Forestland Degradation and Potential Rehabilitation in Southwest Saudi Arabia

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Abstract: The land area of Saudi Arabia is approximately two million square kilometers, it comprises different terrestrial habitats. Saudi Arabia is generally an arid country with a few exceptional sub-humid regions on the southwestern highlands. The southwestern highlands constitute one of the most fascinating and unusual ecoregions in the country with its sparkling mountain streams, forests drenched in mist and incredible high-altitude agricultural terracing. These highlands receive variable rainfall particularly during the summer with most rain falling in April/May and July/August and ranges between 600 and 800 mm, rising to over 1,000 mm in the wettest areas. Rainfall in this region is adequate for most crop requirements, as well as for forest cover, estimated at about two million hectares. Terraces are the most efficient method for combating soil erosion on steep lands. They are considered to be the best way to convert poorly productive lands into highly productive farms.

Unfortunately, the forestland in the southwestern region of Saudi Arabia is suffering from degradation represented by poor regeneration among the main tree species, spreading of die-back on juniper trees, and abandonment of the agricultural terrace systems. This degradation may be attributed to different factors including over grazing, expansion of urbanization at the expense of forest land, climatic change, and the migration of rural people to towns for higher education and/or work opportunities. Rehabilitation of the degraded forestland needs collaborative efforts and support from the different related governmental sectors as well as the locals. Protection, silvicultural practices, and sustainable management must be adopted as tools of rehabilitation.

Key words: Southwestern Saudi Arabia, forestland, agricultural terraces, degradation, rehabilitation.

INTRODUCTION

The importance of forests and trees is widely recognized. Forests and trees fulfill extremely important social, economic and environmental roles. The role of forests and trees for environmental protection is well known. They are crucial to land stabilization, watershed protection, desertification control, sand dune fixation, windbreaks, erosion control, agroforestry, soil fertility restoration and microclimate mitigation. They are also important sources of wood and non-wood forest products as well as browse for domestic animals. In addition, they are important habitats for wildlife and flora. Many communities over the world derive their livelihoods from the wide range of goods and services that forests provide.

Forests present a significant global carbon stock. Global forest vegetation stores 283 Gt (gigatons = a billion metric tons) of carbon in its biomass, 38 Gt in dead wood and 317 Gt in soils (top 30 cm) and litter. The total carbon content of forest ecosystems has been estimated at 638 Gt for 2005, which is more than the amount of carbon in the entire atmosphere. This standing carbon is combined with a gross terrestrial uptake of carbon, which was estimated at 2.4 Gt a year, a good deal of which is sequestration by forests (Joint Liaison Group of the Rio Conventions, 2008).

The natural forests of Saudi Arabia are located in the southwestern region. According to the data of the Ministry of Agriculture, there are 27,000 km² of woodland or 1.2 percent of the country’s national land area. Of this area, about 80 percent (21,000 km²) is scattered throughout the Sarawat mountain range in the southwestern region (NCWCD and JICA, 2006). These forests have been familiar with human life in this region for a long time, where it was an important source of woods that were used mainly for house constructions, cooking and warming. Unfortunately, these forests have been subjected to misuse mainly through intensive cutting and overgrazing.
In addition, they have not received the deserved care in terms of applying silvicultural practices and protection. Therefore, this forestland has been suffering from varying degrees and types of degradation due to both human-induced and natural factors.

The present article aims at reviewing the issue of forestland degradation in southwestern region of Saudi Arabia. It is a try to encompass the present status situation of this forestland in terms of its main physiographical features, its most important tree species, the problem of degradation and its forms and causes, the ongoing and suggests efforts to restore them. Forestland in this context is used to denote the whole area where the trees grow whether they are classified as closed forest or woodland or open woodland. Thus, the forestland includes agriculture terraces and pasture areas.

**Natural Forests in Saudi Arabia:**

The natural forests of Saudi Arabia is a mountainous area extended from Taif in the north to northeast Jazan. The mountains from Taif to Abha City are known as Sarawat or Aseer or Hejaz Mountains or (Assarah), while the northeastern Jazan area has separated mountains with different names such as Tallan, Al-hasher, Bani-Malk, Al-kaheer and Fyfa. This mountains area ranges in width from 10 to 40 km and the highest point of the Aseer – Jabal Soodah reaches 3050 meters above sea level in elevation (Chaudhary, 1997). The Sarawat Mountains are parallel to the Red Sea and extend for about 1,800 km (NCWCD and JICA, 2006).

The climate of the region varies considerably depending on altitude, aspect and season. The highlands receive variable rainfall caused by the southwestern monsoon, which brings damp oceanic winds. These winds are uplifted by the mountains and trigger thunderstorms, particularly during the summer, with most rain falling in April/May and July/August. Annual average rainfall in the Escarpment Mountains is 600-800 mm, rising to over 1,000 mm in the wettest areas. The high plateau receives 300-500 mm, dropping rapidly to below 100 mm in the east. Temperatures in the highlands are highest in the summer, reaching 20-25°C, and lowest in winter with a mean temperature of 10°C, although frosts can occur above 2,000 m and snow occasionally falls on the highest peaks (Miller, 1994).

A thousand years ago the mountains of the Hijaz and Asir were much more densely covered with woodlands according to old records. Only remnants of those forests, estimated at 2.7 million hectares, still remain in the mountains of Saudi Arabia particularly in the remote, steep and inaccessible areas (NCWCD, 2005). The southwestern mountainous region of Saudi Arabia is characterized by semi-arid climate which is suitable for the growth of certain non-xerophytic trees and shrubs. The entire southwestern region is the richest in terms of species diversity and contains the highest concentration of endemism, despite the fact that these high altitude areas are heavily populated with human settlements dating to ancient times (NCWCD, 2005). Woodlands of Juniperus procera Hochst. ex Endl. are present at altitude 3000 m. a. s. l. In the lower zones (~2000 m. a. s. l) other tree and shrubs (e. g. Olea europaea ssp. cuspidata, Pistacia palustina, Dodonaea viscosa Jacq. etc.) grow with Juniperus procera. In the zones less than 1000 m. a. s. l where there are noticeable changes in the climate conditions juniper trees disappear and Acacia spp. predominate (Zahran, 1999).

**Juniperus procera** is the most prominent component of vegetation at or above 1600 m elevation. It is present as Juniperus procera forest or Juniperus procera woodland or Juniperus procera open woodland or as co-dominant with some other tree species (Chaudhary, 1997). Juniperus procera represents approximately 95 per cent of the tree species grown in these forests (Abo-Hassan et al., 1984). Some researchers believe that the centre of origin of the African juniper is the southwestern region of the Arabia peninsula, from which it immigrated to the west across the Red Sea to the Ethiopian Highlands, then to Eastern Africa down to Tanzania (Spalt and Stem, 1959; Kerfoot, 1963-64b; Hora, 1981). In the northern part of Sarawat mountains, at about and north of the latitude 20° 20' N, the Mediterranean juniper, Juniperus phoenicea L. is found now in isolated patches and near Taif, there is an overlap of J. phoenicea and J. procera (Chaudhary and Le Houerou, 2006). Juniperus procera communities are found at or above 900 m elevation in almost pure form while mixed with Olea europaea and Acacia sp. at the lower elevation (Abo-Hassan et al., 1984; Aref, 1996; Bady, 1997). Beside Juniperus procera, Olea europea ssp. cuspidata and Acacia spp., the forest area comprises also other forest species such as Barbeya oleoides Schweinf., Celtis Africana Burm.f., Dodonaea viscosa, Ficus salicifolia Miq., Euryps arabicus Steud. ex Jaub. & Spach, Tarchonanthus camphorates L.

