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Mogadishu
November 1987

Somali Democratic Republic
Ministry of Forestry, Range and Wildlife
National Range Agency

Overseas Development Administration
British Forestry Project Somalia

FORESTRY CONDITIONS
AND
PROSPECTS IN SOMALIA

[Situazione e prospettive forestali della Somalia]

by

Giovanni Preto

Anali dell'Istituto Sperimentale per
la Selvicoltura. Volume 7, 119-201 (1976).

Translated from the Italian by
M. Roderick Bowen, et al.



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PREFACE

The independent Somali Republic was formed in 1960 by the union of the Somaliland Protectorate in the north, and Italian Somalia in the south. These two territories had been under British and Italian administrations respectively for some sixty years prior to independence: there therefore exists a moderately extensive, forestry related literature in both English and Italian.

Access to much of the Italian literature has been denied to English speaking foresters because of the obvious language barrier. This review article by Giovanni Preto is the most significant general paper published on Somali forestry in Italian. For this reason the British Forestry Project, Research Section, funded by the UK Overseas Development Administration, undertook the translation of the article into English. The translation per se was made by Somali nationals, fluent in Italian and also speaking excellent English; they were, however, not foresters and the forestry 'jargon' and interpretation was carried out at the draft stage by a native English speaker. It is therefore possible that some of the subtleties of the original have been lost in the dual translation process, but the translators are confident that the concepts of the original have been retained. Where doubts exist, these are indicated by a question mark, (?) before the word or phrase. In a few instances there was a need to add words or phrases to clarify a point; these are indicated in [] brackets.

J.D. Leefe OBE
British Forestry Project

Forestry conditions...

Preto G. (1976).

Situazione e prospettive forestali della Somali [Forestry Conditions and Prospects in Somalia].

Annali dell'Istituto Sperimentale per la Selvicoltura 7 119-210 (1976).
Translation prepared by Bowen et al as Working Paper No 3. British Forestry Project - Research, Mogadishu, Somalia (1987).

AUTHORS ENGLISH SUMMARY

On the basis of direct experience, and after a critical review of forestry activities carried out in Somaliland, the main problems of forest development and of natural resources protection are examined.

The most urgent needs can be summarised as:

- 1 - delimitation of permanent forest reserves for fuel, gum and charcoal production.
- 2 - delimitation of grazing areas, to be managed by up-to-date methods and scientific techniques, to make a better use of forests and pastures.
- 3 - establishing plantation stands of species for wood and timber production in the neighbourhood of urban and rural centres.
- 4 - the planting of shelterbelts, and tree and shrub windbreaks, to protect cultivated areas and to control soil erosion and dune drift.
- 5 - increasing green spaces in urban and sub-urban areas, by establishing "tree-alleys" and gardens.
- 6 - development of the local administration, for the management of wooded and grazing areas, and the setting up of a basic and permanent education programme with the support of the national government.

- 7 - training of technicians at various levels, in order to apply the forest laws and regulations and to carry out the stated forestry programmes.
- 8 - carry out interdisciplinary studies and research, with the cooperation of governmental agencies, farmers, nomads and Somali or foreign researchers, in order to develop and apply management plans and programmes for environmental protection and use.

For every problem, a course of action is suggested in order to stop the desertification processes and to increase the production of wood and of other forest products.

FORESTRY CONDITIONS . . .

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1. PHYSICAL

The Somali Democratic Republic is located in the eastern Horn of Africa, between the latitudes 11°30'N and 1°50'S and the longitudes 41° to 51°E. The total surface area is 637 661 km². Its borders are: north-west with Djibouti, west with Ethiopia, south-west with Kenya, south and east with the Indian Ocean, and north with the Gulf of Aden. The coastline of Somalia is 2 800 km in length. It is a wide, generally flat territory, which can be divided into the northern coastal band, northern mountainous zones and Bari, central Somalia and the Ogaden, and southern Somalia.

The northern coastal band is a tongue-like territory ranging in width from 60 km (toward the west) to less than 1,9 km toward the east. It is made up from flood deposits of sand and gravel, and coral rocks of the quarternary era. The coast is generally high, except for the spacious depression formed by deep deposits of fine sand and gravel.

In central Somalia the sub-stratum soil is generally a non-differentiated sub-desert layer. In the eastern part, toward the north, there is a non-differentiated sub-desert soil with a high content of gypsum; the soil of this area is similar to that of Bari, south of Karkar; towards the south, parallel to the coastal line, is a ferruginous tropical soil overlying a sandy original.

Footnote

The information for this report was gathered during a visit to Somali from July to September 1976. During the course of the tour, discussions were held with Somali technical foresters and expatriates closely associated with forestry in the country.

Although several key publications were consulted and the literature reviewed there is still a lack of information. There is a need for a multi-disciplinary approach to the many forestry problems of Somalia: consultations with the local people, the nomads, agriculturalists etc are desirable.

The many people who helped us with the tour are thanked for their assistance.

Southern Somalia is defined as lying to the south of the Shabelle river. It is a vast plain where it is possible to distinguish, moving inland from the coast, four different soil types:-

1. a limited zone characterised by a tropical ferruginous soil over a sandy layer,
2. a wider band characterised by vertisols which are typical of the topographically low lying areas,
3. toward the north there is a band of land characterised by a non-differentiated, tropical, ferruginous soil with calcareous components, and one zone with a non-differentiated, sub-desertic soil similar to that of the central region,
4. in the southern part, close to the Juba river, there is generally a non-differentiated ferruginous soil, rich in organic components and predominantly fertile.

2. CLIMATE.

The climate of Somalia has been studied by many authorities and we have used data from the Meteorological Office. However, lack of trained technicians has meant that many data are not available and others are unreliable. These researchers include: Eridia (1936), Fantoli (1964), Griffith and Hemming (1963), Hunt (1951), Macfadyen (1951). On the basis of the data collected by these workers, it has been feasible to define for Somalia, and the neighbouring zones, reliable and accurate climatic information.

Most of Somalia is arid or semi-arid, while the coastal zone east of Berbera to Cape Guardafui has a hyper-arid climate (Meigs, 1951).

Fantoli (1964), Griffith and Hemming (1963), and Griffith (1966) divide the climate of the central region, including Cape Guardafui, into three main areas; coastal, savanna and sub-desert. While in the north there are four distinct regions; coastal desert; coastal savanna; a mountainous region with climate controlled by altitude; and inland savanna with little rainfall.

The succession of the seasons is determined by two alternating monsoon winds, north-east and south-west, which are of variable intensity and duration.

The rainfall pattern depends on the swinging of the inter-tropical front (ITF) which follows a convergence phenomenon generally associated with thermal changes (Fantoli, 1964).

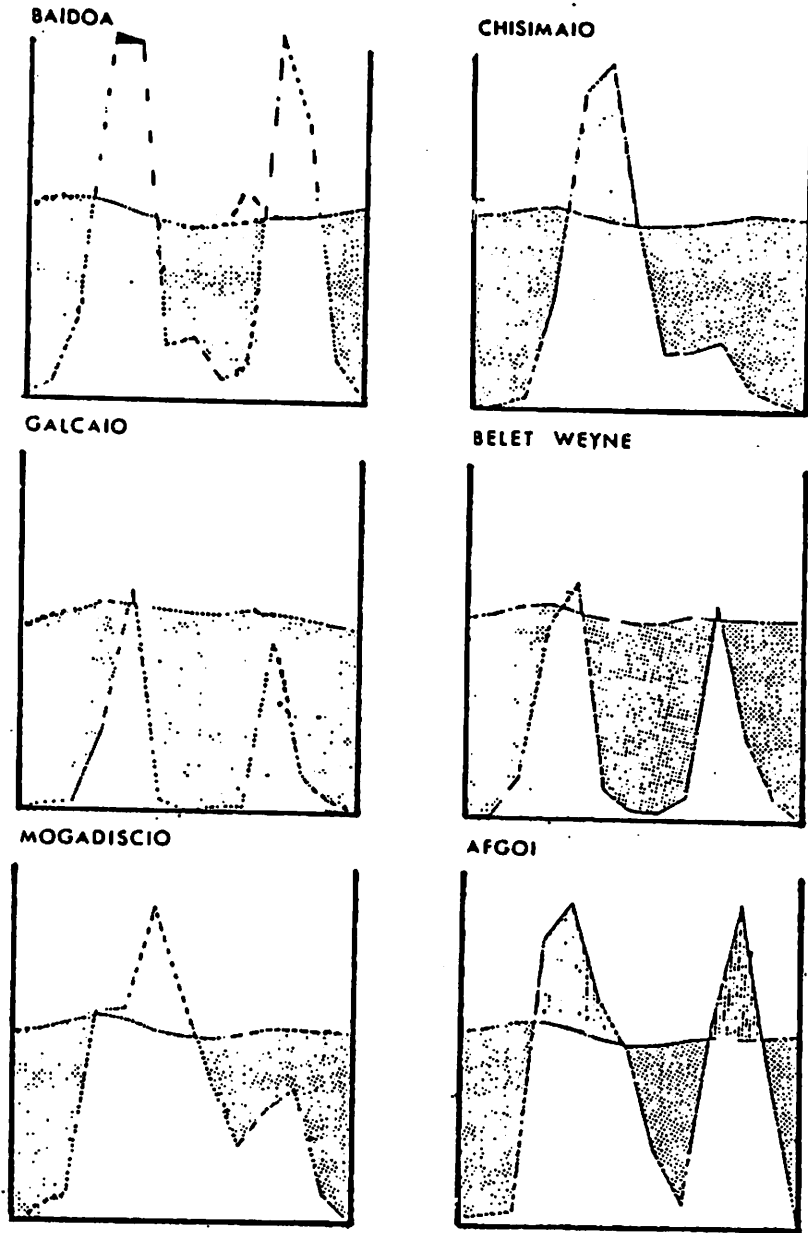
Between December and March, the north-east monsoon, which comes from the Arabian Sea, produce a long dry period (jilal). The winds of this monsoon become dry during contact with the northern coast of Somalia where it is known as 'forah'. Here the winds lose a great part of their humidity, becoming dryer and weaker as they move south.

The 'gu' rains take place from April to June. These rains are followed by 'hagai' from May/June to September/October and are characterised by the south-west monsoon coming from the Indian Ocean.

Table 1. Climatic information (elevation, temperatures, precipitation and evapotranspiration) for Several Somali locations.

	Elevation	Number of Observations	Annual average temperature	Monthly average maximum temperature	Monthly average minimum temperature	Absolute maximum temperature	Absolute minimum temperature	Average annual precipitation (mm)	Precipitation range (mm)	Annual evapotranspiration (mm)
CENTRAL COASTAL REGIONS										
Berbera	(8m)	6	29.8	41.5	20.0	47.0	14.4	57	178-13	
Bosaso	(2m)	16-19	29.5	41.2	21.0	45.0	14.4	.18	57-0	1750
C. Guadafui	(205m)	4-6	25.8	31.7	20.0	44.4	16.7	90	182-29	
HIGH PLAIN ZONE										
Hargeisa	(1370m)	12-35	21.9	31.1	11.6	34.4	2.8	432	811-259	1065
Erigavo	(1730m)	14-21	17.5	26.7	5.6	33.3	3.3	332	550-224	
Burao	(1040m)	23-31	24.9	31.6	12.8	44.4	0.0	186	307-48	1385
Las Anod	(700m)	3-15	24.2	32.8	13.3	36.1	8.9	162	341-61	
CENTRAL ZONE										
Galcaio	(302m)	6-11	27.6	32.8	18.9	37.2	15.0	110	192-33	1785
Belet Wayne	(173m)	11-19	28.6	36.7	22.2	42.8	15.0	184	289-45	1830
Gardo	(812m)	5-12	25.3	34.4	12.2	38.9	6.1	111	261-36	
Mogadishu	(17m)	27-23	27.0	32.8	23.3	37.8	15.0	371	660-148	1689
Afgoi	(86m)	11-10	27.1	34.9	21.0	44.0	17.0	402	656-192	1669
Iscia Baidoa	(410m)	5-15	26.2	36.1	19.4	38.9	16.1	527	757-305	1780
CENTRAL JUBBA ZONE										
Kismayo	(10m)	6-39	27.0	31.7	22.8	37.8	18.9	365	750-170	1698
Bardera	(116m)	8-26	29.4	40.0	21.1	45.0	16.1	324	433-200	
Guimbo	(30m)	3-9	26.6	32.8	21.1	36.1	16.7	363		

Figure 1. Climatic graphs for six Somali towns.



In the south the majority of the rain falls between April and November and is more intense between April and June. There is also a secondary peak between October and November. There is almost no rain between January and March.

In the northern regions the rains take place mostly between November and April; normally it is dry between June and September.

In the northern mountainous zone there is, perhaps, orographic rain. No detailed information is available but rainfall increases with altitude (?) at the rate of 25 mm per 100 m below 1 500m, and 45 mm per 100 m (?) above 1 700 m. (Hemming 1964).

The number of raindays per year varies throughout the country, from 40 - 55 in the extreme south, to 20 in the north, where some of the coastal regions have as little as five.

Rainfall is irregular in quantity, time and place, with the annual totals varying considerably from year to year and place to place.

Temperatures are uniform and more or less constant with a range of only 3° - 4° C. The coolest time of the year is June - August when the monsoon has depressed the temperature. The hottest period (March-May) precedes the gu rains.

In the central regions, protected from the effects of the south-west monsoon, the temperatures are higher. They reach a maximum between June and August, with an average daytime temperature of around 40°C in the summer period. In the winter (December-February), the average day temperature is 29°C - 30°C. Here, the variation in temperature is more pronounced, and can reach 6 - 8°C.

