghum bicolor* (L.) Moench) in the dairy cows feeding. Rev. Bras. Zootec. 31, 273–281.

Annex 1

Through employment of agro-ecological principles and the use of agricultural technologies customized to local needs and circumstances, ATTS seeks to conserve and regenerate the deteriorated resource base of farms. In the process of achieving these objectives ATTS produce a broad range of impacts that reduce social, economic and environmental vulnerability. Reduction in these vulnerabilities is the one of the fundamental desired outcomes of sustainable economic process for small scale farmers in many parts of Sudan. The concept of integrated approach to planning management of environmental, resource and sustainability issues has been accepted by the government.

ATTS focus on providing benefits more directly to poor rural communities by simultaneously and directly addressing;

- Poverty alleviation
- Food security and self reliance
- The ecological management of resources
- The empowerment of local communities and the establishment of support services

Annex 2

The centre has been accredited a legal license from the Ministry of Labour, Public service & Human Development Resources, National Council Training Secretariat and provisional work permit from the Supreme Council for Vocational training & Apprenticeship.

The skills building training centre seeks to build the capacity of poor rural communities which responds to real local needs and is adapted to the specific local conditions. It is initiated with the aim to provide advice and technical assistance so as to contribute to poverty reduction by improving access of poor livestock producers to markets, goods and services, skills, knowledge and appropriate technologies and also to assess appropriate technologies and processes, and ways for their development, transfer and adoption in areas and systems of rapid livestock expansion and intensification. Activities carried on by the centre is expected to result in concrete and measurable improvements in the livelihoods and living conditions of the rural poor, thus contributing to the implementation of ***Chapter 14 of Agenda 21*** and achievement of the ***Millennium Development Goals*****.** Focusing on areas deemed essential to accelerate and make more rapid progress toward the Millennium Development Goals of eradicating extreme poverty and hunger *(MDG 1)* and ensuring environmental sustainability ***(MDG 7)***. Postgraduate students and research scientists could take advantage of advisory services and training programs provided by the action. The action may in future and with planned development attain a regional importance as a provider of training in livestock technologies to clients from neighbouring countries. The training program shall respond to requests by governmental and non-state actors to provide specific or tailored training programs in the area of animal production.

Banking instructions

Name of account Agricultural Technology Transfer Society.
Bank : Faisal Islamic Bank , University of Khartoum Branch
Account No.: 8029

Planning timetable:

Activity↓ Month→												12
Field survey	■	■										
Identification & organization of beneficiaries			■									
Training basic cactus cultivation, harvesting and animal nutrition & management				■	■	■						
Cactus cultivation and harvesting demonstrations							■	■	■			
Cactus feeding demonstrations										■		
Follow up visits to beneficiary groups											■	■