Forests in Saudi Arabia are considered of the renewable natural resources that play an important role in the ecosystem of the Kingdom in view of its extensive area and diverse environment. They provide protection to such areas by preserving the soil from water and wind erosion. They also help in the distribution of water and control its flow, and consequently the increased moisture in the soil. In addition, forests have economic, recreational, scenic, touristic and climatic moderating values (Johannesburg Summit, 2002).
The juniper woodlands provide construction materials and firewood, grazing and beekeeping areas, and other benefits mainly for the local inhabitants. In contrast, their indirect function is to provide benefits not only for the local population, but for the inhabitants of the entire province, the national population, as well as the world at large. They are home to a variety of families, genera, and species of living organisms. These forests as a part of the global forest vegetation play a vital role in storing amounts of carbon in its biomass and soils.

**Agriculture in Forestland:**

The most widespread agricultural system in the southwestern region of Saudi Arabia is located in the mountainous areas as man-made terraces and has been practiced since ancient times. The terrace fields are constructed by leveling a section on the slopes of the mountain to form steps (in Arabic masateb or mudarajat), the width of which depends on the steepness of the slope. As the population increased with time, terraces were extended up and down the slopes of mountains (Kanbour, 2003). These steps are reinforced on the edges by walls of rock to prevent soil erosion and to allow maximum water absorption. Land terraces system is a method for using rainwater to irrigate mountain slopes and meanwhile conserving water and soil.

Al-Turbak (1999) mentioned that terracing system collects rainfall for farming and slows it down the runoff process. Rainwater collects in the terraces and soaks into the shallow soil. Walls at the edge of the terraces prevent runoff from flowing down to the next terrace except during intense rainfall events. The walls of the terraces are built of stones, while voids between the stones allow water to move down to successive terraces without eroding the soil. Water can also move from level to level near the sloping bedrock. The terraces also trap fine sediment. They are designed and constructed in a manner to allow the passage of runoff through sheet flow, which prevents damage to the terraces from runoff concentrating at certain points.

There are no historical documents regarding the origin and diffusion of artificial terraces in this area (Al-Shomrany, 1980). It is said that terracing system has been first developed by the Phoenicians along the western coast of the Mediterranean and practised in northern Africa and the Arabian Peninsula (Al-Turbak, 1999). We believe that agriculture terraces in the southwestern highlands of Saudi Arabia were developed on forestland that was covered with trees. This was done by felling trees and clear area for constructing terraces gradually according to the increase in population. The coexistence of agriculture terraces and trees in the observed present landscape suggests that the area was dominated by forests. This is supported by the fact that juniper trees have never been planted in this area before the year 2001 (Aref and El-Juhany, 2004). World Wildlife Fund (WWF, 2001) asserted that terraced agriculture has replaced native forest in the Asir highlands. Judging by the patches of forest scattered through the region, Assarah must originally have had a continuous woodland cover (Al-Shomrany, 1980). This is true as in its natural condition; land is covered by forest trees and other natural vegetation (Karkee, 2004).

Moreover, McGuire and Wilkinson (20) in their report about the investigation of terracing system in Yemen recorded numerous exposures of a dark organic soil that had apparently pre-dated the construction of terraced fields. This soil indicates that, before the creation of terraced agriculture, the mountain slopes were stabilized, probably with forest.

More than 27,000 hectares of rained terracing located at an elevation of 1700 m or more are being farmed, and the terraces are cultivated twice a year. The number of terraces is estimated at 59,000 distributed in the areas of the Asir highlands (Al-Turbak, 1999). They are considered to be the best way to convert poorly productive lands into highly productive farms.

**Definitions:**

**Forestland:**

Although forest land has many national definitions, many of these definitions have the following in common: “All lands bearing vegetative associations dominated by trees of any size, exploited or not, capable of producing wood or other forest products, of exerting an influence on climate or on water regime, or providing shelter for livestock or wildlife. Includes lands which have been clear-cut or burned but which will be reforested in the foreseeable future, excludes orchards, shelter belts, groups of trees along roads or city parks” (Encyclopedia Britannica, 1970; IPCC, 1998). Another definition was presented by Lund (1999) as “Forestland would be any land that has tree cover above a certain threshold crown cover percentage. This would include orchards, urban areas, etc.

**Degradation:**

The degradation in natural environments is a concept used to describe the deterioration of an ecosystem as a result of natural processes or man-made activities.
Forest Degradation:
Forest degradation refers to changes within the forest class (e.g. from closed to open forest) which negatively affect the stand or site and, in particular, lower the production capacity. Thus, degradation is not reflected in the estimates of deforestation” (FAO, 1995b). Forest degradation goes back to the early history of humankind. Forest degradation and deforestation are often distinctly different processes. The former involves the loss of ecosystem services or changes in species composition due to various factors including overexploitation, plant parasites, exotic species invasion, pollution, or fires, while the latter involves the conversion of forest to another type of land cover (Sasaki and Putz, 2008). It is difficult to separate the causes from the effects of deforestation and forest degradation. Some direct causes of deforestation are land clearances for agriculture (including shifting cultivation), other land use changes including unplanned urbanization, land transfers, different forms of encroachments, over-grazing, uncontrolled and wasteful logging, illegal felling, and excessive fuelwood collection (National Action Programme of Combat Desertification, India, 2001). Overgrazing and uncontrolled fires add to problems of land degradation, especially in sub-humid and dry lands zones (Arid zone forestry, 2008).

Degradation takes different forms, particularly in open forest formations, deriving mainly from human activities such as overgrazing, over-exploitation (for firewood or timber), repeated fires, or due to attack by insects, diseases, plant parasites or other natural causes (Contreras-Hermosilla, 2000). In most cases, degradation does not show as a decrease in the area of woody vegetation but rather as a gradual reduction of biomass, changes in species composition and soil degradation (Jinlong, 2004). Forest degradation often has different driving forces than deforestation, and degradation is not necessarily a precursor to deforestation. Forests can remain degraded for a long time, never becoming totally deforested (Murdiyarso et al., 2008).

Forestland Degradation:
Forestland severely damaged by the excessive harvesting of wood and/or non-wood forest products, poor management, repeated fire, grazing or other disturbances or land-uses that damage soil and vegetation to a degree that inhibits or severely delays the re-establishment of forest after abandonment (ITTO, 2002).

