Somali Natural Resources Management Programme

Renewable Natural Resources and Production Systems: Issues and Priorities

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Introduction

The livelihood of the Somali people is closely intertwined and dependent on the access to, and use of, the terrestrial and marine resources. Livestock, agriculture and fisheries are the dominant production systems upon which the Somali economy and culture are based. Ecological degradation of the terrestrial and marine resources that support these dominant production systems leads to decreased productivity, and if non reversible degradation exists, the sustainability of the production systems will be in jeopardy. In addition, where production systems access and use natural resources beyond the renewable limits of the natural resources there can arise further ecological degradation and in turn decreased productivity.

Today, emerging regional and local Somali administrations, with assistance from the international community - in particular the EC Rehabilitation Programme for Somalia - are initiating interventions aimed at rehabilitating and developing social and economic systems and infrastructures. These institutions recognise the need to ensure that rehabilitation and development interventions contribute to ecologically sustainable use of natural resources and conservation of the Somali environment and its natural resources for sustained economic development for current and future populations.

In order to guide rehabilitation and development activities in Somalia[1] today, there is need to establish thematic and geographic priorities for addressing sustainable natural resource management and conservation of the Somali natural heritage.

This report aims to:

- Identify and describe Somalia's terrestrial and marine ecosystems, biodiversity and natural resource characteristics;
- Identify and describe the linkages between Somalia's terrestrial and marine natural resources and dependent production systems, and problems and opportunities that exist towards sustainable use.
- Present and apply criteria for setting thematic and geographical priorities through which strategic principles can be applied to guide sustainable management of renewable natural resources.

Natural resource base and biological diversity

Somalia's natural resource characteristics reflect the semi-arid and arid climate, and geographical processes that have taken place over millions of years. Mean annual rainfall ranges from 63mm to 586 but is highly variable; evapotranspiration exceeds rainfall for most of the country except for a few months in the southern regions. The climate is primarily semi-arid to very arid; rainfall

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is low and unreliable and there is a high evapotranspiration water demand on plants. Land with agricultural potential is limited.

Somalia is primarily rangeland which supports most of the country's natural resource-based production systems. Small areas of forest are highly valuable locally. Water from groundwater and seasonal surface sources is fairly abundant nation-wide but is often patchy in occurrence at the local level.

Marine resources are diverse, abundant, potentially productive and, for the most part, relatively little used. Overall, biodiversity is high for the region rendering a significant conservation and economic value for endemic and endangered flora and fauna species found in Somalia.

Production systems

Most Somalis subsist on livestock production which also earns the greatest amount of foreign exchange (through sales of livestock). Cattle, sheep, goats and camels are raised and herd composition reflects both the natural environment and economic opportunities. Total livestock biomass is positively related to annual rainfall.

Agriculture is next in importance and growing. Rainfed agriculture is a low input, high risk production system which, in areas of lower rainfall and poorer soils, involves shifting cultivation - commonly by agropastoralists - with short cropping and long fallow periods. Fenced enclosures, erected to protect crops, are increasingly used for other purposes. Riverine irrigated cropping is the most productive type of agriculture; some oasis farming occurs in the north. Most irrigated farming is by smallholders.

Rangeland areas produce fuelwood and charcoal but also much fencing. Charcoal, which is made from hardwood trees like *Acacia bussei*, is both used locally and exported. The collection and export of tree gums (Frankincense and Myrrh) employs a large number of people and is one of Somalia's major earners of foreign exchange. This is especially true in Bari and Sanaag regions where gum-producing *Commiphora* and *Boswellia* trees are privately owned. However, pastoralists also collect tree gums in southern Somalia where the resource is communally owned. Honey production is a non-destructive production system that produces a high quality product that is both used locally and can be exported. Natural vegetation is widely used by Somalis for a variety of traditional and highly important uses, such as medicine.

Terrestrial wildlife are heavily harvested but used only locally for subsistence. Freshwater fisheries provide a subsistence for a limited number of Bantu people along the two rivers. Somalia's marine fisheries are under-utilised. Present Somali involvement in marine fisheries is through artisanal fishing close inshore. The major catch, lobsters and shark (for fins), is exported. An unknown amount of industrial fishing by outside interests occurs over the continental shelf and in deep oceanic waters within the 200 n.m. Somali Economic Exclusion Zone (EEZ).