In the highlands the weather is cooler. The average day time temperature is 28°C during the hot period, while that of the cool period is around 15°C. In some [? mountainous] areas, the variation in temperature is considerable with [minimums around zero].

The humidity is high near the coast and around the [two] rivers, ranging on average between 70 percent and 80 percent. In the interior the humidity is lower, falling on occasion to 10 - 20 percent during the summer season.

The winds are governed by the north-east and south-west monsoons; they are strongest during the winter and summer months respectively. The strength of these winds is generally low, except in the north and along the coast near to the mountains. Certain local winds, like the marine breezes, can have remarkable strength, significantly influencing the vegetation because of their desiccating effect and the (? low) humidity they can produce.

3. VEGETATION TYPES OF SOMALIA

The Somali vegetation has been the subject of many different studies and surveys, as was underlined by Pichi-Sermolli in particular (1955 - 1957), who studied the extensive bibliographic material existing before that date, and later by Moggi (1960) and Hemming (1966).

The types of the Somali vegetation have been classified and mapped by Pichi-Sermolli (1957) at a scale of 1:5 000 000. This classification took into account climatic and edaphic factors.

This geo-botanic study is of great use in planning objectives (e.g. applied forestry studies and vegetation ecology studies) and to plan feasible, environmental protective measures and the rational utilization of the rich resources. The study was unfortunately, based on data collected more than 20 to 30 years earlier and is, probably, obsolete, because of the profound cultural, economic and environmental transformations which have and are taking place in the country.

It is necessary therefore to reconsider the present situation of the geo-botany of Somalia through environmental, inter-disciplinary studies. These studies should utilize the modern technologies of land-survey, satellite photography, aerial photography, geometric-survey etc., in association with field-surveys conducted with the participation of Somali staff and research workers involved in the agricultural, livestock-raising, and environmental protection services. They should design, through accurate knowledge of the environmental conditions of the country, the necessary protective measures and plan the correct use of the resources of the whole territory.

The main type of Somali vegetation is xerophilous woodland, which is the most noticeable characteristic of the landscape. Pichi-Sermolli (1957), on the basis of the diversity in the arboreal stratum density and the composition of the flora, identified two kinds of xerophilous woodland; xerophilous open-woodland and broken xerophilous woodland.

The second type is a result of degradation of the first, by excessive grazing and the irregular [? uncontrolled] use of forest products, which

lead to erosion and physical, chemical and biological alterations of the soil. The continuing increase in areas of the broken xerophilous open woodland is generally associated with man's activities. In certain cases, this degradation represents a phase of the steppic process, because of the fragile ecological balance of the region resulting from the permanently semi-arid climate.

Steppic shrub couch grass with some wild fruit plants, is the other more widespread vegetation that is characteristic in Somalia.

Other less important vegetation areas are: woodland, highland evergreen fruit plants (wild orchard), lowland evergreen woodland, lowland evergreen dry forest, different kinds of savanna and lastly, other types of vegetation connected with specific edaphic conditions e.g. mangroves, riverain and coastal.

The xerophilous woodland is the most widespread vegetation in Somalia. It contains ample structural and floristic heterogeneity owing to the climatic conditions, as well as that brought about by present and past human activities. Moving from the humid south-west to the north, the height and density of the vegetation diminishes and the floristic composition becomes richer.

On the basis of these considerations, Pichi-Sermolli (1955) distinguished two kinds of woodlands: xerophilous open woodland, and broken xerophilous open land, which correspond roughly to the "Acacia etbaica open woodland" and "Acacia bussei open woodland", described by Hemming (1966) for northern Somalia.

The composition of the xerophilous woodland association has been studied only in the north of the country, where Gillet (1941) described two kinds of associations: an "Acacia etbaica association" and an "Acacia glaucophylla - Terminalia brownei - Dracaena schizanta association".

In the first group, besides Acacia etbaica, the followign tree species are frequently found: Acacia varek, Acacia mellifera, Acacia orfota, Acacia spirocarpa, Euphorbia grandis, Balanites glabra, Maerua sessiflora, Combretum spp.; while common among the shrubs and grasses are, Cadaba farinosa, Capparis spp., Euphorbia nubica, Blepharis fruticosa, Blepharis

edulis, Barleria proxima, Dicrostachys glomerata, Hypoestes hildebrandtii, Vernonia spp..

The second association is developed along the mountainous region, between 900 and 1 000 m elevation. And on calcareous soils it is generally made up of Acacia glaucophylla, Acacia etbaica, Acacia nilotica, Terminalia brownei, followed by Commiphora tubuk, Peucedanium fraxinifolium, Ficus populifolia and different grasses and couch grasses.

In 1957, the Acacia etbaica formation covered about 20 000 km² (British Commonwealth Forestry Conference Proceedings) in a zone where the average rainfall is between 300 and 550 mm, which has a relatively constant temperature and is on a relatively poorly developed [evolution] soil.

The xerophilous open woodland usually has a more abundant, differentiated floristic composition than the previous formations.

This formation occupies the semi-arid zone of south-east Somalia and assumes different growth and density according to the substratum environmental conditions. The main species are: Acacia spirocarpa, Acacia nilotica, Acacia senegal, Acacia misera, Acacia orfota, Delonix elata, Terminalia rupali, Terminalia somalensis, and Dobera glabra, with different shrubs, Dicrostachys glomerata, Zizyphus spina-christi, Zizyphus mucronata, Lawsonia inermis, etc., climbing trees (Cissus spp., Sacrostemma spp.).

A distinctive type of flora is found on the hills of central Somalia, the so-called "bur" [a rock outcrop forming an isolated hill].

Another important formation from the forestry point of view is the mountain dry evergreen forest which is found in limited areas of northern Somalia such as around Ga'an Libah, Libah Heleh, Golis, Surad, etc., at altitudes ranging from 1 400 m to 2 400 m. It is a multi-layered formation made up of tall trees in the upper stratum, followed by small trees, shrubs, grasses, epiphytes, parasites, lianes etc.

The rainfall in the area is relatively low, reaching around 700 mm a year, but the humidity is quite high. The characteristic vegetation of this area is Juniperus procera, Olea chrysophylla, Dodonea viscosa, Cadia purpurea, Buxus hildebrandtii, Ephedra alta.

To the south of the Juba river there is lowland, evergreen dry forest extended mostly in the Bubasci and Ximoti basins. The main species of this association, characterized by a high, non-continuous canopy of 25-30 m and an under layer of 10-15 m rich in lianes, are: Afzelia quanzensis, Cecchia somalensis, Diospyros cornii, Combretum copaliferum, Sideroxylon diaspyroides and Delonix elata.

It is within this formation that we find some valuable timber species e.g. Afzelia and Mimusops.

The riparian formations, because of the high soil moisture content, have more floristic variation and richness than the other Somali types. However, this important vegetation zone is threatened by agricultural extension.

In northern Somalia the 'tugs' which are waterless during the dry season, are bordered by Acacia spirocarpa, Acacia senegal, Zyzyphus mauritania, Z. hamur, Balanitus orbicularis, etc.

Along its course through the Somali plains, the Shabelle river is bordered by luxuriant woodlands of limited width and degraded at certain points.

[By 1987 only one small (10 ha) area of riverain forest remained, at Balcad in the Middle Shabelle region. it is heavily degraded.]

The main species are Phoenix reclinata, Acacia seyal, A. glaucophylla, Tamarindus indica, Moringa ruspoliana and Ficus spp.

More luxuriant, and floristically richer, are the riparian formations of the Juba river, which are of significant width especially where the water floods. [Only two isolated areas remained by 1987 at Barako Madow (140 ha) and Shoonto (267 ha)]. The more frequent species are Mimusops degan, Piptadenia erlangeria erlangeri, Ficus spp., Garcinia ferandii, Afzelia quanzensis, Tamarindus indica, Teclea alexandrea, Trichilia jubensis, Hypseloderma jubensis and Acacia stenocarpa. These species can reach 20 m in height, while the lower trees, which are between 4 - 6 m, are Hunteria africana, Chiarenia jubae-fluvii, Cecchia somalensis, Zyzyphus mauritiana and Ximenia americana.

On the Juba coastline, as well as that of Shabelle, it is possible to find almost pure stands of the Hyphaene benadirensis.

Other than the riverain woodland, the other main formation linked to edaphic conditions, are the mangroves. These are of significant forestry importance.

The mangroves are found around Gesira (20 km from Mogadishu), and around the outlet of the Juba river. Although some degradation has occurred they have economic as well as scenic importance. On the northern coastline the mangrove is of only one species, the marine Avicenna marina ([near] Alula, Bosaso, Las Korri, etc.), while between Mogadishu and Merca, Rhizophora mucronata and Ceriops somalensis are also present. South of the equator Bruguiera gymnorrhiza, Sonneratia alba and Xylocarpus obovatus are found.

The steppic and sub-desertic wild fruit trees have little forestry importance, although they can be useful for reafforestation and environmental protection measures.

Different kinds of savanna are present in southern Somalia, south of the Juba river, and in depressions flooded by the river itself. The more extensive savanna is that with trees and high grasses, including Diospyros, Balanites, Combretum, Terminalia and Adansonia (Senni 1955).

4. GRAZING PROBLEMS AND ENVIRONMENTAL PROTECTION

The growth of the traditional livestock market, together with the new attractive commercial prospects connected with the export of livestock produce, have forced the subsistence, pastoral economy of Somalia to produce and increasing surplus for the external markets. This situation has produced challenging social and economic problems in the country.

The export of livestock has favoured the rise of rich traders, especially in the northern port towns, who were buying cheap animals to export at high profit and who, in turn, import the commodities requested in the towns; they were thus controlling the market monopoly.

Under these conditions the increase in livestock numbers was out of control, requiring surplus water resources, grazing, and forage, all of which threatened environmental degradation. The creation of an animal health network, together with additional watering points, have both further favoured the increase in livestock production. While this has had positive effects in the economy, it has also led to considerable social and environmental problems. The grazing practices of the nomads, the scarcity of forage and water in certain seasons and locations, and the increase in livestock requiring to be fed, plus the heavy dependance of the Somali economy on animal exports, have led to disastrous [environmental] conditions. The traditional biological balance, based upon the rotation of grazing areas, is broken. The basis of rotational grazing was to herd the animals in humid areas, with relatively abundant water, during the dry season. Then to shift to the drier areas with an availability of temporary water during the rainy period.

This rotational system allowed the Somali pastoral economy to establish a biological balance between the needs of the vegetation ecology, and the necessity to raise livestock.

The balance between the environment and the livestock raising system was crushed under the pressure of the rapidly increasing number of animals, brought about by the attractive business opportunities connected with livestock export.

The absence of a rational land-use policy, and the overcrowding of animals in an environment of delicate, biological balance, owing to the extreme aridity

of conditions, produced widespread erosion of different types: together with a remarkable reduction and degradation of the vegetation and forest land in the country. In some cases desertification increased.

The grazing of different kinds of animals with diverse dietary requirements (zebu cattle, sheep, goats, camels and wild herbivores) has produced a general reduction of the grass and herbaceous and shrub cover of the soil, which has resulted in the degradation of the pasture through the selective reduction of the better forage, and through a reduction of the genetic resources of the flora.

In addition to the grazing pressure, there is a growing utilization of the timber resources as raw material in the joinery industry, for charcoal making and in lime burning.

The extension of agriculture, the building of new urban centres and the growth of old ones, plus the growth of communication networks, are other factors which contribute significantly to the degradation of the afforested land in the country.

Range activities are increasing, with considerable cutting of wood for charcoal needed by the urban dwellers. There are also considerable amounts cut to fuel lime kilns and small, blacksmith's shops etc. This is leading to an overall degradation of the land, which has become devastating around the larger towns. Beginning in 1960, the export of charcoal to Aden increased the pressure. However, exports were stopped in 1969.

Because of the indiscriminate use of the land, there is increasing desertification, with (?) increasing grassland rather than forest vegetation. Elimination of the tsetse fly in some areas has led to an increase in livestock numbers, with a consequent increase in erosion. The long term future of Somalia is being threatened.

Erosion is now clearly seen, especially round the urban settlements and also near the rivers and wells where livestock congregates. There is no system to regulate these events.

Heavy wind erosion is frequent, especially in the central and northern regions with scarce rainfall and sandy soils such as near Balad, Bulu Burte, Beletweyn, Baidoa, Merca, Brava and Mogadishu: in the north, Galcayo, Elbur and Scusciuban;

Table 2. Somali Livestock Numbers and Exports.

	Source: Missione Economica 1974-1975	Source: Somalia Today	Source: Livestock Dev. Surv. 1967	Source: Annual Report FAO	Source: Min. Egal Ital. Nov 1975
Cattle	2 800 000	2 800 000	2 850 000	1 400 000	2 100 000
Goats & Sheep	14 000 000	5 400 000	8 950 000	7 000 000	9 500 000
Camels	3 000 000	2 500 000	3 000 000	2 000 000	2 200 000
EXPORT (1000 units)					
	1974	1975	1976	Value of Animals exported (US \$ million)	Value of Livestock products exported (US \$ million)
Sheep	663	793	19,6	1965	11,3
Goats	575	743	29,2	1966	13,5
Cattle	31	40	29,0	1967	13,7
Camels	24	34	46,1	1968	17,4
				1969	18,5
				1970	16,7
					19,3

Anon. (1975). "Livestock exports 1975", *Marches Trop. et Medit.* 3, 1625: 3472.

and in the south, around Juba, Bardere, Jamama and Afmadu, etc.

In these and other areas of the country, traditional farming methods together with other previously mentioned factors such as grazing and land clearing, produce a general degradation of the vegetation. In fact, near water courses the traditional farming practices, as well as irrigated farming are developed at random, determined only on the basis of the urgent needs of the population. Many highly compacted alluvial soils of high salinity become 'sterile' and are invaded by low quality vegetation after some years of farming without desalination and adequate cropping techniques.