Forest Rehabilitation:
Forest rehabilitation is a management strategy applied in degraded forest lands that aims at restoring the capacity of a forest to produce products and services. The rehabilitation of degraded forest land, applied where the site is so heavily degraded that the spontaneous regeneration of tree and shrub species is severely limited (ITTO, 2002).

Indications of Forestland Degradation:
The area of forestland in the southwest Saudi Arabia has a long history of overexploitation and degradation. So that most forests are now classified as other wooded land, but there is still a small percentage of closed forests in the hills and mountains (ACSAD, 2003). At present, there are indications of forestland degradation in various parts of the region; however, there are no statistics on its extent and severity. Al-Shomrany (Al-Shomrany, 1980) postulated that excessive deforestation in the region is clearly evident and can be attributed to various causes. The most obvious indications of forestland degradation in the southwestern region of Saudi Arabia can be summarizing as the following:

• Low capacity of natural regeneration of the main forest species
• Spread of gaps in forest cover
• High proportion of irregular trees (curved, twisted, cleft, multi-stemmed, dwarfish, Leaning, etc.); in particular Juniperus procera
• High proportion of deteriorated trees (partly cut, fully cut, burned, etc.)
• Existence of a number of dead trees
• Disappearing of the most larger trees
• Noticeable eroded soil
• High number of abounded agriculture terraces
• Destroyed agriculture terraces
• Loss of shiny appearance of trees
• Die-back and die-off of trees
• Spread of forest fires
• Marked wood cutting
Some of the aforementioned indications of forestland degradation have been presented in a number of publications. In fact, the research work on this issue is rather limited. In the following, I will present, in brief, the most relevant conclusions from a number of articles.

Extensive decline has been reported in the mountain juniper woodlands of Arabia. In these areas, the decline is characterized by dieback at the lower altitudinal ranges of the woodlands and is a matter of concern. Available evidence indicates drought and/or climatological cause in addition to old age without removing dried branches for fuelwood (NCWCD, 2005). In Saudi Arabia, the overall health of Juniperus procera woodlands in the Sarawat Mountains is generally considered to be poor, with extensive decline and dieback (Ma, 2008). Aref and El-Juhany (2000) mentioned that the main problems that are facing the forests in the southwestern region of Saudi Arabia at present are the loss of environmental equilibrium as a result of changes made in the natural streams caused by building roads, declining biodiversity due to use the forests as parks that forced many of the wild animals to escape and others (like monkeys) to increase with increasing the wastes and, finally decreasing the area of these forests as a result of the random expanding in constructional and agricultural activities and fires.

Barth and Strunk (2000) reported that the trees in Al-Soudah family park in Asser mountains show obvious signs of degradation for some years and on several areas within the family park more than 50% of the trees are already dead or extremely damaged. Moreover, most of the dead branches were cut and the relatively flat area shows dramatic signs of soil erosion. They added that degradation processes may have been initiated a long time ago by grazing activities. Harsh environmental conditions, felling of trees and shrubs, urban expansion in forest areas, high cost of re-forestation of areas which had lost their natural vegetation cover and shortage of forestry specialists are the most important problems facing the development and protection of the forests in Saudi Arabia (Johannesburg Summit, 2002).

ACSAD (2003) in its report on Sustainable Vegetation Cover Management in West Asia asserted that although the forest area in Saudi Arabia is limited but it is threatened by degradation due to deforestation, urban expansion and drought, especially around cities in southwestern highest and other recreation areas.

Juniper forests in the southwestern region of Saudi Arabia have become more susceptible to deterioration. This indicated by many gaps, symptoms of diseases on trees, low capacity of natural regeneration as may be noticed from the scarcity of seedlings (Aref and El-Juhany, 2000). They also added that the features of the deterioration of the juniper forests can be seen in large areas lost their trees and other areas stricken by dieback where many of their trees are partly or completely dead (die-off). Die-back of Juniperus procera trees is a phenomenon has occurred since about 30 years in the southwestern forests of Saudi Arabia and affecting other tree species, however, yet there is no a single reason has been accused in this problem (El-Juhany et al., 2008). The majority of the juniper woodlands are destroyed by the die-off and die-back phenomena which affect nearly all juniper woodlands to a greater or lesser extent and the signs of the phenomena are depending on places (NCWCD and JICA, 2006).

These forests have been subjected to misuse, intensive grazing, severe cut and different humanitarian activities. Consequently, large areas of the forest soil have lost their properties such as availability of organic matter, profile depth and moisture holding capacity that help growing trees naturally from seeds. However, there no real efforts have been directed so far toward preventing the deterioration of these forests or to replace the area loosed their cover; apart from the governmental legalization that issued before 30 years to protect these natural forest areas. Most of juniper trees have exceeded the age in which they must be exploited so that they deteriorated (Aref and El-Juhany, 2000). Regeneration of J. procera is reportedly very poor in parts of southwestern Saudi Arabia (Hajar et al., 1991).

Causes of Forestland Degradation:

The numerous features of forestland degradation in the southwestern region of Saudi Arabia must have resulted from intensive humanitarian and natural pressures over a long term. However, we believe that the way to restore this forestland has to be passed through determine the cause(s) of each feature and the
relationship(s) between different causes. Different authors suggested different causes of forestland degradation including low capacity of natural regeneration, misuse, over-exploitation, urbanization and climate change.

Aref and El-Juhany (2004) asserted that causes of this deterioration of Juniper forests in southwestern region of Saudi Arabia may attributed to extensive forest clearing for cultivation, over-grazing, and exploitation of forests for fuelwood and construction materials without replanting and this led to reducing the forest area of the country. El-Juhany et al. (2008) attributed the existence of irregular and deteriorated juniper trees in Ridah Reserve at Aseer Mountains to various factors such as the mechanical effects of wind, soil erosion, competition between trees, animal grazing and others. Barth and Strunk (2000) claimed that the degradation in this area (Al-Soudah family park in Aseer mountains) attributed to the intensive recreation and camping activities that destroy the vegetation cover and make the soil material susceptible to erosion. NCWCD and JICA (2006) reported that juniper woodlands have declined mainly due to human activities, such as tree felling, overgrazing, road construction, expanding farmland, building recreational facilities, and housing construction. FAO (2000) mentioned that extraction of wood from forests for fuel is believed to be one of the most important causes of forest degradation. Some reports tried to simplify the problem of forestland degradation in southwestern region of Saudi Arabia such as that of ACCAD (2003) when postulated that "...the most important hazards are represented in fire and cutting." Nevertheless this report stated elsewhere that this forest area is threatened by degradation due to deforestation, urban expansion and drought, especially around cities, towns, west southern highest and other recreation areas".

**Poor Natural Regeneration:**

Gardner and Fisher (1994) mentioned that human disturbance, grazing pressure and climatic change are the factors that could lead to poor regeneration in the *Juniperus* woodland on the Arabian Peninsula. While Aref and El-Juhany (2004) suggested that the presence of drought, disturbance caused by increasing recreation activity through forests, over-grazing, fires and the natural slow growth of juniper are the main causes of the decreased natural regeneration. This is true as natural regeneration is a feature of forest trees in their natural habitats and requires suitable environmental conditions for seed production, germination, and growth (Margolis and Brand, 1990). Some researchers attributed the low capacity of the natural regeneration in juniper forests to biological stresses caused by specific insects damaging juniper cones (Hajar et al., 1991). Other reports accusing tourism, ACCAD (2003) stated that unplanned activities and development of forest sites for recreational purposes have reduced the capacity for regeneration, produced solid waste problems and polluted forest water resources. In general, harsh climatic conditions limit forestry potential and restrict regeneration once forests are degraded (Abido, 2000a).