Strengths of production systems

Overall, the traditional means of livelihood (livestock rearing based on pastoralism, shifting rainfed agriculture, irrigated agriculture, artisanal fisheries, and wood product harvesting) evolved in harmony with the natural environment by making wise use of natural resources. The Somalis' knowledge of their environment is high as is their perception of the dynamics between their livelihoods and natural resources.

Production system weaknesses

The "development" process during the last decades and the recent civil strife have changed the dynamics of access to, and use of, natural resources. Less mobile and more highly sedentarised pastoralists, increased of water, expansion of rainfed agriculture into dry season rangeland areas, shortened fallow periods (due to restricted agricultural land) and charcoal export, among other factors have all contributed to decreasing productivity and ecological degradation.

Threats to production systems

The major threats are the: a) continued sedentarisation of the human population associated with water supply development without corresponding land use management systems in place; b) uncontrolled exploitation of marine resources driven by external entities and unplanned rehabilitation and development; and, c) decreased biological diversity resulting in loss in current and potential economic benefits.

Opportunities

The Somali people have a high awareness of the dynamics of natural resource and dependent production systems, and the effects of ecological degradation. Local and international institutions have an increased understanding and commitment to global conservation and sustainable natural resource management protocols and agreements. Based on this, opportunities exist for planning and implementing rehabilitation and development on sound environmental principles and approaches that are sectorally integrated, based on increased production whilst ecologically sustainable, and improve livelihoods.

Issues and Criteria for prioritisation

Determining priority issues (or themes) for action requires the setting of criteria. Criteria applied reflect different attributes of an issue that influence the need for, and potential success of, rehabilitation and sustainable natural resource efforts relevant to the issues: These are: (a) ecological sensitivity and potential of the resource and/or production system involved; (b) needs of the affected human population and how they perceive the immediacy of future benefits; (c) technical and social feasibility of actions to address the issue. The three principle types of criteria are further subdivided to provide a relatively greater degree of assessment. This attempts to provide increased objectivity from an inherently subjective prioritisation process resulting from the effect of individual and institutional biases and the necessity of making judgements on, and drawing conclusions from incomplete information and/or analyses.

Natural resource priority issues

Rehabilitation and development planning should address the major issues influencing resource sustainability rather than just the symptoms of resource degradation. Using the criteria established, the priority issues arising from this exercise are: (a) dependence on woodfuel energy sources(charcoal and fuelwood); (b) loss of riverine forest and woodlands; (c) unsustainable exploitation of land resources for rainfed agriculture; (d) poor on-site farming management practices; (e) unmanaged exploitation of marine resources; (f) unmanaged exploitation of targeted resources (all production systems); (g) and, loss of rangeland resources.

Geographic priorities

Priority geographic areas for addressing issues are based primarily on the degree and extent to which an area is affected by the priority issue or issues. However, additional criteria for geographic prioritisation include security, degree of political reconciliation and establishment of local governance structures, and interest and commitment of local governance institutions, civil society institutions, and the population at large towards conservation and sustainable natural resources management. One of more priority issues affect the following geographic areas: (a) the high potential land of western "Somaliland" (Awdal and Galbeed Regions); (b) Central Somalia (exclusive of the Cowpea Belt) and "Somaliland" (exclusive of high potential land noted above); (c) Middle Shabeelle Region and the southern District of Galgadud and Muduq regions (Cowpea Belt zone); (d) The Jubba and Shabeelle river ecosystems; (e) non-riverine southern Somalia; (f) and, the entire coastal area. More issues applied to areas (a) than anywhere else in Somalia.

1. INTRODUCTION

The livelihood of the Somali people is closely intertwined and dependent on access to, and use of, the Somalia's terrestrial and marine resources[2]. Livestock, agriculture and fisheries are the dominant production systems on which the Somali economy and culture are based. Ecological degradation of the terrestrial and marine resources that support these production systems leads to decreased productivity. If non reversible degradation occurs then the sustainability of the production systems will be in jeopardy. In addition, where production systems use natural resources beyond their renewable limits, there can arise further ecological degradation and in turn decreased productivity.