Soil salination is also found in the sugar estate at Johar, on some banana plantations near Jenale, and at Shalambod. This is due to incorrect irrigation practices and inadequate crop rotation.

Going far from the water courses, the rehabilitation of the vegetation becomes more difficult and wind erosion increases easily. Good examples are the areas around Baidoa, Bur Acaba, Oddur and Dinson.

The stages of the degradation of the vegetation under the pressure of the above mentioned factors are described by Gillet (1941), Gilliland (1952) and Hemming (1966) amongst others for northern Somalia, while the situation in the central and south regions is discussed in various Italian reports.

The most evident effect on the land of animal overstocking is a general reduction in the quantity and quality of the pasture, especially certain perennial grasses which are substituted by annual kinds, while the areas without vegetation are increasing. The soil without vegetation, except for sand deposits, absorbs only small quantities of rain compared with those covered by vegetation.

This availability of only small quantities of water favours the survival of xerophilous species, and the trees and shrubs with small root systems tend to disappear. An example of this is Acacia bussei, which dies easily, and Acacia misera which comes in to substitute for it (Glover, 1951).

In the zones where the grazing is overstocked, the perennial and annual grasses are lost, as was described by Hemming (1966), [?as are] Indigofera ruspoli and Astropomoea nogalensis normally found in the transition zone of

Acacia bussei in the 'haud' mixed woodland, with its low formations of Acanthaceae. The areas where the vegetation has been lost are usually covered with species of insignificant pasture value, Aloe spp., Hypoestes hildebrandii, Indigofera articulata, I. ruspoli, Cassia italica and Sanseveria spp. or with spiny shrubs which can give rise to impenetrable, low scrub of little economic value.

The vegetation areas described by various workers for northern Somalia (Macfadyen, 1950; Boaler and Hodge, 1962; Hemming, 1964), are important examples of how the degradation process produces concentrations of particular types of vegetation on small areas of land, where the surrounding, denuded land acts as a water collector to help the survival of the remaining vegetation.

The effect of overstocking of the pasture is more pronounced on soils with a high clay content. The overcrowding creates small paths, which become rivulets in the rainy season. Water penetration becomes difficult, increasing the loss of the surface soil and causing damage to the shallow roots. The compacted soil becomes sandy and is blown by the wind, especially from the rich soils of the lowlands.

This process can assume threatening proportions in the coastal zones where, if adequate and immediate control is not exercised on overgrazing and the clearing of land for agriculture, large movements of sand will take place which may have disastrous effects on agriculture, irrigation systems and transport-networks to urban centres, (Merca, Brava and Mogadishu).

Clay soils have undergone a similar process, when, with the removal of the limey stratum of the soil, there remains a sand with uniform particle size which has little capacity for the accumulation of water, which in turn, allows the survival of tap-rooted vegetation (Balanites orbicularis, Acacia spp., Terminalia spp.), but causes the death of those with fibrous roots.

In conclusion it is evident that in Somalia, erosion with its alteration of the physical, chemical and biological conditions of the soil is profoundly changing the vegetation pattern of the country. Many factors (wind and water erosion, land clearing, the burning of woodland, excessive grazing, changes in the physical and chemical and biological characteristics of the soil, attack by pathogens and modification of the microclimate), hasten the reduction of the vegetation cover and favour the development of

a more xerophilous species mix which is unproductive economically but is biologically able to survive under more extreme environmental conditions. These areas are genetically less differentiated and have a simple ecological structure, both characteristics which reduce the auto-regulation mechanism.

The bases of this environmental alteration are incorrect land utilization, excessive grazing and single cropping. Part of the pressure which leads to this environmental degradation is the continuous economic dependence on imported energy, which enhances the under-developed nature of the nation.

An adequate response to the severe degradation of the environment can be based only on correct economic diversification. Instead of the dependency on a few products (banana, livestock and fisheries), the economic strategy should be based upon the development of differentiated agriculture, self sufficient when possible, and the creation of industry based upon domestic resources. Under these conditions environmental protection measures can have a positive impact.

The forestry problems of Somalia are firmly linked to the grazing problems and its environmental effect. Thus every environmental protection measure must take into account the grazing problem.

To prevent the qualitative and quantitative degradation of the vegetation cover, it is necessary to have both a rational plan for, and rigorous control of, the pasture and water resources. Any increase in livestock numbers must be based on a proportional growth in the available pasture and water resources, together with a strategy to upgrade the marketing of the produce, e.g. processing and commercialisation of the livestock products (tanneries, freezing facilities, food industry etc.).

The achievement of this objective depends upon; the creation of livestock raising associations between nomads, which gives them the right to use defined grazing areas; correct rotational use of the land; adequate water resources; technical assistance; and veterinary services etc. This form of cooperation can be an important factor in the social assimilation of the nomads, who are otherwise subject to a process of socio-economic desegregation which becomes worse with the degradation of the environment.

The settlement programme for the nomads, undertaken by the Somali Government after the severe drought of 1974-1975, when 120 000 were transferred to six

settlement centres (three for agriculture, three for fisheries), will reduce the grazing pressure, strengthen agricultural production, and reduce the mixed agro-pastoral economy which destroyed the land. Rotational use of the pasture, forbidding the use of fixed areas during certain particular months, with measures to increase its extent and productivity, together with measures aimed at increasing water availability (and hence grazing areas) have been proposed by Hunt (1951), Glover (1947), Giuliani (1969), Bettini (1959), Nelson (1958) and Norris (1975). These should help to relieve the pressure around existing wells. Also the nomads themselves recognise the deterioration in pasture and have provided some kind of rotational use of the land to favour the rehabilitation of the vegetation cover.

The creation of zones protected from grazing can be achieved only in collaboration with the population; control and repressive measures require an expensive and not easily organised governing body.

The easiest way to ensure the collaboration of the population is through education (radio and public discussions, based on the advantages of measures connected with the rational management of the pasture).

Eventually pastoral systems must be based on traditional nomadism, which has already existed for centuries within the country, and upon accepting the time-honoured forms of animal raising and land use. For this reason, it is necessary to safeguard the rights of use of the various groups of nomads throughout the country.

It is necessary to develop a planned system of nomadism, which incorporates modern scientific systems of pasture use and management. Along with these, other measures are needed to increase forage production, to (? improve) the vegetation, and to re-establish the diminished vegetation cover. These include; the selection and multiplication of fast-growing fodder and forage plants with high nutritional value and good drought resistance; the introduction of weed control techniques for invasive species; methods to distribute the best forage; the creation of pastures in irrigated zones cleared of tsetse fly and the utilization of alternative food resources for herds (e.g. stalks of maize and sorghum and by-products of the fisheries and canning industries).

At the same time, an inventory should be taken of the existing flora; research should be carried out on the movement of livestock and also into the changes in vegetation (and into ways to ameliorate its decline); into the optimal livestock carrying capacity of the different vegetation types; and into the nutritional requirements of the different domesticated livestock.

A forestry expert will be needed to delimit the zones to be reserved exclusively for wood production and to advise on those that may also provide wood and forage during periods of severe drought, together with those that should be used mainly for pasture.

Dual purpose species for wood and forage include; Acacia albida, A. nilotica, A. tortilis, A. senegal, A. seyal, Azadirachta indica, Balanites aegyptiaca and Tamarindus indica. The forester should also prepare plans for new forest reserves and prepare comprehensive management plans covering the whole country.

The first steps in a policy of forest development are:-

- 1) the delimitation, and protection from grazing, of important vegetation types which provide: good ground cover, a diversity of species; close to urban centres, or are of particular protective, aesthetic or medicinal use, and which may soon be needed for the production of charcoal, fuelwood, gums, resins etc, or for multi-purpose use (protection, production, recreation, beauty etc).
- 2) the good management and improvement measures (soil protection and improvement, introduction and plantation) of new species of trees.

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5. THE NEED FOR WOOD PRODUCTS AND THE COMPOSITION OF THE FORESTS.

The composition of the forests is unknown as there has been no research. Recently however, some work has been carried out in areas of promising economic interest, i.e., the forests on the Juba river and in the Juniperus areas of the northern region.

Various estimates have been made as to the extent of the more important vegetation zones. But reliable data are scarce and the figures are only of a general order. These must be verified through inventories, carried out using modern methods and techniques, such as aerial survey, statistical sampling and other systems of classification.

According to the most recent study (Persson, 1977), the Somali forest areas should be as shown in table 3.

Table 3. Forest types of Somalia (in millions of hectares).

Forest mountainous vegetation (partly dense)	Savanna	Steppe forests herbacious vegetation	Desert & sub-desert	Other dense forest
0,9	2,3	31,6	27,8	0,1

Thus the dense forest covers a total area of 0,2 million hectares of which half is coniferous.

The area covered by bush, degraded forests, xerophilous shrub formations of partially covered by trees, should amount to 10 million hectares.

The estimated stocking should be as shown in table 4.

Table 4.

	Closed forest	Other forests (brush etc.)
Volume per hectare (m ³)	125	5 - 10
Total resources (millions of cubic metres)	20 (conifers 10)	50

According to various estimates the total area of the Juniperus forests of the mountainous chain of the Golis range should be 120 000 ha. Along the Shabelle and Juba rivers, and to the south of Kismaayo, the bush riverain forest covers about 40 000 hectares, with standing volumes varying from 400-450 m³/ha, down to 200-250 m³/ha in the degraded zones.

Where these riverain zones are still largely productive, the Ethiopian Tanning Company [? cooperative] has by import, reduced, through over-importation, the soils in the mangrove zones to such low fertility that they are now unproductive.

The remaining Juniperus procera is certainly less than indicated in the various reports of FAO and other publications. In fact, the inventories recently completed on two important forests in the north (Ga'an Libah and Daloh), have shown that only 1 400 and 308 ha of juniper, with a volume of 67 000 m³ standing timber and about 40 000 m³ of dead wood remain: much less than previous estimates. These volumes are able to supply the only saw mill in Erigavo for the next 8-10 years.

In the south, an inventory was conducted by FAO in 1968, at two sites, one situated near Angle (2 000 km²), the other between Giamama and the coast (600 km²).

However, the extensive irrigation works along the Juba have greatly reduced the forest area in favour of agriculture. It is estimated that the forest presently existing along the river is about 1 550 ha, and this

may be worthy of protection through reservations. The remaining forest composed of isolated areas each of 10-20 ha. cannot be designated as reserve because of its excessive fragmentation.

For the rest of the country there is a complete lack of data on the composition of the forest, on its utilization and on the productivity of the various forest types.

Before a forest policy can be drawn up, it is necessary to carry out an inventory. International organisations (FAO, UNDP etc.) and foreign governments should be asked to finance these inventories which are not aimed at the exploitation of forest resources, but which are real means of conserving and improving the environment.

The changing socio-economic conditions in the country favour an increased use of wood and wood products (tables 5-7). The balance of payments deficit for these items is going to increase in the future, especially for construction, sawn wood and paper products. In the near future, the pressure on the domestic forestry resource is bound to rise.

The supply of charcoal and fuelwood for Mogadishu comes from the intensive exploitation of the surrounding woodland up to a distance of 300 km, although the saw wood supply is limited to defined areas south of the Juba and in the northern region. The present (1975) charcoal consumption is 26 000 tonnes / year and is projected to increase to 45 000 in the coming decade if alternative energy sources are not provided.

According to FAO (1967), the per capita wood consumption (m³) in east and west Africa was as shown in table 8.

Table 5. Consumption of wood products in the Somali Democratic Republic (1000 m³ or 1000 t)

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Roundwood	2 266	2 327	2 290	2 479	2 398	2 582	2 509	2 850	2 900	2 950	3 065	2 151	3 244
Fuelwood & Charcoal	2 231	2 292	2 245	2 434	2 353	2 537	2 464	2 800	2 850	2 900	3 000	3 086	3 160
Industrial roundwood	36	35	45	45	45	45	45	50	50	50	65	65	74
Sawn & cut wood	10	10	20	20	20	20	20	20	20	20	30	20	28
Fibre board	12,5	16,8	26,3	26,4	31,8	26,5	22,7	20,7	20,7	20,7	20,0	20,0	20,0
Plywood	-	-	-	-	-	0,9	0,3	0,3	0,3	0,3	0,3	0,3	0,4
Panels	-	-	-	-	-	0,8	1,2	1,5	1,5	1,5	1,5	1,8	1,8
Newsprint	0,1	0,1	0,1	-	0,1	1,6	-	0,5	0,2	0,2	0,2	0,3	0,4
Writing paper	0,1	0,1	0,1	-	-	-	-	-	-	-	-	-	-
Other papers	0,3	0,3	0,3	0,7	0,7	0,7	1,8	0,3	0,8	0,9	0,9	0,9	0,9

Table 6. Production, Import and Export of wood in the Somali Democratic Republic
 Quantity = 1000 m³; Value = 1000 x US\$. Source: FAO, Year book of forest products, 1975.