Forest fires can also be responsible for woodland degradation in dry lands because they clear up the woody vegetation, destroy the natural regeneration and young trees and kill the aged trees (Somboed and Sene, 1992). In many countries of the subregion (West Asia), population growth and increased demand on forest products, overgrazing, shifting of forestlands to agricultural use and urbanization are leading to overexploitation and increased degradation of the forest resources, resulting in the inability of the forests to regenerate (FAO, 1993). A lack of tree regeneration, owing to high levels of grazing and browsing by livestock, has been observed at several sites and may be a problem (IUCN, 2008). Moreover, mountain goats eat the young juniper woodlands and obstruct regeneration (JICA, 2002).

**Die-back:**

The features of the deterioration of the juniper forests can be seen in large areas lost their trees and other areas stricken by die-back where many of their trees are partly or completely dead (El-Juhany et al., 2008). Die-back affects juniper trees and considers the main problem facing the forestland not only in Saudi Arabia but in many other countries; however, there was no real progress toward detecting what is causing this dieback. Fisher (1997) upon surveying the condition of the juniper woodland of Raydah Reserve in southwestern Saudi Arabia proposed four hypotheses for the decline of the Arabian juniper woodlands. All the four hypotheses depend on climate change and were overgrazing, global warming, periodic droughts combined with long regeneration cycles and a long-term increase in aridity. The dieback of upper branches is normal during years of drought. But now the junipers at lower elevations over hundreds of square kilometers of forests have died in Saudi Arabia (Chaudhary and Le Houerou, 2006). On the other hand, the JICA team who worked jointly with NCWCD in examining the die-back problem in juniper forests of Saudi Arabia stated that although the cause of die-back has not been completely proven, the possibility is high that the damage seen in all the mountains of Jabal Tallan and Jabal Fyfa is due to global warming (JICA, 2002).
Overgrazing:

According to the Ministry of Agriculture in Saudi Arabia, “Forests National Work Plan and Strategy (2002) “Overgrazing is a major impediment to the regeneration of the juniper woodlands”. Juniper woodlands are being destroyed from trampling stemming from overgrazing and it is one of the causes of die-off and die-back (JICA-Japanese, 2002). In Saudi Arabia the vegetation has been so degraded that distances needed for grazing by the goats are such that their hooves are often worn out and tender, the animals then preferring to graze on their front knees! (Chaudhary and Le Houërou, 2006). The intensity of grazing in terms of time, number of animals per unit area plays the crucial role in affecting forest cover. For instance, the acacia woodlands in the southwestern region extend into the intermountain valleys and plains and onto the lower slopes of the adjoining mountains. These woodlands have been under extreme grazing pressure. Combined with woodcutting and charcoal making, these woodlands have suffered a lot. The vegetation within easy reach of the livestock has been overgrazed. There is absolutely no regeneration as the seedlings that come up stand no chance against the onslaught of the livestock. Most of the trees are old, and in some stands the pods are often infested with insects destroying even the seed! The palatable shrubs and herbs have suffered severe overgrazing and are often reduced to small, dense, individual clumps (Chaudhary and Le Houërou, 2006). Heavy grazing by livestock is believed to be the most widespread cause of vegetation and land degradation throughout the subregion (West Asia). In arid and semiarid zones, livestock density is above the carrying capacity for most of the year (Ma, 2008).

In the Asir Mountains there are no restricted grazing rights to using the woodlands and in principle all are free to graze their livestock there. But, in actuality, the majority of the livestock belong to nearby farms. There is no stipulation with regard to the average head of livestock owned by one farming household (NCWCD and JICA, 2006). As the Juniper forests are concerned, we were wondering if the twigs or needles of juniper tree are palatable for livestock or for some kinds of them. Chaudhary and Le Houérou (2006) answered this question when stated that “it is a fact that goats love juniper leaves and branches and the shepherd lop down branches of junipers to feed their goats. As a result of the goat browsing and of the cutting down of branching, the trees lose most of their moisture-harvesting canopy. The goats eat up the seedlings. The ‘nurse’ vegetation on the ground that protects seedlings is also destroyed through overgrazing or trampling. Most of the trees present apparently are ancient in age. Moreover, goats have the capability to stand up on their rare legs while sheep can not, because they can store large amounts of fat in the tail. Fat-tailed sheep are found in Africa, the Middle East, and Asia. Whatever, grazing is specifically harmful for coniferous forest ecosystems (Mountain, 2000). This because overgrazing and over extraction of green fodder, both lead to forest and land degradation through a loss of vegetation and physical deterioration in the form of compaction and reduced infiltration, and increase in soil erodibility (National Action Programme of Combat Desertification, India, 2001). Although the actual impact of overgrazing in the juniper woodlands has not been sufficiently clarified, it is certain that some kind of adverse effect has been produced (NCWCD and JICA, 2006). Some considers overgrazing as a sort of misuse of land (with other causes) lead to land degradation. For instance, GEF (2003) stated that the main causes of land degradation are inappropriate land use, mainly unsustainable agricultural practices; overgrazing; and deforestation. Sundquist (Sundquist, 2008) addressed an additional adverse effect of overgrazing. This is that overgrazing in open forests results in replacement of grasses by woody shrubs. Shrub fires destroy the trees, while grass fires are harmless in this regard. Restoring the trees in a typical semiarid forest takes on the order of a century.

Overcutting:

Forests provide a flow of benefits such as timber, non-wood forest products, carbon sequestration and wildlife habitat (Lipper, 2007). However, threats such as overcutting, overgrazing, urban expansion etc. can result in substantial reduction in this flow. This seems true because firewood extraction from forests (for instance) has been far exceeding the silviculturally permissible limit resulting in a rapid depletion of the forests (FAO, 2000). IUCN (2008) asserted that threats lopping, cutting and wholesale clearance of trees, for charcoal and firewood and for building/agricultural land are widespread and intensifying within the species's range and are known to have reduced the number of large trees at some sites since the late 1980s. Over-harvesting of wood for domestic energy and clearing of forest lands for agriculture also contribute to forest degradation and loss of forest cover. El-Juhany and Aref (2003) described the problem of firewood collection from forestland and other woodlands in Saudi Arabia. They stated that consumption of firewood is very large in Saudi Arabia because people traditionally use wood and charcoal for heating in winter and for cooking all over the year.