Ecological degradation of the Somali environment and its natural resources is an issue that the Somali people have experienced first hand and one that has increasingly been the subject of research and field interventions. The visible symptoms of ecological degradation such as soil erosion (physical and chemical), loss of woody and vegetative resources, water quality, loss of wildlife (fauna and flora both terrestrial and marine), and sand dune mobility have extensively been documented.

Prior to the 1991 Somalia civil war, substantial human and financial resources were directed towards programmes at national, sub-national and community levels. These programmes attempted to redress processes contributing to ecological degradation by managing access to, and use of, renewable natural resources. This was done to improve economic productivity and ensure sustainability of the renewable natural resources.

With the advent of the civil war, the institutions and associated human and infrastructure resources collapsed and with them programmes, documentation, and knowledge pertaining to the Somali environment and development interventions. In addition, the civil war has affected the dynamics on access to, and use of, natural resources by the Somali people as traditionally managed through the Somali clan and central government systems. Distribution of human populations have also changed as a result of conflict.

Today, emerging regional and local Somali administrations, with assistance from the international community - in particular the EC Rehabilitation Programme for Somalia - are initiating interventions aimed at rehabilitating and developing social and economic systems and infrastructure. They recognise the need to ensure that rehabilitation and development interventions contribute to ecologically sustainable use of natural resources for the benefit of sustained economic development for current and future populations.

In order to guide rehabilitation and development activities in Somalia today, there is need to establish thematic and geographic priorities for addressing sustainable natural resource management and conservation of the Somali natural heritage.

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Setting of thematic and geographical priorities is a challenging task since it requires compilation and analysis of historical and contemporary information on both natural resource status and dynamics in access and use. In addition, any process of setting priorities is complex due to the various perspectives of interested Somali stakeholders which influence the criteria for setting priorities. For instance, a Somali pastoralist might consider that conservation of woody resources in rangelands is a priority (along with veterinary services, water resources, etc.) while a Somali agro-pastoralist in the same area might consider increased agricultural land as a priority, i.e. clearing of woody resources.

This report aims to:

- Identify and describe Somalia's terrestrial and marine ecosystems, biodiversity and natural resource characteristics;
- Identify and describe the linkages between Somalia's terrestrial and marine natural resources and dependent production systems, and problems and opportunities that exist towards sustainable use.
- Present and apply suggested criteria to set thematic and geographical priorities through which strategic principles can be applied to guide sustainable management of renewable natural resources.

The report is an output of the IUCN Somali Natural Resources Management Programme which aims to assist the EC Rehabilitation Programme for Somalia to develop adequate and flexible strategies and methodologies for the conservation and sustainable use of Somali natural resources.

The terms of reference for guiding the elaboration of the report are found in Appendix 1. Methods used included: review of the available historical and contemporary literature; distilling conclusions and recommendations emanating from the various IUCN studies and assessments undertaken under the IUCN Somalia Natural Resources Management Programme; the personal experiences of IUCN Somali and non-Somali consultants, the staff of IUCN EARO; and participatory planning workshops involving Somali professionals and staff of international implementing agencies in Kenya and "Somaliland".

The report was prepared over a nine month period by two separate external consultants, the IUCN Programme Coordinator, and the IUCN Eastern Africa Regional Office[3]. The schedule of activities is presented in Appendix 2.

Section 2 of the report provides an overview of the Somali natural resource base and section 3 documents several classification systems of land units that link status of natural resources with economic productivity potential. Section 4 provides a detailed description on the predominant Somali production systems and their nexus with renewable natural resources. An overview of the issues that arise from section 4 are presented in section 5. Lastly, section 6 presents criteria for prioritisation, and suggests thematic and geographic priorities based on the application of the criteria.