TIMBER.	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Production	2 435	2 485	2 545	2 595	2 645	2 695	2 795	2 850F	2 900F	2 950	3 060	2 137	3 230
Import Qty	-	-	-	-	-	-	-	-	-	-	5	14	14F
Value	-	-	-	-	-	-	-	-	-	-	723	2 200	2 200
Export Qty	169	158	255	116	247	113	286	-	-	-	55F	-	-
Value	985	978	1 671	688	1 597	811	2	2	-	-	-	-	-
Fuelwood Charcoal													
Production	2 400	2 450	2 500	2 550	2 600	2 650	2 750	2 800	2 850F	2 900	3 000	3 086	3 170
Import Qty	-	-	-	-	-	-	-	-	-	-	-	-	-
Export Qty	196	158	255	116	247	113	286	-	-	-	55F	-	-
Value	980	978	1 671	688	1 597	698	811	-	-	-	850F	-	-
Fuelwood													
Production	2 400	2 450	2 500	2 550	2 600	2 650	2 750	2 800	2 850F	2 900	3 000	3 086	3 170
Import Qty	-	-	-	-	-	-	-	-	-	-	-	-	-
Export Qty	2*	-	-	-	-	-	-	-	-	-	-	-	-
Value	2*	-	-	-	-	-	-	-	-	-	-	-	-
Charcoal													
Import Qty	-	-	-	-	-	-	-	-	-	-	-	-	-
Export Qty	28	26	43	19	41	19	40	-	-	-	9F	-	-
Value	978	978	1 671	688	1 596	696	811	-	-	-	850F	-	-
Timber for internal use													
Production	35	35	45	45	45	45	45	50	50F	50F	60	51	60
Import Qty	-	-	-	-	-	-	-	-	-	-	5	14	14
Value	-	-	-	-	-	-	-	-	-	-	723	2 200	2 200F
Export Qty	5*	-	-	-	-	-	-	2	2F	-	-	-	-
Sawn/planned													
Production	10	10	20	20	20	20	20	20	20F	20F	10F	20	20
Others for ind. use													
Production	25	25	25	25	25	25	25	30	10F	10F	30	31	32
Sawn shaved													
Production	5	5	5	10	10	10	10	10F	10F	10F	15F	10	14
Import Qty	8	12	21	16	22	17	13	11	10F	11F	4F	5F	5F
Value	805	757	675	731	979	818	780	987	892F	978F	812F	1 150F	1 150F
Fibre board													
Production	-	-	-	-	-	1	1	2*	2*	2*	2*	2F	2F
Import Qty	-	-	-	-	-	1	-	-	-	-	-	1F	3F
Value	-	-	-	-	-	68	59	43	41F	41F	135	480F	480F
Plywood													
Import Qty	-	-	-	-	-	1	-	-	-	-	1F	1F	1F
Value	-	-	-	-	-	68	59	43	43F	41F	135	480	480F
Finished panel													
Production	-	-	-	-	-	1	1	2*	2*	2*	2*	2F	2F
Forest products													
Import value	945	897	815	1 052	1 280	1 642	932	1 402	1 296	2 017	3 787	4 865	4 865F
Export value	985	978	1 671	688	1 597	698	811	2	2	-	850F	-	-
Sawn													
Value	-	624	32	45	45	50	61	92	92	92	189	245	245

* - Official data
 F - FAO estimate

Table 7. Import of Paper Products (1000t).

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Paper & cartons	-	-	-	1	1	3	-	1	1	3	5	2	2F
US\$	140	140	140	321	301	756	93	372	361	996	2 117	1 035F	1 035F
Newsprint	-	-	-	-	-	2	-	1	-	-	1F	1F	1F
US\$	15°	15°	15°	20	15°	15°	6	177	80	50	257	392	392F
Writing paper	-	-	-	-	-	-	-	-	-	-	-	-	-
US\$	-	-	-	15	-	-	29	16	37	230	205	316	316
Other kinds of paper	-	-	-	1°	1	2	-	1	1	2	4	-	-
US\$	125	125°	125°	286°	286	741	58	179	244	716	1 655	327F	327F
Printed	-	-	-	-	-	-	-	-	-	-	-	-	-
US\$	150	150	150	-	150	9	-	354	400	500	428	653	653
Printed & writing	-	-	-	-	-	-	-	-	-	-	-	-	-
US\$	-	-	-	-	-	-	290	-	370	575	1 025	632	632
Other kinds of paper & carbons	-	-	-	-	-	-	-	-	-	-	-	-	-
US\$	417	417	417	409	409	412	193	256	271	398	424	818	818

° = Non official data.

F = FAO estimates.

Table 8. Per capita wood consumption in eastern and western Africa and Somalia (tonnes per year).

	<u>Average</u>	<u>Variation for single country</u>
Fuelwood & charcoal	0,90	0,16 - 1,48
Wood for construction	0,05	0,02 - 0,20
Sawn wood (output)	0,01	0,0003 - 0,0006
Sawn wood (input)	0,02	0,0006 - 0,12

For Somalia

	<u>1967 - 71</u>	<u>1972 - 75</u>
Fuelwood	0,92	1,0
Construction wood	0,02	0,02
Sawn wood & panels	0,01	0,01

During this period population growth was three percent. Therefore it is necessary to increase wood production by improving the condition of the soil, by instituting reserves in which grazing is forbidden, and by other environmental protection measures and forestry improvement.

On the other hand, it is also necessary to develop tree plantations, and to undertake reforestation projects, and to improve wood utilization techniques along the way. Step by step, it is possible to reach self sufficiency in this important raw material.

6. FOREST LAW

Regulations issued during the British colonial period, (regulation number 6 of 1944 with its amendments, number 2 of 5 March 1945, number 24 of 12 March 1945, and number 8 of 9 December 1947), partly recalled those of the Italian Forest Decree (number 11865 of 7 September 1936). They established the terms and methods of any forest utilization such as fuelwood, charcoal sawn timber, which were subject to licence (age of the trees, stem diameter, minimum distance from the water courses, road, channels and wells etc). The protected species were also specified and to cut these required a special licence. However, the list is now obsolete for the present conditions in Somalia.

A proposal for forest regulation, enacted during the Italian Trusteeship Administration and dated 25 November 1954, foresaw the subdivision of the woodlands into different categories, each based on precise, distinctive criteria:- free [open]; reserved; reserved woodlands with forbidden grazing; the protection of a number of species; the general regulations to administer the woodlands; and the issue of utilization licences, etc. These regulations could still form a valid base for today's administration of the Somali forest resources, although they may require small technical changes.

Presently law number 15 of 25 January 1969, on the protection of fauna and forests, prohibits any utilization of living trees and permits only the cutting of dead, standing trees, either for family use or charcoal production.

The objectives of forest development and of environmental defence as defined by the Somali Government, (reaching self-sufficiency in wood production, fixation of sand dune, and conservation of the soil, establishing plantations, constitution of parks and natural reserves, and the reaching of a balanced agro-pastoral system), need new legislative steps. They also require an adequate administration for the forest resource to face the transformation taking place in the country.

It is particularly necessary to settle the problem of the forest reserves. The present legislative system (which does not envisage the elimination of all rights of use when an area is declared a reserve) induces strong pressure to exercise the rights of traditional grazing and usage in the areas declared protected.

Various studies have indicated the most suitable zones to designate as forest reserves: these would guarantee to maximise the direct and indirect benefits deriving from the wood. Unfortunately, owing to the lack of specialized technical staff (especially for the rural activities), scarcity of resources, lack of adequate legislation and a lack of adequate forest services, little has been done practically to implement the ideas and plans already formulated.

7. POSSIBLE SILVICULTURAL TREATMENTS FOR THE DIFFERENT FOREST TYPES.

Some vegetation associations have been over-exploited in the past and are today reduced to small areas on poor land. They have little biological stability and are on the road to extinction. They must now be placed under a more protective and rigid regime. Such areas include; (1) the marine mangroves of northern Somalia and Gezira (in the central zone), together with those in the estuaries of Lak Anole, Lak Kimoti and Lak Bubasci in the south as far as the Kenyan boundary, (2) riparian forests of the Juba and Shabelle rivers; (3) some of the "tug" in the north in which grow Conocarpus; Acacia spirocarpa, Phoenix, etc, and (4) juniper forests of the northern mountains.

7.1 MANGROVES.

The Somali mangroves have, in the past, yielded abundant quantities of tannins for export and various other woody materials. Above all they have supplied poles and charcoal for the local population. To prevent the disappearance of the mangroves it is essential that they are assisted to regenerate artificially by (?) transplanting suckers, and through direct seeding for those species which germinate easily, eg Avicennia and, to a lesser extent, Rhizophora.

Seed harvesting and collection of [?] vegetative parts is generally easy from floating material, although it is necessary to store the collected material quickly, as it loses viability. Temporary storage in sea water is possible. The creation of artificial (?) barrages could maintain the environmental needs of a desired species by controlling salinity, substratum, and light (Rollet, 1974). Through these measures it is possible to re-establish the soil and necessary environmental condition favourable to the future planting and management [of mangroves].

Pre-conditions for these protective measures are a rigorous survey of the extent of the existing mangrove forests, a study of the present supply of mangrove wood, and the setting up of permanent trial areas to increase silvicultural knowledge.

7.1 THE RIVERAIN VEGETATION.

The riverain forests have been heavily destroyed due to the growth of agriculture in these zones. This destruction will increase with the

completion of the irrigation project in the Jubba valley.

It is necessary to establish protected, natural parks for scientific use and cultural objectives (in areas not included in the development projects). These will preserve their significant floristic and ecological importance and also certain forestry species of high value. In the other areas these important formations must be protected, and provision made for the planting and farming of high value forest species either indigenous or exotics.

Some riverain species, such as doum palm (Hyphaene benadirensis and H. carinensis) should also be protected for their beauty and (?) protective value, even if they are of no economic importance.

Renewal of the vegetation through the planting of seedlings, may be useful in certain cases where the wood is used for handicraft production. Also the selective elimination of the male species where the side productions [literally "plant ivory"; the allusion is not understood], is needed for particular objectives.

7.3 JUNIPERUS FOREST.

The high altitude Juniperus association of the north perhaps represents the remnants from an age of higher rainfall: because of this, it is subject to a high rate of degradation under grazing pressure.

The present extent of these forests is less than the [commonly] estimated 120 000 ha, and their characteristics vary according to the impact of man. Many trees are over-mature, with standing dead timber, very little natural regeneration, and an absence of young trees.

Because the trees are grouped by age it will be difficult to create the correct ecological conditions to favour natural regeneration. Heavy grazing will also prevent the development of seedlings except in inaccessible areas.

The possibilities for the natural regeneration of this vegetation are linked to protection from grazing and erosion control. This will permit seed germination and the growth of young trees. Clearance of the competing vegetation, land ploughing and suppression of the grass cover [are the measures which could be taken]. The regeneration of this species is, perhaps, favoured by fire and generally takes place on mineral soils.

In certain areas the control of erosion, protection from arable farming, [?protection from] grazing and other harmful agents have permitted regeneration. In the degraded zones of these forests, a ground cover grows quickly, which protects the young Juniperus, and favours the re-population of the degraded zone with this formation.

[? On the basis of the available forestry inventory data, it is necessary to protect soils for periods of 150-160 years.]

The absence of young and middle-aged stands [of Juniperus procera] necessitates the use of 'forest farming' methods such as total cutting, band cutting, strip cutting with delayed planting, soil moving, and (?) direct sowing. Other species of trees with good wood may be planted throughout the zone such as, Pistacia falcata, which, because of its high value resin, has disappeared from Somalia, Buxus hildebrandtii, Olea chrysophylla or Terminalia brownii.

The experimental introduction of other coniferous species, which may be able to adapt to the high rainfall and the soil types, could be advantageous, eg., Cupressus lusitanica, Pinus kesiya, P. merkusii, P. patula. Other species such as Callitris spp., Eucalyptus citriodora, E. microtheca, E. tereticornis and E. camaldulensis could also be tested.

7.4 XEROPHILOUS BUSHLAND.

Grazing and livestock rearing must be controlled in the bush zones because of their importance as sources of charcoal, wood and other secondary forest products (gums, resins, colouring substances etc), and as (?) sanctuaries for flora and fauna. However, it is necessary that they find adequate alternative uses under management, in order to guarantee the continuous production of raw materials.

The usual measure of protection from grazing and other disruptive factors (fire, excavations, etc), cannot, in fact, guarantee a satisfactory qualitative and quantitative productivity. The natural evolutionary forces of these forest eco-systems are extremely "chancy" and slow. The re-formation of adequate ground cover passes through a period of colonization by pioneer species, generally of little economic value, and which in the end may not lead to the original climax vegetation. Thus the original production and financial objectives are not attained.

The xerophilous bushland is subject to a group of negative environmental factors, biotic and abiotic, which make the work of the forester very difficult.

Grazing is a constraint, as we have mentioned, but the more dangerous obstacle to natural regeneration by seed is the long periods of drought. These droughts cause an enormous loss of seedlings [? or seed]. Strongly linked to drought is the temperature of the air layers close to the soil which often reach lethal values for vegetable tissues, or induce excessive transpiration in the young, small plants. Thus the small plants receive an inadequate water supply through their little developed root systems, or because of competition with the surrounding vegetation.

In many areas the presence of high salinity, alkalinity, impermeable surface layers, or shallowness of the soils prevents the start of recovery.

Other damage can be caused by the very strong winds, by windblown sand, or by insects and rodents which destroy a large quantity of seed. Besides these factors, the harvesting of Acacia pods to feed livestock, is commonly practiced over the whole country. All these factors have extremely deleterious effects on the regeneration of this type of bush.

Natural regeneration is sometimes possible in the more humid zones, along the beds of "wadi", or in the low layers with boundary and surface stratum. But these are exceptional circumstances. Normally it is not possible to rely on the improvement of topsoils through natural regeneration.

The increase of genetically mediocre trees is promoted by overcrowded grazing, the excessive cutting of mature seed producing trees (without saving the best) non-professional low felling and the poor regenerative capacity of the tree stumps [i.e. poor coppicing ability].

Where the correct protective measures are taken, e.g. the involvement of the people, the control of pod harvesting and correct felling practices, it is possible to significantly improve the productivity of the bush. This however, required adequate equipment and skilled labour.

The problems of wood production in the Somali bushland, as in almost all the arid zones of other countries, has not been adequately studied. It is

therefore difficult to give a rational utilization plan, which combines the need to permit adequate exploitation while still maintaining or improving the area.