Illegal cutting of forest trees for firewood and charcoal has been a widespread commercial process comprises two phases; cutting the trees and converting them into pieces then selling those in the firewood
The Degradation of the Indigenous Terraces:

The research work regarding the degradation of agriculture terraces in Saudi Arabia is limited. The few publications in this field presented some suggestions for the degradation of this system. Abandoning the terraces and neglecting maintenance are the main causes of their degradation. We believe that both factors are a result of other causes. However, in addition to these two factors there are some other factors of terracing degradation. But, why the terraces are abandoned, and what lead to neglecting their maintenance? Before presenting the causes of terraces degradation, it is worth to know that terracing agricultural system in some parts of the world considers the main source of food for many people. Therefore, some deals with terrace degradation as more than a problem; as a crises or disaster.

Al-Shomrany (1980) asserted that the abandoned terraces occupy 19% of the total surface area of the study site (Bashut–Asir). In other words, these abandoned terraces constitute half the cultivated land. This shows the
size of the problem of terraces degradation, in particular when we know that the number of terraces is estimated at 59,000 distributed in the areas of the Asir highlands (Al-Tubak, 1999). Abandonment of terraces can lead to undesirable impact on the forest ecosystem. For instance, Al-Shomrany (1994) stated that soil drifting in Assarah region attributed mainly to abandonment of terraces beside misuse of the natural resources (e.g. overgrazing and overcutting) and lighting fires.

Although terrace agriculture has been practised successfully for centuries in southwest region of Saudi Arabia, use of terracing has been declining due to lack of maintenance, migration of labour and emphasis on large scale agricultural development. Unfortunately, migration of new generations to urban areas has decreased the local labour force and caused the use of terrace farming to decline (Al-Tubak, 1999). Al-Shomrany (1994) defined the reason for this considerable degree of abandonment of farming and disintegration of many terraces as a result of tribal hostilities for long periods of time, sever droughts and the discovery of oil in Saudi Arabia. He also added other reasons as the variability of rain; that may come too early or too late for the agricultural process, large emigration of the younger generation, best to work these terraces to cities; leaving a big shortage of farm labor, the distance of terraces from the villages; that entail a great hardship for the farmer to maintain them.

NCWCD and JICA (2006) reported that in the past, many of the farms were family-run operations, but presently, the owners are employed elsewhere despite the fact that they are also farm owners; and in many cases, they employ foreign workers to cultivate their farmlands. Foreign workers are basically inexperienced about farming and livestock raising activities and are the cause of a variety of adverse effects.

People's migration is a major factor causing abandoning land and terraces, or leaving them fallow for many seasons, or even years, thus making them vulnerable to erosion (Ministry of Water and Environment-Yemen, 2004). Poor maintenance and runoff management are believed to be the major cause of mass soil erosion that occurs as a result of the successive collapse of terraces. Terraces require continual maintenance; it is both costly and labor intensive. If an individual terrace is abandoned or not maintained, it can cause the collapse of the entire system (ACSAD, 2003).

The degradation of terracing agricultural system can lead to undesirable effects on the other parts of the ecosystem. Abandoning planting of terraces in Yemen, led to the degradation of the cropped lands. This has extended to the pasture and forest lands, and caused great damage in the water sheds. In West and Central Asia, inadequate maintenance of terraces has led to increasing water erosion, in turn reducing productivity (Ma, 2008). Maintenance of terraces in the highlands of southwestern Arabia has been declining, leading to soil erosion- a major threat to biodiversity (WWF, 2001).

The abandonment of terraces amounts to a national disaster, for terraces are a national treasure built over the years (Ministry of Water and Environment-Yemen, 2004). Failure to maintain the terraces also increases soil erosion in the slopes. The degradation in mountainous areas includes severe soil erosion by water run-off on unprotected slopes, which in extreme cases can lead to degradation of natural vegetation and depletion of biodiversity (ACSAD, 2003).

**Urbanization and Expansion in Forestland:**

Expanding farms, establishing infrastructure, constructing houses, building roads and founding recreational areas are the most factors related to urbanization and have a major role in forestland degradation in southeastern region of Saudi Arabia. Expansion of residential master plans due to the development boom in the Kingdom, particularly in the southwestern region, caused an overlap of forest areas and urban planning of towns, villages and residential areas, and removal of extensive areas of forest for such purposes (Johannesburg Summit, 2002). The construction process entails bringing different materials to the site such as cement, baked bricks, tiles, woods, ironware, sand, etc. which have pollution effects upon vegetation and people. Entering heavy vehicles carrying those materials to the site of construction contributes to the degradation of forestland area. The construction of roads has had the greatest impact on forestland because when roads are built on escarpments, the adverse effect on the natural environment is especially huge. Juniper woodlands that grow on these escarpments, where natural environmental conditions are harsh, have been destroyed by roads that have been constructed in these inclines for the sake of improving the convenience of the local community. On the other hand, due to road construction, rainwater flow is blocked by road and rainwater seeps out on the slope of road and flows down along road. Therefore, sufficient rainwater does not go beyond the road and cause negative effects on the woodlands and vegetations that grow on the slopes on the valley side due to dryness. Thus, junipers are not only damaged by buried roots, but also due to water loss from the soil profile (NCWCD and JICA, 2006). Because of the climatic advantages during the summer time and the natural beauty of the Asir Mountains region, it is highly frequented by tourists coming from all over
the Arabian Peninsula (Barth and Horst, 2000). Forests containing juniper woodlands in the Kingdom provide recreational sites that are ideal tourism sites, where the temperatures are moderate, and the natural scenery is beautiful and magnificent (NCWCD and JICA, 2006).

Because of the distinguished nature of Taif County and using it as a recreation centers, Abo Hasan et al. (1984) decided to exclude the forests of this county from the economical exploitation plan for producing solid wood in the southwestern region. The high increase in population numbers has led to the expansion in urbanization and establishment of residential regions at the expense of juniper woodlands. This is most evident in the southwestern region (NCWCD, 2005).

The advertising effects of recreational activities that have widespread over many sites in the natural forest in the southwestern region of Saudi Arabia are clearly visible as degradation on forestland. ACSAD (2003) stated that tourism has begun to affect forest areas, unplanned activities and development of forest sites for recreational purposes have reduced the capacity for regeneration, produced solid waste problems and polluted forest water resources. NCWCD and JICA (2006) presented a report considered that the waste that is disposed of at the recreational sites moves into the High Priority Protected Areas and in many cases accumulates there. It also pointed to the problem with wild monkeys that congregate in groups in the parking lots and along the roads of recreational sites, scavenging the waste that is thrown there or given to them by visitors. It expected that in the near future, there is the possibility that they may injure visitors and become the source of further trouble.

Other Causes of Forestland Degradation:

In addition to the above mentioned causes of forestland degradation, there are other causes that may not will apparent at a glance. These include outbreak of insects, diseases, parasites and invasion of aile plant species. Insects and diseases influence the health of natural and planted forests, trees outside forests and other wooded lands. Globally, these ecosystems are under increasing threat, as the periods between sequential outbreaks are rapidly decreasing because of a range of factors including climate change and lack of proper forest and plantation management (FAO, 2007). Forest degradation can be defined as impoverishment of standing woody material mainly caused by human activities such as over-grazing, over-exploitation (for wood fuel in particular), repeated fires, or due to attacks by insects, diseases, plant parasites or other natural causes such as cyclones (Milledge and Kaale, 2003). Natural forests are affected by disturbances such as forest fire, storms, or insect outbreaks, but such disturbances are rarely catastrophic (Schroeder and Green, 2001).