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[3] Dr. Robert Douthwaite prepared the first draft in May 1998 but was unable to complete the document due to personal reasons. Dr. Dennis Herlocker prepared the second draft in September 1998, and Mr. Alex Forbes coordinated the final stakeholder consultations on the draft report and the final report production.

2. THE SOMALI NATURAL RESOURCE BASE AND BIOLOGICAL DIVERSITY

Somalia covers an approximate land area of 638,000 km^2. Its easternmost limit is the Horn of Africa at lat. 12° N and the southernmost point, the Kenya coastal border, at lat. 1.5° S. The country is bordered by Djibouti, Ethiopia and Kenya to the west and south. Somalia has one of the longest coastlines on the African continent (3.300 km) along the Western Indian Ocean and the Gulf of Aden. The estimated area of the marine Economic Exclusion Zone (EEZ) is 1.220.000 km^2.

The characteristics of Somalia's natural resources reflect the semi-arid to arid climate and geological processes that have taken place over millions of years. Considering the limitations of the climate, Somalia boasts a diverse and extensive natural resource base that sustains approximately 5.4 million people (FSAU 1996), and approximate 6.3 million camels, 19.5 million goats, 11.8 million sheep and 4.6 million cattle (1989 figures - Janzen, 1993).

Somalia also boasts a relatively high terrestrial and marine biological diversity with high levels of endemicity, and number of flora and fauna species.

2.1 Climate

Somalia hosts an unique climatic phenomenon - a desert (the Somali-Chalbi) on the eastern coast of a continent in tropical latitudes (Griffiths 1972). Thus, instead of tropical rainforest, which occurs in this geographical location elsewhere in the world (e.g. South America and Indonesia) Somalia has, instead, bush, steppe and desert (Willett, 1987).

The prevailing winds that most influence rainfall patterns do not enter Somalia from the Indian Ocean but instead come from Kenya and Arabia, with little humidity, to move across the full length of the country along a Northeast/Southwest axis, depending on the season. Further, the paucity of topographic relief results in little orographic rainfall. Thus, air masses over Somalia are generally dry and the climate throughout most of the country is semi-arid to arid.

A supplementary cause of low rainfall is an upwelling of cold water along the Indian Ocean coastline which occurs during, and is generated by, the south-westerly monsoon (*Hagar*). Sea temperatures in the upwelling area (off Ras Hafun) are typically around 19°C compared to over 28°C off southern Somalia and in the Gulf of Aden (Trewartha, 1981). The cold air reduces convective activity and, therefore, the likelihood of precipitation. On the other hand, seasonal fog along the coast provides moisture for the coastal rangeland vegetation and the upwelling of cold water, which is rich in nutrients, supports high levels of marine fisheries productivity.

Rainfall, which is the key determinant of plant growth in Somalia, is typically low and highly variable (unpredictable) throughout most of the country (Figs.1 & 2). Mean annual rainfall ranges from 63mm on the northern coastal areas to over 586mm at higher elevations in the south (Jilib-Baidoa) and in the northwest along the Ethiopian border around Borama and Tug Wajale.

Figure 1. Mean annual rainfall(mm) (MOA, 1989)