The only existing study of wood production in xerophilous bush is on a strip of land between Adaley and Gusley (kilometre 58-62 of the former railway from Mogadishu to Jowhar). This study was carried out by Moreschini, (1937) on one hectare of relatively dense woodland growing on clay soils which were [? periodically] flooded. A total of 491 trees were felled. The species found were Acacia benadirensis, A. nilotica, A. mellifera, A. stefanii, Dobera glabra, Salvadore persica, Terminalia praecox, T. ruspolii and Euphorbea ruspolii etc.. Wood production is given in table 9.

Table 9. Wood production of four Somali tree species.

Acacia benadirensis.			
* steres	97 equal to 287 quintals	[? of charcoal] from 273 plants	55%
Terminalia ruspoli			
steres	174 equal to 369 quintals	" " from 132 plants	26%
Salvadora persica			
steres	12 equal to 24 quintals	" " from 32 plants	6.5%
Dobera glabra			
steres	34 equal to 76 quintals	" " from 54 plants	10%

[* A stere is a metric cord, i.e. a stack of round wood occupying one cubic metre].

Biomass totalled 317 m³, equivalent to 756 quintals of charcoal wood; branch production (not utilizable) was 96 m³, equal to 120 quintals altogether then a biomass of 413 m³ equal to 876 quintals. [1 quintal = 100 kg]. Taking into account the different specific gravities of the wood, the following unitary production was obtained. (table 10).

Table 10. Total production (m³/ha) of four Somali tree species with specific gravity and average weight of each tree.

Species	Specific gravity [?green]	Weight of stere (kg)	Stere coefficient	Average weight of tree (kg)	Total production m ³ /ha
Acacia benadirensis	1,326	295	0,222	105	21,50
Terminalia ruspolii	0,930	312	0,227	279	39,50
Salvadora persica	0,885	203	0,229	75	2,75
Dobera glabra	0,970	225	0,232	140	7,90

According to this unpublished study, which has been extensively reported because of its wide interest and uniqueness, the yield from one hectare of woodland of good stocking "determined by felling" is technically 71,7 m³ of charcoal, and 11,3 m³ of branches - a total output of 83,2 m³/ha.

At the present, many small farms are in the survey area. The vegetation is therefore substantially reduced and degraded. For this reason, it is not possible to deduce with any certainty, the condition of the woodland 40 years ago.

On the basis of discussions with Somalis involved in forest utilization and with various technical staff, it is reasonable to assume that the data supplied by Moreschini are near the average. The study of the farming [? raising] and the growing [? planting] of different kinds of woodland is of vital importance as an aid to designing a management and utilization plan for these soils.

A recent survey by the Technical Centre for Tropical Forests, a French organisation, has shown that through appropriate histological techniques, it is possible to identify the woody growth ring, which marks the fall of leaves during the arid season, even for the dry savanna species. The annual growth rate of the woody species is dependent on variations in the natural environment, soil type, etc., as well as the browsing pressure. It should be possible to determine this by trunk analysis, based upon appropriate sampling techniques, or by using a technique based on felling after a number

of years. Such a study has been carried out by Catinot (1966), in Upper Volta.

In the absence of precise data we can estimate that the recovery of the moderately degraded xerophilous woodland is about 0.5-1, 2m²/ha/year (about 1,5-3,0m³ of fuelwood). A rotation period of 15-20 years should be adopted for charcoal, fuelwood and pole cutting, while a period of 40-60 years or more will be needed (diameter 30 cm) for the valuable Acacia and for Terminalia species used in the production of furniture and as construction timber. These periods are largely indicative, since recovery will be longer or absent, in vegetation which has been degraded by over-exploitation.

Felling in these areas, and for this type of woodland, should be based on cutting only selected trees 4-6 m apart. This would avoid drying out the soil and will control erosion. The cutting of live trees should be based on the advice of forestry experts. In the first instance the standing, dead trees and the bushy shrubs should be cut. (?) Empirical management under the guidance of an expert is a preferable form of management to aid the recovery of the topsoil. (?) As a second possibility, rotational cutting around settlements may be considered, with less cutting in areas with a high livestock population. Single or repeated coppicing (? pollarding), based both on the type of wood required and the characteristics of the vegetation, is the best method of managing this type of woodland.

However, in many instances, the best woodland utilization is based more on the production of other valuable raw materials, such as gums, resins, balsams and dyestuffs, than on wood production. With the abolition of grazing, correct silvicultural practices may guarantee a higher productivity from the woodland as well as aiding the reconstitution of the topsoil. These measures must be aimed at retaining water in the soil. In fact the spatial distribution of the tree and shrub species in the woodland is linked to erosion and water movement. permeable, fine material moves to low-lying land, where the vegetation can grow vigorously thanks to the water coming from the surrounding compacted, higher areas. The different vegetation areas of northern Somalia, as well as the open woodland with discontinuous cover in the southern central regions, can be compared morphologically to the "savane tigre" (striped savanna) typical of the dry zones of Africa.

Silvicultural intervention is therefore very closely linked to the protection and improvement of the soil [?] which has a sufficient water supply. For

this reason, the areas chosen for reafforestation, as well as improvement measures for the existing forests, should use soil cultivation techniques that maximise and conserve the available water resources.

The use of the 'step' method [?terracing], deep soil working (earth moving, and breaking etc), with bulldozers and graders, on strips, or the whole area according to the slope and contours, has given good results in semi-arid regions, eg, Algeria, Sudan, Arabia and Kuwait, and should therefore be tried in Somalia. Deep earth moving in strips before the rainy seasons together with repeated surface working during the dry seasons, should give a significant increase in vegetation and a higher survival percentage of seedlings in those areas where an increase in vegetation would aid the recovery of deteriorated topsoils.

The present system of charcoal production is not efficient and significant wastages occurs. To increase the charcoal yield from the woodland it is necessary to introduce a more rational manufacturing and marketing system. The yields from the present Somali system, based on a hole excavated in the soil, ranges from 8-12 percent of the weight of raw wood, while with more rational technology the output can increase to 18-20 percent.

Tests conducted in the forties with a "Rex" kiln gave the following percentage yields, (referred to the dry weight of the wood):-

Acacia bussei - 17 percent, Balanites spp. - 19 percent, Acacia nilotica - 19.75 percent. The possibility of utilizing branches and twigs, at present discarded, should be considered.

The transport of charcoal by lorries is an uneconomic way of using resources. Marketing procedures must be improved and the charcoal transported in sacks or bins, rather than loose as at present, this should reduce the percentage lost. Strong control should be exercised on the quantity of timber cut, and where and when this is taken.

Principal species for reafforestation in the xerophilous bushland are: Acacia albida, A. aneura, A. brachystachya, A. dealbata, A. farnesiana, A. nilotica, A. peuce, Azadirachta indica, Ceratonia siliqua, Conocarpus lancifolius, Dalbergia sisoo, Dodonia attenuata, Eucalyptus beheriana, E. bicolor, E. blakelyi, E. brockwayi, E. erebra, E. dumosa, E. flocktoniae, E. longicornis, E. robusta, E. rudis, E. salmonophloia, E. salubris, Hakea leucoptera, Prosopis chilensis, Schinus molle and Tamarix aphilla.

8. REAFFORESTATION, SOIL PROTECTION MEASURES AND MEASURES TO INCREASE WOOD PRODUCTION.

8.1 REAFFORESTATION.

The [Governments] Reafforestation Development Plan (1973-78) made provisions for 3 000 ha of plantations in three years. The planting was to be divided as shown in table 11.

Table 11. Reafforestation schedule.

	<u>Year 1.</u>	<u>Year 2.</u>	<u>Year 3.</u>
Batalaale (ha)	500	1200	1300
Labour (no. of men)	650	1525	1641
Gacan-Libah (ha)	300	1200	1700
Bokh			
Labour (no. of men)	200	627	1043

The project is, however, only partially completed because of technical and economic constraints. At Ga'an libah, about 50 ha was planted in the first year and 100 ha in the second. No planting took place at the other two sites.

Labour problems were one of the difficulties. The maximum number of available workers was 500, (?) most of whom were employed on work not directly connected with reafforestation. On average, 1,0ha/person/year was planted. Another problem was the distance of the nursery from the reafforestation site, about 45 km on unsurfaced [rough] road. This greatly influenced the implementation schedule of the projects, as the area that can be reafforested depends on the number of seedlings which can be transported from the nursery during the two, short, rainy seasons. This was only 1 400 seedlings per truck load and the trucks were scarce and frequently damaged by the difficult road conditions.

For these reasons, the different phases of the job should be carefully studied [prior to starting] to avoid delays in the execution of the programme. Construction of a mobile nursery, an adequate transport network and relief irrigation are all required.

At the present there are four main nurseries in the country which have adequate technical equipment and a satisfactory rate of production of seedlings. These are at Berbera, 164 000 seedlings/year; Dibbis, 670 000; Afgoi, 600 000; Jilib, 200 000. There are six other small nurseries, in Mogadishu, Jenale, Alassandria, Yontoi, Baidoa and Belet Weyne.

With this number of nurseries it is possible to undertake an extensive programme of afforestation and to start middle and long-term programmes of soil and environmental improvement.

The reafforestation programme should be implemented with care. The transport of seedlings, the quantity of irrigation following planting, the digging of catchments etc, should be carried out with care. For this work, technicians and trained labour are required.

In the regions with irrigated agriculture, Shabelle and Juba for example, the reafforestation measures should be mostly directed towards:-

- tree and shrub windbreak systems, to reduce the transpiration of, and to create favourable micro-climatic conditions for, various agricultural crops.
- creating plantations of fast growing timber species which produce high value wood.

8.2 WINDBREAKS

The beneficial effects of windbreaks on agricultural crops in semi-arid regions have been widely studied and described by many researchers (Karshon, 1968; Costin, 1974; etc.). There is an increase in the quality and quantity of the crop, more rapid maturation, less water consumption and the creation of a micro-climate which is favourable to workers and animals. Windbreaks also protect the infrastructural networks (eg. streets, walls etc.), from strong winds and other problems brought about by wind driven sand. They improve the supply of fuelwood and other woods used by households and improve the amenity characteristics, especially near urban centres.

To exert the most effect, windbreaks should be: located in the correct places; have a structure and composition suitable to the characteristics of the wind (intensity, strength, direction); be suited to farming practices; and tolerate the environmental conditions, They should also have a [potential] intensive, economic use, eg. gum production. The windbreaks should give the crop the greatest protection possible, while themselves occupying the minimum

possible area. (Goor, 1963). Recent research has shown that the protection factor does not depend upon the width of the break but its height and the vertical structuring of the trees.

Through careful selection of species, and the correct spacing of the trees, it is possible to create an efficient windbreak. The importance of these protective strips to Somali agriculture has been realized for a long time, as can be seen by the rows of Casuarina created around the banana plantations near Shalambot, Jenale, Afgoi and Jowhar.

To protect agricultural crops from the strong winds of the south-west monsoon, hedges of Parkinsonia aculeata were planted alongside the roads which divided the farms. The provision of these protective rows was enforced by law, (Agriculture Concession Law - RD Number 266 of 24 January 1926).

To be most effective the windbreak should be planted at a close espacement and must have the main rows at ninety degrees to the south-west and north-east winds. Secondary lines should be planted at right angles to the main rows. When fully developed the maximum protection is obtained to leeward of the windbreak for a distance of some 20-30 times the height of the denser protective band, and for distances of 5-10 times for the overwinds. It is possible to calculate that the windbreak should have an average height of 20 m. In lighter winds, the distance between the secondary rows should be 600-700 m. When the winds are strong and the soil texture is fine, these distances decrease to 300-200 m for the main rows, and 500-600m for the subordinates.

The correct selection of species for windbreaks is important. They should be easily established and be suitable for the climatic conditions. The trees should grow rapidly, have a uniform, conical form, possess a deep root system and have a good mechanical resistance. They should also protect against insects, and harmful, pathogenic animals, and supply wood, forage and other useful products.

In the irrigated agricultural zones Somalia, the following species have been found to be suitable for the job:- Casuarina equisetifolia, Conocarpus lancifolius, Tamarix aphylla, Azadirachta indica, Meliza azedarach, Parkinsonia aculeata, Kigelia aethiopica, Washingtonia fillifera, Phoenix spp., Albizia lebbek, Ceiba pentandra and Sueda fruticosa.

Also tested recently have been:- Eucalyptus camaldulensis, Anacardium occidentale and Acacia cyanophylla. Only the last species was successful; the other two being sensitive to the strong winds as well as competing with the surrounding crops.

In the irrigated zones of Shabelle and Juba the windbreaks may be composed of straight rows of Casuarina and Conocarpus which can grow to 22-30 m in height and 40-60 cm diameter with a life-span of 40-50 years. They have a uniform structure and protect a wide area efficiently.

On sandy areas exposed to wind erosion, and where the winds are strong, the following species with dense foliage and of medium height are better:- Parkinsonia aculeata, Tamarix spp. and Sueda fruticosa. They act as a protective screen to the main windbreak trees (Casuarina, Conocarpus, Azadirachta etc).

Near the sea, salt resistant species are better, eg: Acacia saligna, A. cyanophylla and Tamarix spp.

In zones with scarce water resources we can mention the following indigenous species for use as windbreak:- Acacia nilotica, A. seyal, Zyzyphus jujuba, Tamarix aphylla, Phoenix spp., Hyphaene spp., Euphorbia tirucalli: and the exotics, Prosopis juliflora, Dalbergia sissoo, Parkinsonia aculeata and Melia azedarach.

Previous research has shown that to be successful, seedlings should be planted just before the "gu" rains into holes of 40 x 40 cm set in small irrigation furrows.