The reports in these causes for the natural forests of Saudi Arabia are limited. There are no complete studies on the insect species of Saudi Arabia (NCWCD, 2005). Ma (2008) asserted that although fire, insects and disease are the main destructive factors threatening the forests and woodlands of West Asia, data on these elements are generally sparse. The range of forest types in the subregion make it hard to make any general statement on the health of the forests, and some countries produce no reports on the ill-health of trees. The remaining forests in the Near East Region are threatened by outbreaks of pests and diseases, droughts and uncontrolled forest fires. In many parts of the region, there is little or no natural regeneration and the tree population is ageing (FAO, 2006). Poor regeneration among the juniper forests in southwestern region of Saudi Arabia is causing concern among environmentalists. One cause may be infestation of cones by a tortricide moth (Hajar et al., 1991). The juniper woodlands in the Asir Mountains grow in a harsh natural environment and minute environmental changes ranging from spells of abnormal aridity, destroyed roots due to grazing, disease and insect infestation will cause intense damages (NCWCD, 2006). Juniper tree considers durable to termites and fungal decay, however the old trees are susceptible to the heart rot. They also can be infected by twig blight, some sorts of rust and attacked by insects like scale and aphid (El-Juhany et al., 2004).

A plant is considered parasitic only if it forms a direct haustorial connection to a host plant. Parasitic organisms make up a large percentage of the Earth's total biodiversity (Nickrent, 2008). Mistletoes, the predominant group of angiosperm shoot parasites, are a fascinating and diverse group of plants found in a wide range of ecosystems including boreal forests, tropical rainforests and arid woodlands. Mistletoes live in an intimate association with their hosts and derive nutrition from the host, and, of course, share a life-long association with a single host individual (Norton, 2008).

In the natural forests of Saudi Arabia in southwestern region different parasitic plants are grown on the aerial parts of different tree species including Juniperus procera and Acacia spp. While those parasitic plants seem healthy, their host trees are not.

Nonnative species often out-compete native forest plants and may degrade forest productivity, wildlife habitat, recreational values, and water quality. Nonnative plants can be introduced and spread by wildlife or
through other natural means. Humans also spread invasive species by planting them in their gardens and yards and by seeds hitchhiking on their clothes. Additionally, tractors and mowers used in multiple locations without being cleaned often spread nonnative plants (Science News, 2009). When an alien species enters an ecosystem, it can have an impact on the species that are present, on important habitats, or even on the ecosystem itself. Concern arises when an alien species changes the system for the worse, either by reducing or eliminating populations of native species, or by otherwise changing the way the ecosystem works (Lee and Hovorka, 2003).

It is not uncommon to see non native tree species spread over the entire southwestern region, in particular in nursery, gardens and houses and streets. Before almost 30 years, *Eucalyptus spp.*, *Casuarinas spp.*, *Cupressus spp.*, and others were the main tree species grown in the governmental nurseries. Invasive plants are species that aggressively compete with and displace native plant communities. Non-native invasive plants impact in different ecosystems. The result can be loss and destruction of forage and habitat for wildlife, loss of available grazing land, diminished land values, lost forest productivity, reduced groundwater levels, soil degradation, increased risk of devastating wildfires, and diminished recreational enjoyment (US Forest Services, 2009). FAO (2007b) in a report about the Near East Region mentioned that it is apparent that forests are increasingly vulnerable to the impact of exotic invasive species (plants, insects and diseases) and it was felt that the region lacks adequate detection, prevention, and management strategies to deal with invading forest species.

Recently, there is a book issued containing details about many of these non native plant species which grow in Abha City (Shalaby et al., 2007).

**Rehabilitation Badly Needed:**

As the degradation of the forestland in southwestern region of Saudi Arabia has become serious and threatens this unique forest ecosystem, a set of actions must be taken in a holistic manner and directed sooner not later toward rehabilitation. There are some important pre-requisites should be ensured before starting any rehabilitation project for restoring forestland in order to build future solid and successful processes. These comprise clear definition of the degradation of forestland in terms of its size, extend, forms and perilousness. It is also important when thinking of restoration to organize awareness raising activities to develop the understanding of the land and vegetation degradation issues, as well as to increase the awareness on the inter-linkages between ecosystems and other sectors (ACSAD, 2003).

A further problem with many reforestation schemes is that they are not based on a full understanding of why the forests were degraded or lost in the first place (Sayer et al., 2004). The first consideration in attempting any recovery of degraded forest land is to understand the processes and underlying causes leading to degradation (the 'stress' factors) and then to try to remove or correct them (ITTO, 2002). Rehabilitation of forest cover must start with the understanding that forests, woodlands and trees are renewable resources and then the nature of deforestation and degradation should be considered (United Nations Commission on Sustainable Development, 1998). Benefiting from the experiences of others who have similar conditions and involved in such projects considers of strategic lessons to construct suitable plans and guides future efforts (CIFOR, 2005). Sharing experiences enhances rehabilitation efforts especially when countries adapt approaches to local conditions (FAO, 2004).

Unfortunately, there are no statistics for the degraded forestlands of Saudi Arabia and for the degree of such degradation. Therefore, any project will be proposed for rehabilitation of this forestland should be constructed on right bases that can lead to the success of the objectives.

The following points may be useful to be taken in account for successful rehabilitation actions:

- **Establish an independent instrumental body to be responsible for planning, supervising, evaluating and monitoring the project processes.**

  Al-Katly (2008) recommended establishment of a national authority to care of the forests and develop them in Saudi Arabia.

- **Create awareness of the multiple values and services of the forestland and the seriousness of forestland degradation.**

  Raising awareness for the public that supports the rehabilitation activities, tailored to the needs of the local community, the needs and concerns or conflicts of interest between stakeholders should be taken into account.
It can be noted that some of the countries in West Asia Sub-Region started to increase local population awareness in activities related to vegetation cover protection and organize and rationalize the exploitation of natural resources (ACSAD, 2003).

• Invite stakeholders and relevant forest-related instruments to participate in the activities as partners.

It must be emphasized that setting objectives must be done with the involvement of, at least, the primary stakeholders and have their full agreement (United Nations Commission on Sustainable Development, 1998). Those concerned with forest restoration must recognize that different stakeholders have different needs and should be represented in the research and development process (Burley, 2004). The technical constraints that may inhibit rehabilitation efforts need to be addressed as part of a comprehensive programme implemented through decentralized structures and with the active involvement of key stakeholders and interest groups (Gilmour et al., 2000).

• Encourage research into all disciplines related to forests, forestland and their conservation and rehabilitation.

To rehabilitate mountain areas in China, Wenhua (2004) suggested conducting research in significant topics such as the basic theory underpinning sustainable forestry development, forests and the environment, biodiversity, techniques for intensive plantation management, techniques for the efficient utilization of forest resources, biological technology, remote-sensing technology and social forestry. Research may offer significant breakthroughs that will help overcome the many constraints to the process of rehabilitating and/or restoring degraded forest ecosystem (CFNRAKECU, 2001).