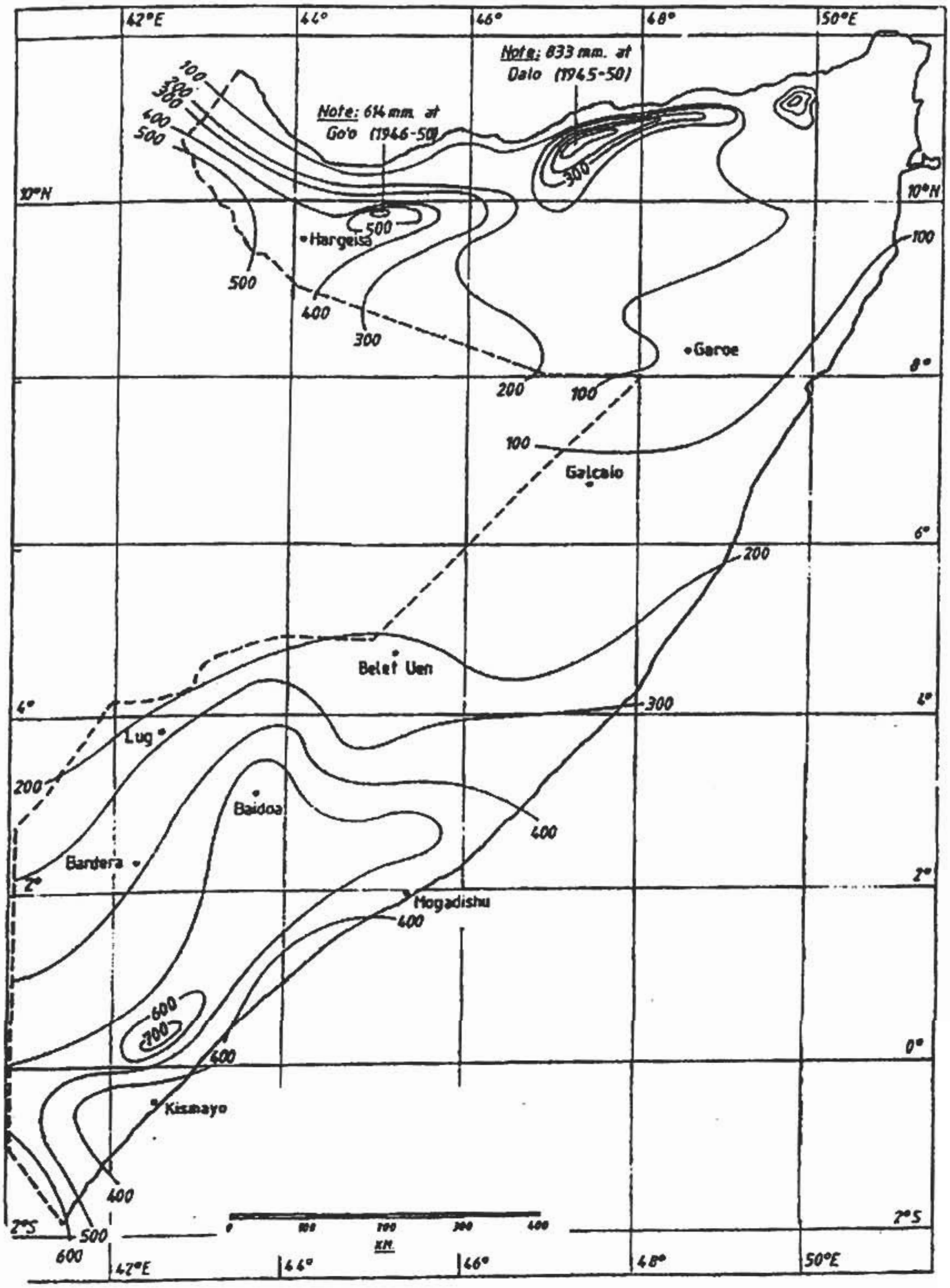