In the zones with an annual rainfall of between 250-300 mm and with 5-8 months of drought, it is necessary to supply water to each plant. A quantity of about 10 l on 4-6 occasions is needed during the first year.

The use of seedlings grown in polythene containers for 6-8 months prior to planting gives good results for all the mentioned species except Tamarix spp. Propagation of this species takes place easily through cuttings, each 30-40 cm in length. A suitable planting espacement is 3 x 4 m, or 4 x 5 m and, when there is a good supply of water, 2 x 3 m.

The wood production that can be obtained with rotations of 20 years

(Conocarpus and Casuarina) is around 30-35 m³ of fuelwood per 100 m of double row of windbreak. It is possible however, to find wood of good quality through lopping and trimming techniques. This depends on the availability of good forest technicians who can control the irrigation. Windbreaks can be important sources of wood for the agricultural estates and contribute to the improvement of the main crop.

The use of species of trees and shrubs which flower throughout the year, and which have pollen and valued nectar, can make it feasible to undertake profitable activities such as bee-keeping. Other species can supply additional fodder.

In this field, it is necessary however, to undertake research and trials to identify and evaluate the positive and negative impact of the windbreak on the crop. Work is also needed to identify, on the basis of the results, the particular environmental condition of the trial sites, suitable windbreak species, and the species mix which gives the crop the maximum protection with the loss of the minimum area of land.

8.3 TIMBER PLANTATIONS.

The scarcity of wood as a raw material imposes an economic burden of foreign exchange on the Somali economy. It is necessary therefore, to study the possibility of establishing timber plantations in irrigated areas.

In this field we have some experience along the Juba and Shabelle rivers, using various species, and various plantation and irrigation methods. At Mordile (Benadir region, with four drought months), a plantation of five hectares of Eucalyptus microtheca and Gmelina arborea has been established on argilleous soils. At Jamama, on the Juba river, an irrigated area of about 150 ha of valuable timber species has been established: Tectona grandis, Swietenia macrophylla, S. mahagoni, Khaya senegalensis, etc. Trial plots of other important timber species have been started at Ionte (Eucalyptus camaldulensis, Gmelina arborea, Tectona grandis, Swietenia macrophylla and S. mahagoni).

At Bulo Gudud, because of the lack of irrigation, Eucalyptus camaldulensis, of three provenances, and at Daloh, E. gomphocephala have been tried.

In the fifties, plantations of Conocarpus lancifolius were established, with good results, particularly at La Furug and Batalaleh, and on other sites in the north - zones of extreme drought which necessitated supplementary watering, at least in the first years after planting.

First observations from these plots of different species on different sites have shown the possibility for this type of timber production. This should free Somalia from its dependence on imported timber. This is particularly the case with irrigated plantations, where early results are especially promising.

In the Juba region after three months of growth (ie. about one year ? after planting), we recorded the following average heights; Eucalyptus camaldulensis, 3,3 m; Gmelina arborea, 2,5 m; Tectona grandis, Swietenia macrophylla and S. mahagoni, 1,5 m.

In other zones of the country we can find plantations of Eucalyptus camaldulensis, aged 15 years with an average height of 25 m and about 25 cm diameter; for Casuarina a height in excess of 16-18 m was recorded in six years.

The best zones for irrigated plantations may be Shabelle near Mogadishu using Gmelina arborea, for the production of matches in order to satisfy the annual need of 300 m³ of wood currently imported by the local industry. An annual increment of 20m³/ha is anticipated. Plantations of Eucalyptus camaldulensis, E. tereticornis, E. gomphocephala and E. microtheca, (the last two species mainly on alkaline, heavy soils) for the production of handicraft items [should also be considered]. Casuarina equisetifolia, should be tried in the zones subject to sea winds and wind erosion, while Swietenia macrophylla, Dalbergia sissoo, Cassia siamea, Entandophragma spp. and the production of valuable ebonys [may also be possible].

Because of the high costs of irrigation the plantations along the Juba should be used mainly for the production of valuable woods. Species should include, Tectona grandis, Swietenia macrophylla, S. mahogoni, Entandophragma spp., Khaya senegalensis, K. grandiflora and Dalbergia sissoo. Other local species easily found in the bush such as Mimusops degan, Diospyros corni, Trichila spp., and Xilocarpus spp. could also be tried.

8.4 SAND DUNE FIXATION.

Solving the problem of fixing the mobile sand dunes is vital to Somalia, as it is a widespread phenomenon which occurs throughout the country, and which is increasing with the growth of many new dunes near towns and villages.

The most important fixation project is on 700 ha near Merca, 100 km from Mogadishu. The system used, and tested by long experience, consists of the erection of dead hedges and the planting of hedges of Commiphora spp., Acacia spp., Cordia somalensis, Dicrostachys benadirensis, Sesamothamnus busseanus etc. The hedges should be set at the correct angle of ninety degrees to the prevailing winds. For Commiphora spp. a distance of 1,5 m between plants and 6-8 m between the rows is satisfactory. On very eroded sites, Opuntia spp. and Euphorbia tirucalli can survive and grow well if planted at the start of the rainy season. Other species which are suitable for dune fixation are Casuarina equisetifolia, Tamarix aphylla, Anacardium occidentale, Acacia cyanophylla, A. saligna, and Eucalyptus camaldulensis. To date, Casuarina and Anacardium look less promising, the others already show good results, particularly the Acacia spp. and Eucalyptus.

The work accomplished to date has taken place thanks to the full collaboration of the people, of the army, and of the political authorities under the

leadership of Mohamed Siyad Barre, the President of the Somali Republic.

It is essential that the work of dune fixation be continued, so that the annual dune movement (about 20-30 m/year) does not become damaging to agricultural plantations and the infrastructure [? roads, canals]. To speed up the programme it is necessary to improve the present systems and to create [nursery] sites suitable for the plants. The seedlings are currently transported by trucks from Afgoi at an average load of 700 plants per 150 km round trip.

In the areas near the sea it is possible to obtain good dune fixation using Ipomaea pes-carprae (ararek), I. macalusoi (gheresial), I. whyteana (curtup), and also Salsola spp., Sueda spp., (assad, diluc), Calatropis procera (bohe), Cordia somalensis (marer), Cordyla africana (untar), Maerua spp., Scaevola plumieri, and Acacia cheilanthifolia, which spread spontaneously in areas protected from grazing.

Other species which could be tried are: Acacia auriculata, A. cyclops, A. farnesiana, A. nubica, A. raddiana, A. tortilis, A. senegal, Prosopis juliflora, Cassia auriculata, Conocarpus lancifolius, Zyzphus spina-christi, Parkinsonia aculeata, Calliganum comosum, Azadirachta indica, Salvadora persica and Vernonia spp..

Tamarix gives particularly good results as it puts down roots quickly.

(?) Other indigenous and exotic species are also successful (?) if tied to a stake (1,0 to 1,5 m tall and 20-30 mm in diameter) which gives protection from the salty winds.

Apart from Opuntia and Euphorbia, there is a need for species trials to find other 'fast planting' species, eg. the grasses Elymus giganteus, Ammophila arenaria, A. breuiligulata, Aristida pungens, Agropyron junceum, Eragrostis curvula, Panicum antidotale, Boutelona curtispindula and B. eriopoda. These pioneer species should be used to consolidate the area, but it would be interesting to find new succession species of greater economic importance.

9. SILVI-PASTORAL TRAINING

Because of the scarcity of forestry experts with professional or university degrees, we face great difficulty in achieving adequate, silvi-pastoral policies. Many silvi-cultural projects have failed due to lack of experts.

The Somali National University is now teaching some courses in this field. We hope in the future to also have a course of silvi-pastoral studies, in order to face the problems of the grazing activities of nomadic livestock, conservation in its ecological and silvi-cultural aspects, forage production, management of the pastures and forests, and animal nutrition in the forests.

The supply of silvi-cultural technicians and specialized staff can be achieved through training with the assistance of national and international staff and institutions.

10. PRODUCTION OF INCENSE, MYRRH AND GUMS

Somalia, known from ancient times as "Punt Land" or "Scents Earth" has played a very important role in the production and commercialization of frankincense, myrrh and other gums and natural resins. This is shown in the famous, old Dair paintings of Bahri and Luxor representing the expedition of Queen Hatshepsut (in the middle 1400's B.C.) to import these substances, which were used largely in funeral rites and to try and import and acclimatise these trees into Egypt.

The frankincense from Somalia forms around 70 percent of world production. However, frankincense opoponax [perfume from the resin of Commiphora spp.] are not extracted or commercialised in the country.

The other gums and resins, both fresh (damar, sandarak) and fossil (amber) have on the contrary, little economic importance. The frankincense, myrrh and opoponachs are rubber-resins, which are semi-liquid exudates from different species of Boswellia and Commiphora.

Data on the commercialisation of these products are scarce. This is because they deal with products which are subject to large variations in quantity from year to year but which, on the whole, are of no great importance. (see table 12).

Production takes place mostly in the northern regions of the country and is limited, for frankincense, to a narrow, mountainous strip over-looking the seas and 50 km in width, with collection centres at Erigavo, Las Koreh and Berbera. The myrrh grows mainly in the region of Bosasso (towards the Ogaden) at Dolo, Lugh and Hoddur. The various gum products from Acacia species come mainly from the large territory between latitude 04° 05'N and the Juba and the Shabelle. The more important centres of production are, Haidi, Mait, Las Koreh, Bosaso, Candale, Gardo, Alula, Scusciuban, Dorgal, Baidoa, Lugh and Oddur.

While the harvesting of frankincense takes place under government control, generally through producer cooperatives, the harvesting of gums and of myrrh is uncontrolled and takes place on a family basis.

To date in Somalia, there is a lack of any real "cultivation" of gums and resins. In fact, the gummiferous Acacia spp. grow wild in the bush or are found on abandoned farmland near the villages, where they remain untended.

The trees are not planted, whereas in Sudan and Western Africa (Senegal, Chad etc.) they are cultivated. Up to now, propagation has taken place naturally through seeding. There have been no measures to improve production and harvesting techniques or marketing.

Even for frankincenses, "cultivation" is lacking. The plants reproduce through seed [?contained in hard coated pods] and it is only recently that cuttings were tried to multiply the plant (Bergstrom, 1957). Myrrh is also a natural product of the bush.

The harvesting of gums and resins is carried out by cutting and removing a strip of bark from the tree trunk using a suitable chisel, sharp on one of its sides and called a "mengaf". The exudate is harvested when it reaches the desired consistency and is sub-divided according to its quality and purity before being sold. Most gum production is for the domestic market, while almost all the frankincense and myrrh is exported through the harbours of Berbera, Bender Cassim, Bosaso, Alula, Durbo, Bereda and Hordio, or from Mogadishu for the products coming from the south.

10.1 FRANKINCENSE

The main Somali frankincense species, which according to Glover (1947), covered in 1966 [sic misprint for 1946] an area of 30 000 ha, belong to the Burseraceae. They are Boswellia freereana (iagaar, ghet maidi) which produces the incense known as "maidi"; Boswellia bhau-dajiana (moxor add), supplying "bejo", and Boswellia carterii (lufood) which produces "bejo lufood".

Other species of Boswellia present in Somalia and of botanic interest are Boswellia microphylla (bei-bei=, B. multifoliata (gurre, murgian, merchan), B. boranensis and B. rivae (onsi, merafur). The distribution of these trees is along a strip stretching between latitude 11° - 12° N and longitude 45° - 51° E. The area is characterized by a very low rainfall (average 34mm/year) concentrated into two seasons and with an average temperature around 38°-30° C. The plants are usually facing the sea winds, on rocky, calcareous and not very deep soils. The production of resin is almost continuous, lasting for 10 months/year. It begins at the end of August and lasts until early May or even June.

The number of the cuts, each 40-80 mm long and 2,6-4,0 mm deep, varies from four to 20. The plants continue to produce for 20-50 years or more, according to the degree of exploitation. It is generally preferable to tap resin every other day on warm windy day.

Boswellia freereana produce the more valuable frankincense. It is usually tapped twice a year and its harvesting, with the healing of the incision, takes 15-20 days. For the other species, the harvesting is made with a pause of only 15 days.

To prevent exhaustion of the trees, harvesting is stopped every 5-6 years. The average yearly production from each plant is about 10-12 kg, subdivided by different quality of the product. (see table 13).

Frankincense is used, other than in religious rites, in the cosmetic industries, where it is an essential oil for its clear and aromatic properties. The main countries which buy the Somali production, through the National Agency for Commerce, are; The People's Republic of China, which imports resins of B. bhau-dijana, and B. carteri in a more processed and non-graded form; Saudi Arabia, which imports mainly B. freereana re-exporting it to Europe; lesser quantities are exported to France, England, Italy and the U.S.A.

The price of this produce in 1976 was in Italy about 15 000 lira/kg. Export of frankincense could be increased if there was a guaranteed supply, adequate control of the quality and a better marketing system.

To increase production and put the business on a firm footing less subject to variation of the product, it is necessary to widen the cultivation of Boswellia. This could be done by creating suitable "gardens" through vegetative propagation, and by starting the production of seedlings in nurseries. The results obtained to date (Guidotti, 1930; Bergstrom, 1975) on reproduction by cuttings and on cultivation in well-prepared plots, are promising and satisfactory. They deserve to be continued on a larger scale using more modern techniques (applications of rooting hormones, tests on seed germinability, study of the ecology of the various species, etc.)

On the other hand, the improvement of harvesting techniques [from wild trees] can also help to regularise production.

Table 13. Commercial classification of frankincense.