• Stop the causes of degradation (e.g. prevent grazing, fire, hunting, etc. and reduce human access to the forests).

In almost all situations protection from grazing, fires and exploitation, sometimes in conjunction with soil conservation work, will ensure the recovery of some vegetative cover (United Nations Commission on Sustainable Development, 1998). Prevention will be strengthened on the basis of controlling fire sources and guarding key areas that are vulnerable to fire (Wenhua, 2004). Forest management plans that involve reduced human access to the forest must therefore include alternative means of achieving a sustainable livelihood for forest-dependent populations (Lipper, 2007).

• Use native species in reforestation process, where appropriate. Include regeneration of degraded forest species.

The rehabilitation of degraded forest land can be done by facilitating natural regeneration through measures such as protection from chronic disturbance, site stabilization or water management (ITTO, 2002). Native species are adapted to the local environment and, thus, may be less susceptible to stress, serious disease, and pest damage. Local people are more familiar with their native plants and have more uses for them (Evans, 1982).

• Manage the forests in sustainable manner should be considered within a comprehensive policy.

The proper management application system is that can prevent enhanced cutting, conservation of goods and services offered by forestlands, afforestation practices, prevention of forest fires and rehabilitation of water sheds (ICEDAR, 2007).

• Social factors should not be neglected but to have a great concern.

There is indeed a general trend towards better integration of social concerns in natural resource management, and with regard to forests, more integrated and holistic management systems are needed (FLR, 2005). It is important to study the socio-economic impacts of land and vegetation degradation on local population, and carry out awareness raising activities in this domain and determine the cost of rehabilitation and presenting the findings to the decision makers (ACSAD, 2003).

• Specialists only should be taken the responsibility in carrying out and supervising all the processes proposed in the plans and programmes of the project.

Equipping participants needs to be strengthened to insure that the different phases of the program will be handled by technically capable members. This could include the planning, implementation, monitoring and evaluation stages of the project components (CFNRAKECU, 2001).
• Education and training of the employees involving in the technical processes must be given a great consideration.

Wenhua (2004) addressed the issue of forest degradation and restoration in China and recommended training professional forestry personnel and human resources. He stressed on future education and training activities and asserted that it will further optimize the structure of education and give priority to developing vocational education and adult education and foster steady development of higher education by raising the quality and benefits of education. He suggested the following practical measures to be undertaken:

○ Extend forestry educational reform, promote forestry education and raise the quality and benefits of forestry education.
○ Increase and improve the conditions for forestry education.
○ Strengthen vocational forestry technical education.
○ Develop adult forestry education with emphasis on on-the-job training and continuing education.
○ Establish and develop a public forestry education system to enhance public understanding of the importance and multiple functions of forestry and of the need for sustainable forestry development.

• Use of the available developed technology would help achieving the processes in a good quality and within reasonable time.

Policy interventions will be needed to increase the attractiveness and profitability of forest restoration and these include policies to support research on technologies. Application of technological development is one of the factors determining the potential development of degraded forests (ITTO, 2002). Education, training, research, and technology development would enable to focus on analyzing and adapting conditions and principles for sustainable land use as well as resource conservation technologies and practices (CFNR AKECU, 2001).

• Monitoring, evaluating and sustainable management are the key issues in the success of the whole work and its different activities.

Monitoring and evaluation is an important element in effective forest restoration and rehabilitation work. In this respect, applied and participatory research is essential to both support the implementation of adaptive management strategies and to facilitate information sharing and hence local capacity-building. Monitoring may include evaluations of tree growth rates, forest stand structure and composition, changes in physical and chemical properties of soils and the frequency of fire or other major disturbances.

• Cooperation with the international, regional and national organizations that are working in forestry and other related fields is very important to exchange information and experience to enhance the quality of actions to be done.

Gilmour et al. (2000) in their review about rehabilitation of degraded forest ecosystems in four countries in South Asia mentioned that it was felt that improved progress could be made by using institutions presently in the countries, although some external support may be needed. Networking throughout the region would help to transfer local experiences across national borders and assist with learning.

• Involvement of the national scientific institutions in the different phases of rehabilitation projects should be emphasized to enhance the quality of technical processes.

Collaborate with the local community to improve the resource management with scientific input and to communicate the results of this integrated project to a wider research community and particularly to donor agencies and decision makers is the key to such project (Schreier et al., 1998).

Research organizations and their staff members could play significant roles by improving and promoting indigenous knowledge, generating new knowledge and appropriate technologies that could be used to rehabilitate, expand, manage, sustainably utilize and conserve forest resources (Teketay, 2004).

Sayer et al. (2004) conclude with the following six principles that should be applied to restoration programs to enhance their environmental and social benefits and to reduce the risk of expensive, failed projects.

○ Involve stakeholders in the definition of objectives.
○ Define objectives in measurable ways.
Ensure that causes of degradation are understood and addressed and not just symptoms.
Invest in people and local institutions and not just in physical infrastructure.
Encourage learning and adaptation in the management of programs.
Apply ecosystem and common property management principles

Main Constrains to Restore the Forestlands:
The Factors that constrain to developing the natural forests of Saudi Arabia can be summarize in the followings:

The Harsh Environmental Conditions:
The lack and variability of rainfall induces drought which result in conditions can not support the growth of the excited plants and the planted seedlings.

Wood cutting:
Wood cutting is likely to continue despite the existence of protection legalizations. Unfortunately, in the past the cutting was not exceeding only few trees or even some branches and only at need, but now large areas of forest cover is clearing for expanding agriculture land or establishing houses and economical enterprises. These activities started to replace not only the forests but the agricultural land too. They begin as a small spots then start to expand more and more via clearance through extensive cutting of trees or overgrazing or fires. There is an apprehension of losing of the whole forests at the end (Aref and El-Juhany, 2000).

Uncontrolled Overgrazing:
Uncontrolled overgrazing refers to letting the animals browse in forest land regardless their species or numbers or the maximum period in which the land can be support such numbers or the right time of the forest age to support grazing. Some animals eat the terminals of the seedlings or the small trees or the green twigs that result in malformation growth of the trees or stunned when losing their terminals. If the number of the trees affected is high this will be reflected on the whole forest as a lowering in its productivity and regeneration capacity. Moreover, the forest land can be eroded later on and the soil is drifted due to the frequent rainfalls.

Forest fires:
Forest fires in the southwestern region of Saudi Arabia have become more frequent lately. They consider a major threat to the plant cover as a whole and especially the natural forests. Fire has a distinct effect on the species composition of the forest, as the sensitive plants such as the conifers which are rich in resins may disappear while the broadleaved trees that can resist fire remain. Note that forest fires historically consider one of the elements of environmental equilibrium, and rarely accounted of the main causes of forest degradation. So that the problem is with those forest fires that are mostly started intentionally by people for a purpose (Aref and El-Juhany, 2000).