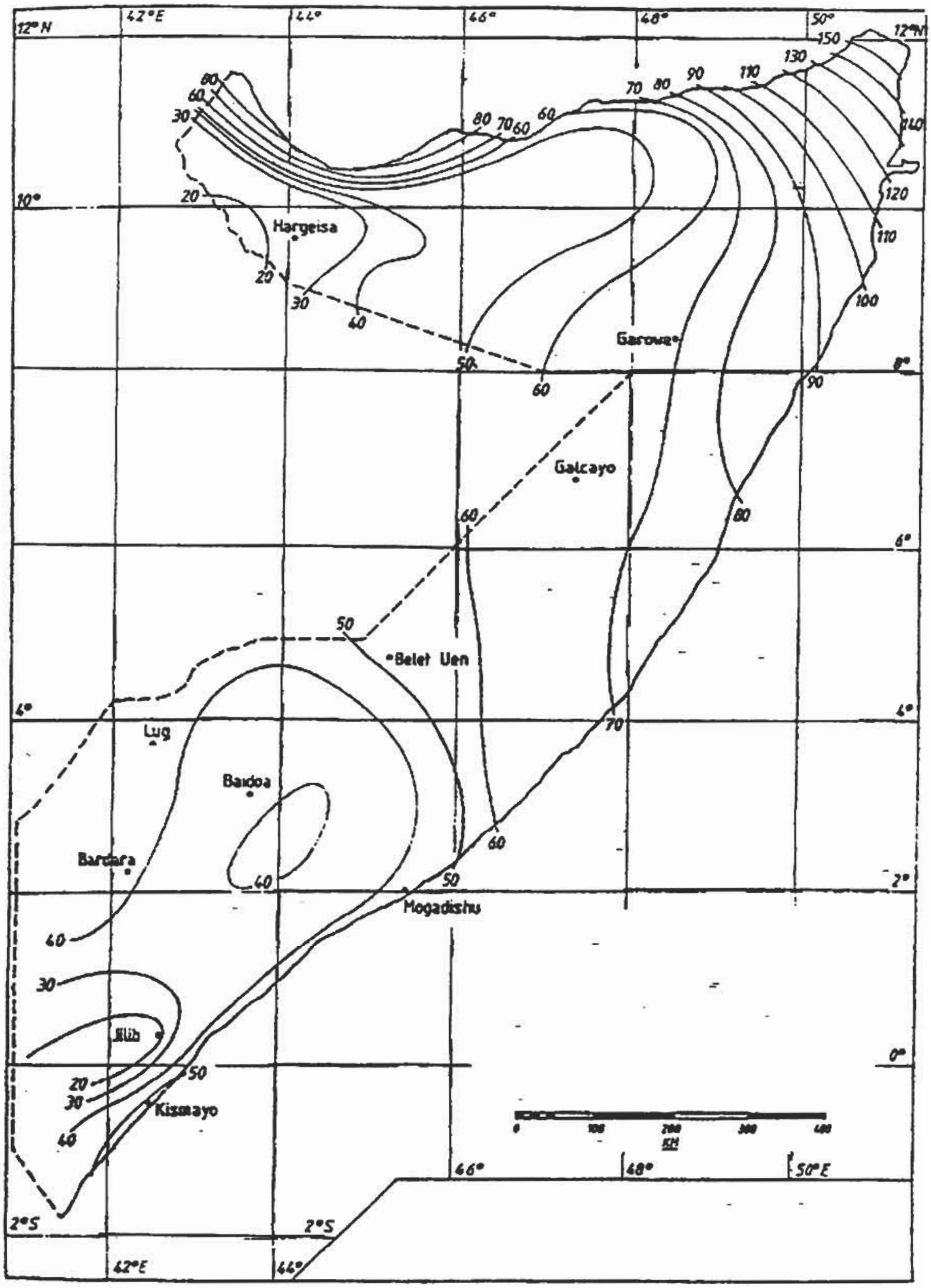