Maidi Type

Quality of the raw product	Classification (Arabia/Somalia)	English Classification	Description	% total production	Commercial classification of select product.	% complex raw product
I	Mashad	Extra superior	Big pieces	25	Mushat	10
II	Ghernol Mujaruel	Superior	Small pieces	45	Magiruel	20
III	Duco-Foh-Falah	Mixed	Fragments & dust	30	N.1,2,3B 3U,4,5,6 Large waste small waste Impurity	15,10,8 6,8,6,6 4 5 2

Bejo Type

I	Fassus	Extra superior	Big pieces	50	Extra superior White drops n/1.	36
II	Makassar Luban Dakar	Superior	Broken pieces Light yellow small pieces	20	Superior White drops n/2	4
III	Duco-Foh-Falah Bejo bark	Mixed	Dust, fragments with leaves & bark	30	Number 3B 3U,4,5,6 large waste leaf waste Impurities	10,5,8 5,5 5 20 2

Table 14. Average unitary prices for frankincense in US\$/tonne in 1975.

<u>Boswellia freereana</u>		<u>Boswellia carteri & B. bhau-dajana</u>	
Mushat	5 500	grade 1	2 695
Mujarval	5 500	grade 2	2 686
Fas Kabiir	2 750	grade 3	2 582
Fas Saqiir	2 750	grade 4	2 582
Siffiin .	1 800	grade 5	2 296
Powder	550	Gimadid	500
Gimadid	500	Powder & 'Shor' [small pieces]	550
Foh	488	Foh	450

10.2 MYRRH

Myrrh is a gummiferous resin produced by Commiphora playfairii benadirensis (malmal, dhai - the resin; dedin, didin - the plant), a small, thorny shrub (4-5 mm) of the Burseraceae family. It is distributed throughout northern and southern Somalia on rocky, calcareous and chalky soils.

The bark is scratched at the base of the trunk usually between June and August, at the point where branching begins. The resin is in the form of small pieces, with irregular dimensions (about 1 to 7 cm diameter) and is brown-reddish in colour.

The resin (its taste is rather bitter) is particularly aromatic and four different composites are obtained from the raw product, absolute myrrh, dye of myrrh, oil of myrrh and resin of myrrh. The first is generally obtained by alcoholic extraction and subsequent evaporation of the filtrate. It is sold under the name of "absolute resin". The second is obtained by alcoholic extraction without evaporation and is used in pharmaceutical preparation. The resin and the oil of myrrh, obtained by extraction through benzene, ether or ethanol, are used mainly by the cosmetic industry as fixatives and for "sweetening" in various scents. The resin of myrrh is also used like the aromatic substance in various pharmaceutical preparations, in aerosols, oral disinfectants etc.

The product is sold as "light myrrh", either selected (made up of transparent granules) or non-selected (small blocks of resin mixed with small pieces of bark and dust often due to harvesting during the dry season when some of the

resin drips to the ground).

Myrrh is often mixed with other gummiferous resins produced by other species of Commiphora. It is particularly the custom to adulterate the true myrrh with the so-called "false myrrh" (xabak hadi) produced by Commiphora guidotti. This species is a shrub or small tree found mainly in southern Somalia, from which is obtained a dense, resin, light-yellow in colour and which on drying becomes reddish-brown. This product is also sold under the name of zabek hadi (selected and non-selected), and though less valuable than the true myrrh, is widely used in the pharmaceutical and cosmetic industries. Locally it is used to treat ulcers and as an aphrodisiac.

The annual average production of myrrh is about 3 kg per tree. It is estimated that while annual world production averages 5 000 tonnes, there is a wide fluctuation due to irregular harvesting and to trading difficulties.

Myrrh accounts for 15 to 35 percent of the whole production of gummiferous resins from Somalia. The most important foreign markets are China, Saudi Arabia, India and the Middle East and the countries of Western Europe. The price of myrrh on the Italian market in 1976 was about 4 000 lire/kg, an increase of about 30 percent on previous years.

On the whole we think that this product, like other oils and resins will be less used in the pharmaceutical and cosmetic industries in the future. Its market is very 'elastic' as it forms a small fraction of the total cost of the finished products, and can be partly replaced by artificial products at lower cost.

The most important factor then is not the price of the raw material but regular supply, together with consistent, high quality [of the organic fractions] of the product. Thus an ensured constant supply of a product of good quality can guarantee moderately high and constant gains [? financial return]. Vegetative propagation or cultivation of myrrh has not been tried and this could be an important step in the rationalisation of cultivation.

Some other myrrhs have aromatic and characteristic smells - like musk. These products are typically from Somalia and the eastern region of Ethiopia. They are marketed under the commercial name 'opoponax', this oil is starting to be used in high quality perfume. Total production is about 100 tonnes per year.

10.3 GUM ARABIC

The production of gum arabic in Somalia is not of great economic importance. Nevertheless it may be extended and improved to become a new source of wealth, as has happened in other parts of the Sahel.

The main gum producing species in Somalia are Acacia senegal var platyosprion (cadaad, xabag), A. seyal var fistula (fullay), A. orfota (gummar) and A. socotrana (gerin, dierin). Additional gums of inferior quality are produced by Acacia stenocarpa, A. oxyosprion, and A. mellifera.

Gum arabic belongs to the carbohydrate group and is composed of potassium, calcium and magnesium salts, a glucosidic acid of high molecular weight - arabic acid - sugars and an oxydising enzyme. It forms a viscous solution in water and is used as an emulsifying agent for the fixation of oils and paraffin. It is also used by the pharmaceutical and cosmetic industries, to manufacture cosmetics, and in the preparation of colouring substances and inks.

The more valuable gums are extracted from Acacia senegal and A. seyal. The gum is tapped through incisions [in the bark] as in frankincense production. The annual average production of each tree is around 150 g reaching 400 g in the best plants.

Harvesting takes place from May to October on trees older than 4-5 years. The greatest production is reached [with trees] of 6-8 years and ceases after 18-20 years. Quantities per tree are less than those obtained in the Cordofan region and in west Africa, as only 25 percent of the trees normally produce gum.

If the product is to become more important, traditional harvesting methods from wild trees must be improved and plantations set up using selected individuals. These methods should improve quality and quantity.

Since 1945 to the present [1976], world production of gum arabic has increased regularly, stimulated by an increasing demand from the medical, pharmaceutical, textile and paper industries of Europe and the U.S.A.

In recent years, however, the supply of available gums has been decreasing because of the catastrophic drought which struck the gum-producing countries.

As a consequence of this shortfall in production, artificial 'gums' have been

increasingly used as substitutes for gum arabic (eg. polyvinylalcohol, polyvinylpyrrolidine and polymers of ethylene oxide). An increase in the price of the gum has hastened this change. However, it is probably that because of the present oil crisis and the high costs of production in energy terms of the substitute products, the demand for gum arabic will continue at a high level over the next few years. This possibility is enhanced by the rapidly increasing consumer demand for "natural products". If this is so, Somalia will be in an excellent position to produce gum arabic. Eventually this out-put should be processed in the country to a product of high value which will still be required by industry. The main species should be Acacia senegal, Acacia seyal, other Acacia spp. and Combretum spp.

It should be possible to develop in Somalia, gum production (mainly kordofan, Acacia senegal) by using this species for reafforestation and by establishing monospecific plantations and by using Acacia in rehabilitation of exhausted soils abandoned by agriculture. Development of the "taungya" system should also be attempted, ie. supplying [tree] seedlings to farmers to plant in with their agricultural crops which will nurse them until the land is abandoned for agriculture when a tree crop remains.

The problem of gum production deserves careful consideration because of favourable export prospects and the chance it allows to develop a more stable silvi-agricultural economy. It is also a good method of protecting the environment from erosion and desertification.

11. THE MAIN UTILISABLE WOODS OF SOMALIA.

As previously emphasised, Somalia has a remarkable scarcity of wood for the construction industry and for making furniture. Many tree species have excessive branching and knotted and curved trunks. These are characteristics of most of the arboreal vegetation of the sub-arid regions. They make the production of sawn wood, carpentry, joinery and furniture difficult.

The more important species producing sawlogs are Juniperus procera (deyib) and Conocarpus lancifolius (dhamas). The first of these is localised in the mountain heights in the north of Somalia and gives wood fit for carpentry, furniture, joinery, boat building and construction. The second, originally indigenous to the north, is now spread over the whole country because of its remarkable resistance to drought and its good growth. [Conocarpus] gives a white wood, which is compact and homogeneous. It is useful for trusses and ship construction.

Some species of the riverain forests of the Juba and Shabelle rivers are important for particular uses and produce a good assortment of woods with valuable, technological characteristics. These species should be safeguarded and planted elsewhere in the more humid zones. Possible species are; Mimusops degan, (degaan), Trichilia jubensis, (garomass), Acacia stenocarpa, (damal), Azelia quanzensis, (sihiouri), Antidesma venosum (geedbiyood), Sorindeia obtusifoliata (matambiyood), Excoecaria venenifera (uarancole), Thespesia danis, (kabxan), Garcinia ferrandi, (scanfarood), Hunteria africana, (geedmadow), Cordia ravae, (mareerdocol), and Piptadenia erlangeri, (raydop). Diospyros corni (ollatti, collatti) grows in the Upper Juba savanna, mainly south of Las Badna. It has a very hard, compact, homogenous wood, similar to ebony. The tree has a black bark and best examples have straight trunks, free from branches to a height of 4-6 m. Other species similar to ebony, which may be used in a handicraft industry or for the making of furniture and inlays are; Piptadenia erlangeri, (raydop) which is found along the Juba river and has a cream wood. This species can grow to a big tree and the wood is easily worked. The timber is very hard, compact and homogenous with dense grain and a blackish-reddish colour. Some species of Dalbergia [also provide useful timber] eg. D. microphylla, D. commiphoroides and D. melanoxylon. The first is a rare species of the Ogaden region; the second grows in central Somalia in shrub bushland. dicrostachys glomerata (ditar), a shrub or small thorny tree with a dirty-grey, fibrous bark and yellow wood, has a very hard fine grained wood, easily finished and excellent for carpentry. Plectronia schimperi

(from Upper Juba) and other species may also prove valuable.

The following species are also good for furniture making and the production of luxury articles; Sizygium guineense, Combretum usaramense, (cogan), Hypseloderma jubense, (ghedad), Grewia tembensis, (lovei), Albizzia amara, A. anthelmintica, Oncoba spinosa and the species of Cadaba, Maerua and Boscia.

Species with similar wood characteristics to mahogany are those of the genera Trichilia and Xilocarpus, especially Trichilia jubensis. This latter tree, of 9-10 m in height, has a diffuse distribution along the Juba river. It has a hard, compact, pale-reddish wood which is easily worked and finished. Xilocarpus obovatus, (seclal, mucomagi), 6-8 m tall, grows in the mangrove associations mainly in the south of the country. This species has a straight trunk and is generally well-formed, with a reddish-yellow, heavy wood fit for construction, furniture, boat making etc., but which is unfortunately not resistant to [?insect, borer or termite] attack.

Other important species present in the mangrove regions and which should not be overlooked are:- Rhizophora mucronata, (mcauda), which has a strong wood, (although difficult to work) and is very good for parquet flooring, turnery and house tools. It is resistant to termites; Bruguyera gymnorryza, (msindi) also has a hard wood which is difficult to work, but it is resistant to termites. The timber is usable both for construction and as fuel; Avicenna marina, because of its high resistance to immersion, finds a ready use as a construction timber, in boat building and as piles. The wood is also used for furniture but it is not very resistant to termites, nor is it very good fuelwood.

As contrasts, Sonneratia somalensis, (scelale) has an easily split wood, not very resistant to termites or rot and is a poor fuel. On the other hand, Ceriops somalensis has a good wood, useful for construction, turnery, fencing etc., is resistant to termites and is a good fuel.

More widespread (and similar to mahogany) is Mimusops degan, (Sapotaceae) - degan - 20-25 m tall, with a branch-free trunk until it is 8-10 m in height. It occurs throughout the riverain forests of the Juba and Shabelle. The wood is of very good quality, brown-reddish in colour and is easily worked and finished; it is used for furniture, cabinet-work, and luxury articles.

In northern Somalia, on the border of the tablelands and upper reaches of the

rivers, is a moderate quantity of Mimusops angel, (angel) with analogous characteristics and use, to M. degan. In the south we find two other species of the same genera, also with valuable woods, M. densiflora, (carobba) and M. somalensis, (ijaney). In the region of the Juba is Afzelia quanzensis, (Caesalpinaceae - sciaurri, sciovri). This tree which grows to a height of more than 20-25 m, with a conical crown and a 10 m straight trunk, has excellent wood which is easily finished. Wood colour is whitish-reddish to brownish in colour and has the same characteristics as teak. It is used in the making of luxury furniture and for boats [? building or fitting out].

The Terminalia species - Terminalia praecox, (bisaq), T. polycarpa, (harzeri), T. brevipes, (eyrab), T. catappa, (bidan), T. somalensis, (xarar), T. holstii, (hareeri), T. hispinosa, (hareeri) and T. orbicularis, (dhisag, bisaw) all have straight trunks devoid of branches. They can be readily used for construction-wood, for poles (3-6 m), and for furniture and various other objects. They have compact, hard, heavy wood, which is easy to finish and paint.

Other species which give construction wood and poles are: Terminalia polycarpa, Acacia nilotica, (tugaar), A. spirocarpa, (aqab), A. seyal, (tula), Albizia amara, (tugaar, maraay), Acacia stenocarpa, (damal), Chiarina jubae-fluvii, (embebe), Trichilia emetica, (lachi), T. somalensis, (mofuratre), T. holstii, Phyllogeiton discolor, (xamur), Hyphaene benenadirensis, (haar), H. thebaica, (baar), Teclea alexandrae, (agnogolet), Balanites aegyptiaca, (hullan, shillan), Dobera glabra, (garas), D. macalusoi, (garas), Rhizophora mucronata, (moauda), Zizyphus mucronata, (gob), Z. spinachristi, (gob), Ficus sycomorus, (mukay gadunch), and Buxus hildebrandtii, (dosokh).