Shortage of Forestry Specialists:
The number of forestry specialists in Saudi Arabia is considered very low relative to the programmes to be implemented in this area, such as the inventory of forest areas, or the evaluation, development or monitoring of such activities (Johannesburg Summit, 2002). In other words, there are not enough qualified foresters to handle the forest expansion of reforestation programmes that the State would like to implement (NCWCD, 2005).

Governmental Efforts Towed Rehabilitation:
The Government of Saudi Arabia has laid down very clear guidelines, rules and regulations for the protection of the native vegetation. The Kingdom of Saudi Arabia had long realized the need for conservation of its renewable natural resources (FAO, 1996). Several governmental organizations are responsible for the conservation and restoration the forestlands in the Kingdom of Saudi Arabia, each within range of interest.

The Council of Ministers adopted forestry and range regulation No. 392 on 18/04/1398H (1978) and passed the forestry and range law in accordance with the Royal Decree M/22 on 03/05/1398H. The Ministry of Agriculture formulated the bylaws. This regulation has been renewed in 2005 and adopted by The Council of Ministers under No. 247 on 4/9/1425 H (2005) in accordance with the Royal Decree M/55 on 29/10/1425H (2005).
The objectives of the forestry and range law and its bylaws were to control and stop some of the activities that lead to degradation and loss of vegetation. Regulations were passed on the following:

a. Forests in fragile habitats susceptible to deterioration cannot be exploited.
b. Forest areas in valley bottoms cannot be exploited for farming.
c. Areas with more than 40% slope cannot be cropped or cleared.
d. Areas used as control of sand encroachment cannot be exploited.
e. Tree cutting and uprooting of plants in their native habitats for fuel were regulated. Only people with special permits from the Ministry of Agriculture are allowed to cut the plants for specific needs.
f. Burning was completely forbidden in forest and range lands.

In order to promote the rehabilitation and restoration of damaged ecosystems, The National Commission for Wildlife Conservation and Development (NCWCD), which is responsible for the conservation of all the wildlife in the Kingdom, has adopted a two pronged approach. First is the proclamation of protected areas to restore damaged ecosystems. Second, it carries out captive breeding programmes of endangered native species for reintroduction into these protected areas if it falls within the historic range of the specific species (Johannesburg Summit, 2002).

In 1989, the NCWCD designated juniper woodland in the Asir Mountains in Raydah district, located 15 km west of Abha City, as a Special Nature Reserve. The NCWCD has also implemented the project on the “Joint Study Project for the Conservation of Juniper Woodlands” from 1999 to 2002 in cooperation with the Japan International Cooperation Agency (JICA) (2002).

The Ministry of Agriculture funded a multidiscipline national project started in 2001 lasted for five years and aimed at inventory of the natural forests in the southwestern region of Saudi Arabia and mapping them using satellite image data. It was executed by the Space Research Institute of the King Abdulaziz City for Science and Technology (KACST) with collaboration of scientists from the Saudi Universities, in particular King Saud University, and the Ministry of Agriculture.

In 2006, The Council of Ministers endorsed the national work strategy for the forests of Saudi Arabia.

Research and Studies in the Natural Forests:

"The natural forests in Saudi Arabia and the possibility of exploiting them economically" is one of the first studies published regarding this important natural resource. This study included the results of the first project for inventorying the natural forests in the southwestern region of Saudi Arabia which was carried out by a research team specialized in forest sciences and wood technology from the College of Agriculture (Now: Faculty of Food Sciences and Agriculture) - King Saud University and funded by King Abdulaziz City for Science and Technology in collaboration with the Ministry of Agriculture.

There is also a number of research works on the forest cover of Saudi Arabia and other forestry and wood science topics was carried out by researchers and postgraduate students in the universities inside and outside the country. Some of those are mentioned elsewhere in the present article. However, this consider a low product in view of the importance of the natural forests of Saudi Arabia and their problems.

Recommendation for Conservation of Forests:

Aref and El-Juhany (2000) suggested some recommendations as guidelines to deal with the conservation of the natural forests in the southwestern region of Saudi Arabia as the following:

- Support scientific research in the forest fields such as silviculture, forest management, forest pathology, forest ecology, watersheds, wildlife, wood technology and other related research.
- Carry out periodic inventory for the forests in order to collect data about their areas, species composition, growth rates, wood volume of different species and the pests might outbreak. Analyzing this information will enable managing these forests in sustainable way, control the degradation forms that may occurred and improve the efficacy in giving their products and services in a proper way.
- Quick intervention is important to stop the degradation that has been occurred in different area of the forestland in the southwestern region. Essential effective rehabilitation programmes of these areas based on mapping for all the forestlands should be started as soon as possible.
- Reforest the gaps within the forestlands with the same prevailing indigenous tree species. These may grow slowly but their successful percentage will be high if they received proper care.
- Stop opening roads in the forestlands for recruitment activities. It is more beneficial to open accesses to the remote sites inside the forests in order to develop them and/or control fires.
Restore the agriculture terraces that were degraded due to abandonment or as a result of severity of rains. This is important to conserve and make use of the rain water in order to not leak away from trees and other plants.

Restrict urban expansion of the cities, towns and villages which located nearby the forests and find an alternative in other areas with no tree cover.

Return some of the wild animals which were lived in the forestlands and escaped as a result of frequently getting in of the visitors on cars and using glare lights and lighting fires.

Determine lands suitable for afforestation or reforestation and allocates them for establishment of parks and recreational enterprises as an alternative to deforest areas inside the forests.

Intensify the informative programmes in the media (TV, press, broadcast and others) about the importance of forests and the necessity of conserving them. Also, holding symposiums and scientific meetings regarding the development and conservation of the natural forests and it is of great benefit to invite experts in this field from inside and outside the country.

Increase the establishment of forest nurseries nearby the forestlands in order to provide the seedlings required for planting the gaps in the forests; with emphasizing on excluding the exotic seedlings to avoid epidemic to the endemic species.

Define the sites and names of the forests and fixing advising signboards nearby them for restricting cutting, lighting fires and all other illegal actions. It is also important to produce maps for these forests to be lodged at the different related authorities to secure them against any encroachment. Develop the skills of the specialists on the field of planting trees through training programmes under supervision of experts.

Contribute the comprehensive security to not in following the encroachments in forestlands as what is excited right now with monitoring the restriction of transferring palm trees from place to another inside the country without permission of the Ministry of Agriculture.

Ensure enough measures for facing forest fires; as observation towers, water tanks, and all means of control fire, in addition to training the firemen to cope with such fires.

REFERENCES


JCEDAR., 2007. Arab Region Report on Sustainable Development of Land Resources, Agriculture and Rural Areas of the Arab Region Presented to the Ninth Session of the Joint Committee on Environment and Development in the Arab Region, Cairo, Egypt, 4-6.


The Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD, 2003). Inventory Study and Regional Database on Sustainable Vegetation Cover Management in West Asia (TN2), Prepared for the Sub-Regional Action Program (SRAP) to Combat Desertification and Drought in West Asia under the memorandum of understanding signed with UNEP/ROWA 21st August 2001.