Figure 2. Reliability (variability) of annual rainfall (Coefficient of variation - %) (MOA, 1989)



These areas, together with the Jubba and Shabeelle riverine systems, are the major farming areas of Somalia. The centre and Northeast of the country, which are primarily covered by rangeland with low productive potential (agriculture seldom being feasible), have the lowest and least reliable rainfall.

The occurrence (or non-occurrence) of rainfall is linked to the movement of the sun back and forth across the equator twice a year. This produces four seasons: the Northeast monsoon (*Jilal* - December to March, dry and hot), a transition period (*Gu* - April to May, hot), the south-west monsoon (*Hagar* - June to September, cool with showers along the coast but dry inland), and another transition period (*Der* - October and November, similar to the *Gu*). The *Der* is an important rainy season in the north.

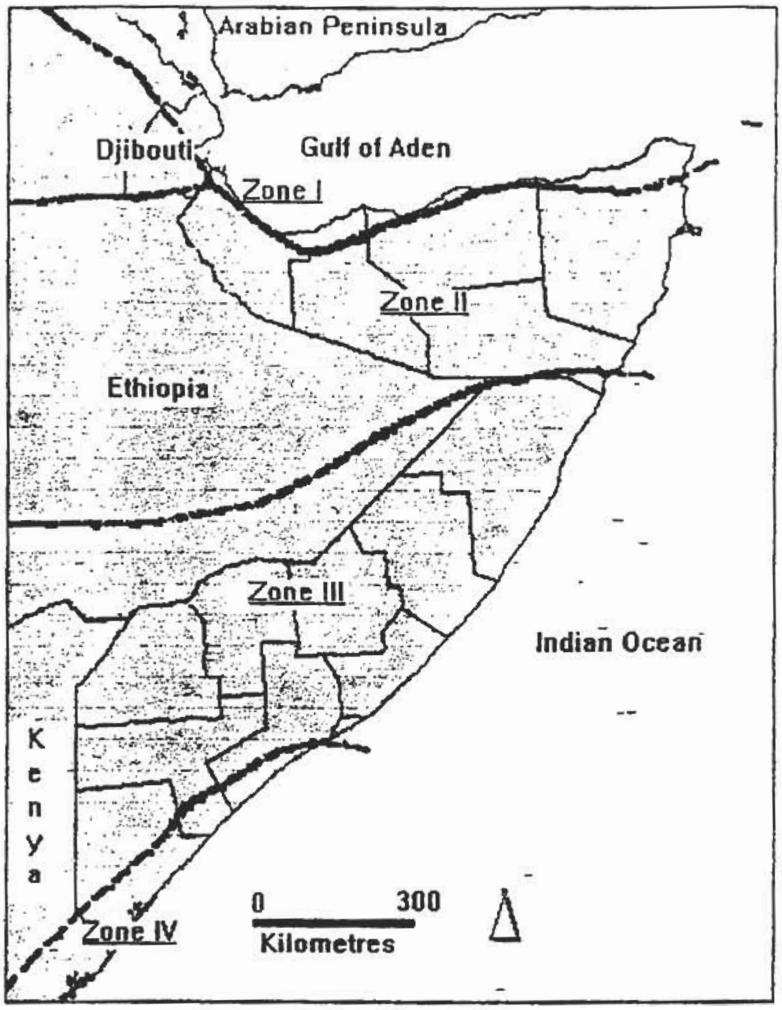
The interaction of the seasonal movements of regional air masses, the degree of latitude and the geographical features of Somalia result in four climatic regions which can be identified by their characteristic patterns of rainfall, humidity and temperature (Fig. 3). The northern coastal strip within Zone I experiences a single season of low and highly variable winter rainfall (63-200 mm/yr) (Figs. 1 & 2) during November - May with high humidity and little variation in temperatures. Zones II and III differ from Zone I in that they both have two rainy seasons a year and, over most of their areas, higher annual rainfalls (Fig. 1). They differ from one another in that temperatures are lowest in Zone II during December - January and in Zone III during July - August. Zone IV, along the southern coastal strip bordering Kenya, has a single rainy season each year (June - July). Rainfall is relatively high (400-700 mm/yr) and, compared to the other zones, shows little variability (Hutchinson & Polishchoul, 1988)(Figs. 1 & 2).

2.2 Topography

With the exception of the northern range of mountains and the associated escarpment facing the Gulf of Aden, the topography of Somalia is fairly uniform. However, five major topographic units can be identified: (a) the mountains in the north; (b) a broad limestone-sandstone basin covering all of central and southern Somalia; (c) the northern coastal plains; (d) the broad floodplains of the lower Shabeelle and Jubba rivers; and, (e) the central coastal plains. The physiographic features of these units are related to, and sometimes strongly influence, climate and soils and, therefore, vegetation characteristics and potential biological productivity.

Thus, because of their high elevations, the mountains in the north support *Juniperus procera* forests which benefit from the lower temperatures, higher rainfall and seasonal presence of mists. Fog drip during misty days provides part of the forest's moisture requirements. The coastal plains at the base of the mountains and the associated escarpment lies within their rain shadow. Consequently, it receives little rainfall and supports a drought-adapted type of vegetation consisting of annual grasses and forbs, and scattered shrubs and trees which have a low production potential.