Widespread use of two Euphorbia species, E. bilocularis and E. ruspoli, has led to a drastic reduction in their numbers.

Several specialised and very valuable timbers are known for making small handicraft work and utensils. These come from more shrubby trees, with short trunks but with excellently coloured wood which has prominent venation. The woods are also easily finished. Among these are Ormocarpus kirkii, (marodi macaran), Terminalia balla dellii, (tirab), and Randia fiorii, (bingaras, dingras, dengaras).

Among the species introduced at various times and which are now well acclimatized and have good, valuable construction timber, is Albizia lebbek,

(indigenous to India, Burma and the Adams [Andaman/] Islands). It is now widespread in Somalia as an ornamental, growing up to 20 m in height and with a diameter of one metre. It is grown in the reclamation zones (Genale, Afgooye, Jowhar etc.) and has a light-brown wood which is resistant [? to termites]. It is used for furniture making and cabinet-work.

Other exotic species are listed below;

Azadirachta indica, originally from the arid regions of India, is now used almost everywhere as an ornamental. The wood is reddish, very hard and is used for the construction of furniture and huts.

Cassia siamea, from Burma, is cultivated in various urban centres, such as Mogadishu, Afgooye, Genale, Jowhar and Gebit, as an ornamental and windbreak tree. It reaches a height of 10-12 m and 23-30 cm in diameter. The wood is whitish, very hard, and is used for poles.

Cassia fistula and Casuarina equisetifolia are of Australian origin and grow mainly in the irrigated areas as good windbreak species. In these irrigated areas it [? Casuarina equisetifolia] can reach 25-30 m with a diameter of 40-50 cm. The tree gives a good assortment of poles and the wood is used in marine construction. The timber is hard, compact and resistant.

Ceiba pentandra, introduced from southern America, is found mainly in the irrigated areas around Genale and Afgooye as well as along the Juba, where, because of its rapid growth, it is utilized as a windbreak species and for the production of 'cotton' and 'kapok'. The wood is used in the production of packing cases.

Dalbergia sissoo, originating from India, is cultivated in Jowhar as an ornamental. The wood is very good for cabinet making.

Entandrophragma spp., of African origin, is cultivated at Genale, Afgooye, Jowhar and in the irrigated zones with good results. It gives a wood similar to mahogany and is good for marine construction, luxury articles and cabinet making.

Melia azedarach (beluchistan, kashmir) is cultivated both in the urban centres and in the irrigated areas of the Juba river. It gives a soft

sweet wood, with reddish bark and is used for furniture and utensils.

Swietenia mahogani, (South and central America, Cuba, Venezuela, Honduras, Columbia) is widespread in many agricultural centres (Genale, Afgooye, Alessandira, Lower Juba). It gives a very good, fine-grained wood which is easily finished and is used for furniture, utensils, tool handles and cabinet making.

Tamarindus indica, (considered indigenous to Ethiopia and Central Africa), is widely cultivated, mainly in the south of Somalia (Juba, Upper-Juba, Chisimaio) and in many other regions where it has become naturalised and spreads spontaneously. The tree gives a goo, hard, wood fit for construction.

Tectona grandis, (Burma, south India, Thailand and Java) was introduced with good results into Lower Juba (Alessandria, Bardera, Jelib) and gives a valuable wood used for furniture and cabinet making.

Acacia saligna and A. cyanophylla, (originating from Australia) are used for reafforestation of the shifting sand dunes along the coast. They give good construction timber and fuelwood.

Eucalyptus spp. (from Australia) have been planted in some reafforestation schemes (Merca, Lower Juba) for the production of construction timber and fuelwood.

[Table 15 summarised the mechanical properties of some of the species noted above. A number of previously unmentioned species are also included].

Table 15 Physical properties of various timber species found in Somalia.

SPECIES		PHYSICAL PROPERTIES			
Latin name	Somali name	Air dried weight (kg m ⁻³)	Nominal specific gravity	Equilibrium moisture content (%)	Coefficient of absorption of oven dried wood
<i>Acacia bussei</i>	Galool	1,250	1,140	9,8	20,0
<i>Acacia fistula</i>	Fullay, ojiid	890	0,780	12,3	60,5
<i>Acacia mellifera</i>	Bilcil	1,240	0,990	20,0	51,0
<i>Acacia nilotica</i>	Tugaar	900	0,780	12,0	58,0
<i>Acacia spirocarpa</i>	Aqab	935	0,840	12,0	68,2
<i>Acacia stenocarpa</i>	Damal	900	0,820	9,8	54,0
<i>Aridocarpus glaucescens</i>	Reydab	910	0,851	15,0	62,5
<i>Albanites spp.</i>	Kullan, shillan	990	0,710	28,8	154,0
<i>Adansonia farinosa</i>	Qalanqaal	990	0,870	12,2	54,0
<i>Acacia siamea</i>		830	0,650	21,4	108,0
<i>Acacia suarina equisetifolia</i>		780	0,660	15,7	86,8
<i>Albizia pentandra</i>	Suff xariir	440	0,320	24,9	289,0
<i>Acacia sp.</i>	Mareer	840	0,730	13,0	80,9
<i>Acacia sp.</i>	Lebi	700	0,485	9,2	132,0
<i>Acacia sp.</i>	Garas	900	0,780	13,5	78,0
<i>Acacia thorbica tirucalli</i>	Dani, Dano	500	0,420	12,6	178,0
<i>Acacia sycomorua</i>	Mucoi adda	455	0,415	8,8	176,2
<i>Acacia ferrandii</i>	Shanfarood	740	0,630	14,8	94,0
<i>Acacia ligofera sp.</i>	Xagar	785	0,625	22,0	105,0
<i>Acacia acthiopica</i>	Bocorale	700	0,600	14,4	85,5
<i>Acacia inermis</i>	Allan	930	0,790	13,9	63,5
<i>Acacia usops degan</i>	Deegaan	870	0,630	21,0	79,0
<i>Acacia inciana regia</i>		725	0,640	11,8	85,0
<i>Acacia vadora persica</i>	Caday	850	0,720	15,4	98,0
<i>Acacia fruticosa</i>	Dalluc	680	0,600	12,5	119,0
<i>Acacia arindus indica</i>	Raqay	815	0,665	18,3	80,0
<i>Acacia minimalia brevipes</i>	Eyrab	1,070	0,940	22,4	35,5
<i>Acacia minimalia polycarpa</i>	Tiyeg	1,060	0,920	23,2	31,0
<i>Acacia minimalia praecox</i>	Bisaq	1,100	0,925	16,0	25,2
<i>Acacia spesia danis</i>	Cabxan	820	0,780	13,7	110,0
<i>Acacia yphus spinachristi</i>	Gob	790	0,595	24,5	92,0

continued on next page

Table 15. continued.

SPECIES	MECHANICAL TESTS								
	TENSILE STRENGTH	COMPRESSION STRENGTH					BENDING		
		Breaking stress (kg cm ⁻²)	Force parallel to the grain		Force perpendicular to the grain			Sample of 25 x 4 cm on supports of [?22] cm apart.	Breaking load in impact test [? 2 km cm ⁻²]
			Breaking stress (kg cm ⁻²)	Concentration prior to breaking (%)	Load reducing the width of the sample by (kg cm ⁻²)				
0.5mm	33% of width	50% of width			Modulus of rupture (kg cm ⁻²)				
<i>Acacia bussei</i>	-	682	2,0	160	500	750	750	1,9	
<i>Acacia fistula</i>	-	431	2,5	65	455	750	760	3,0	
<i>Acacia mellifera</i>	-	785	3,7	87	480	630	790	2,2	
<i>Acacia nilotica</i>	-	372	3,0	110	400	760	637	1,8	
<i>Acacia spirocarpa</i>	-	592	5,0	182	550	682	580	1,6	
<i>Acacia stenocarpa</i>	2,050	600	3,0	92	367	575	838	2,6	
<i>Acridocarpus glaucescens</i>	-	-	-	-	-	-	-	-	
<i>Balanites</i> sp.	577	462	4,0	72	270	420	700	2,4	
<i>Cadaba farinosa</i>	-	340	3,0	52	350	580	580	2,0	
<i>Cassia siamea</i>	-	427	5,0	66	220	440	770	2,2	
<i>Casuarina equisetifolia</i>	-	470	4,0	71	280	500	963	2,0	
<i>Ceiba pentandra</i>	-	156	7,5	16	50	116	210	1,0	
<i>Cordia</i> sp.	-	480	5,0	50	337	569	-	-	
<i>Delonix</i> sp.	-	254	4,0	44	164	260	400	1,2	
<i>Dobera</i> sp.	-	193	5,0	56	237	532	510	2,0	
<i>Euphorbia tirucalli</i>	-	383	6,2	68	140	203	390	0,6	
<i>Ficus sycomorus</i>	185	280	5,0	43	118	176	375	1,4	
<i>Garcinia ferrandii</i>	-	387	5,0	75	320	745	1,020	2,8	
<i>Indigofera</i> sp.	-	367	6,3	119	235	362	585	-	
<i>Kigelia aethiopica</i>	515	280	5,0	18	184	372	637	2,0	
<i>Lawsonia inermis</i>	-	-	-	-	-	-	960	-	
<i>Mimusops degan</i>	2,000	347	5,0	118	322	450	625	3,0	
<i>Poinciana regia</i>	1,132	390	2,0	76	192	460	637	2,8	
<i>Salvadora persica</i>	-	492	6,2	59	185	425	-	2,8	
<i>Sueda fruticosa</i>	-	352	5,0	62	212	372	-	-	
<i>Tamarindus indica</i>	-	296	3,7	69	275	438	580	1,4	
<i>Terminalia brevipes</i>	695	640	2,0	150	420	735	995	3,4	
<i>Terminalia polycarpa</i>	845	637	3,0	152	311	616	962	5,0	
<i>Terminalia praecox</i>	510	382	4,0	112	244	384	662	2,0	
<i>Thespia danis</i>	-	477	5,0	88	461	825	450	2,4	
<i>Zyzyphus spinachristi</i>	-	370	4,0	80	232	380	463	3,0	

12. CONCLUSION.

Silviculture in Somalia has a fundamental role to play in the production of trees for timber, browse, fuelwood and charcoal, other forest products (gums, resins, colourings, cosmetic and medicinal) for the protection of the environment and in the control of desertification.

Especially important are the roles that the various woodland types can play in the control of erosion - above all wind erosion, in the conservation of water resources, in the protection of the fauna and flora, in the production of forage, and as a factor in the amelioration of the climate.

Little attention has been paid to the contribution that an appropriate forest policy could make to the struggle against desertification which is occurring in many regions of Somalia. Also receiving scant consideration is the planning of an integrated land use policy. This policy would take into account the different economic, forestry and agro-pastoral needs withing a dynamic outlook for the preservation and development of the environmental resources.

This lack of environmental resource-use programming is helping to accelerate ecological degradation. Such degradation will have negative effects on the socio-economic development of the country, where immediate measures (?) are not taken [? need to b] to increase the availability of food for the rural population and livestock.

Within an economic development context, an environmental resources policy would provide:- an increase in food resources and agricultural production for the domestic market; progressive settlement of the nomadic population and the creation of agro-pastoral cooperatives; the decentralisation of political power; and strengthening of the involvement of the population in the decision making processes. Within this framework it is desirable to design a long-term ecological and forestry policy to solve the most urgent problems of the sector.

To cope with the growing demand for wood, it is necessary to create natural or plantation forest 'reservoirs' which can provide a sufficient supply of timber to the local market.

In the forest reserves, it is necessary to adopt through reafforestation

measures, management and forestry stock-improvement systems. These would be designed to:- increase the number of valuable species; preserve the water resource; protect the soil from erosion; increase the existing vegetation cover, and; carry out reafforestation and the rehabilitation of degraded zones. It is possible to introduce exotic species in the mountainous zones of the north and in the south in the Upper Juba region.

The establishment of tree plantations in the irrigable parts of the country will guarantee fast growth rates and conserve natural resources.

Above all the planting of windbreaks is required in the agricultural areas. These should be made up from trees which have [?] additional valuable uses.

Consolidation work on the mobile dunes began a long time ago and needs to be continued. This will prevent damage to agricultural cultivation and its infrastructure, and produce extra timber, for the construction industry: more and more will be required by the domestic market.

An adequate conservation policy is necessary for some types of forests which have been heavily degraded by past exploitation - eg. the mangroves, Juniperus forests and riverain forests - while it is desirable that grazing practices adopt modern management techniques to the local traditions of the nomadic population. This will ensure a greater quantity of livestock feed.

Reafforestation projects and inventory of the forestry resources are the basic beginnings of a long-term forest policy. This policy may be executed successfully by training adequate numbers of technicians in the schools and universities of the country. Also through the direct participation of the local population in the carrying out and development of the plans.

At present there are good possibilities for the development of the gums and resins industry, through cooperation and through improvement in both production techniques and the system of marketing.

The production of fuelwood and charcoal must be placed on a much more controlled and technical footing, with improved mobile kilning methods and improved mechanisation, such as the introduction of band-saws. [? chain saws]. There is also a need to develop the cooperative system of cutting and the transport of the product on a national scale.

There are also possibilities to create several game reserves, both in the

north (Ga'an Libah, Berbera, Sheikh, Erigavo, Mait) and in the south (Lower Juba, Bajuni Islands). These reserves should increase the flow of tourists. This will only be possible through adequate planning, eliminating the usage rights of the population in the reserves, enforcing rigid controls on poaching, and preventing the cutting of trees. Further ecological and social studies are required to foresee the consequences of these actions.

Particular effort must be made to train foresters to manage the Somali silvi-pastoral resources.

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