Figure 3. Climatic regions



The floodplains of the lower Shabeelle and Jubba rivers contain fertile, and usually well watered, alluvial soils which support some of the most productive agriculture in Somalia. The broad limestone-sandstone basin comprising the remainder of Somalia is characterised by a relatively featureless topography which, especially in the centre and Northeast of the country, has little or even a negative influence on the occurrence of orographic rainfall. The passage of air masses along the length of the country, where they are not forced by hills and mountain ranges to rise, cool and produce orographic rainfall, causes them to drop, diverge and warm. Already dry to begin with, the air masses now dry out even further.

2.3 Geology

On a regional scale the geology of Somalia is relatively simple. The Precambrian basement complex, one of the oldest geological formations in Africa, and sandy limestones of the Cretaceous and Jurassic periods, constitute the main sources of the sandy soils that occur so widely throughout Somalia. Limestones occur everywhere in the country and are abundantly overlain by sands of various origin (sub-aerial, littoral and marine). Various types of evaporites, derived from the differential evaporation of the water from ancient lakes, are common in southern and central Somalia. Anhydrites and gypsum deposits are extensive in the north. The crystalline basement rises to the surface in the north and in isolated inselbergs in the south. The northern mountains consist of basement system and limestone materials. Deep, undifferentiated sediments of coarse sand, silt and clay cover large areas in the far south (RMR, undated, 1979, 1983/4). A large dune belt of Quaternary sands (now mostly stabilised) extends along the central and southern coast and blocks entry of the Shabeelle River to the sea (Baumann, 1993).

The nature of the geological material from which soils form strongly influences soil texture and fertility as well as the rate of soil development. For instance, soils developed from sandstones are sandy whereas those developed from limestone tend to be finer textured. Soils formed from basalt tend to be fertile whereas those formed from sandstone, and even more the extremely old granitic and gneissic rocks of the Precambrian basement complex, are less so (Brady, 1974). Vaporites, such as gypsum, produce relatively heavily textured soils with high salt content and poor soil water-plant relationships. Consequently, these soils support vegetation that is dramatically different from that on adjacent non-gypsic soils. Gypsum deposits in Somalia are mined and carved to make household stoves and curios (ETC, 1997).

2.4 Soils

Figure 4 presents the major soil groups of Somalia. These soil groups reflect the combined influences of geology, climate and, in some cases, special geomorphologic processes, such as the formation of dune and floodplain areas by wind and water transport. Thus, Yermosols and Xerosols occur over large areas where the climate is arid to very arid and sandstone and limestone are the major geological materials; Lithosols along the coast of central Somalia have developed from marine sands; Arenosols have been formed in the past by wind deposited materials; Vertisols, are the result of deposition of fine textured sediments from the waters of the Shabeelle and Jubba rivers (Bowen & Bird, 1988).

Some soils in Somalia have severe limitations for crop production, including irrigation development. These include Yermosols, Xerosols and Regesols (Bowen & Bird, 1988) where a combination of limestone parent materials and the tendency, in hot, dry climates, for well watered, poorly drained, heavily textured soils to become saline and/or alkaline. In addition, saline and alkaline soils (Solonetz and Solonchaks) occur along the two permanent rivers, in some cases as degraded Vertisols or Fluvisols.

Soils of the Nitosol and Fluvisol groups are some of the most suitable for agriculture in Somalia. Nitosols, characterised by an argillic (clay) horizon with a high base saturation, occur in the south, primarily around Baidoa and Burr Hakaba. Fluvisols, which have been developed from recent alluvial deposits, occur along rivers and wadis throughout the country. Fluvisols are fertile, level to gently sloped, and usually found near water (Bowen & Bird, 1988). They are, therefore, favourable for irrigation as well as rainfed cropping and livestock husbandry. For instance, Fluvisols of the Jubba River floodplain support a standing crop of grass 2-20 times that found elsewhere (Deshmukh, 1990). However, most areas of Fluvisols are limited in extent and, in some cases, poor drainage leads to the development of soil salinity. Vertisols, which are found along the southern part of the Shabeelle River, are fertile, heavy textured and have good moisture retention capacity. However, tillage of vertisols poses a problem and their very low permeability requires special care with regard to irrigation and prevention of salinization.

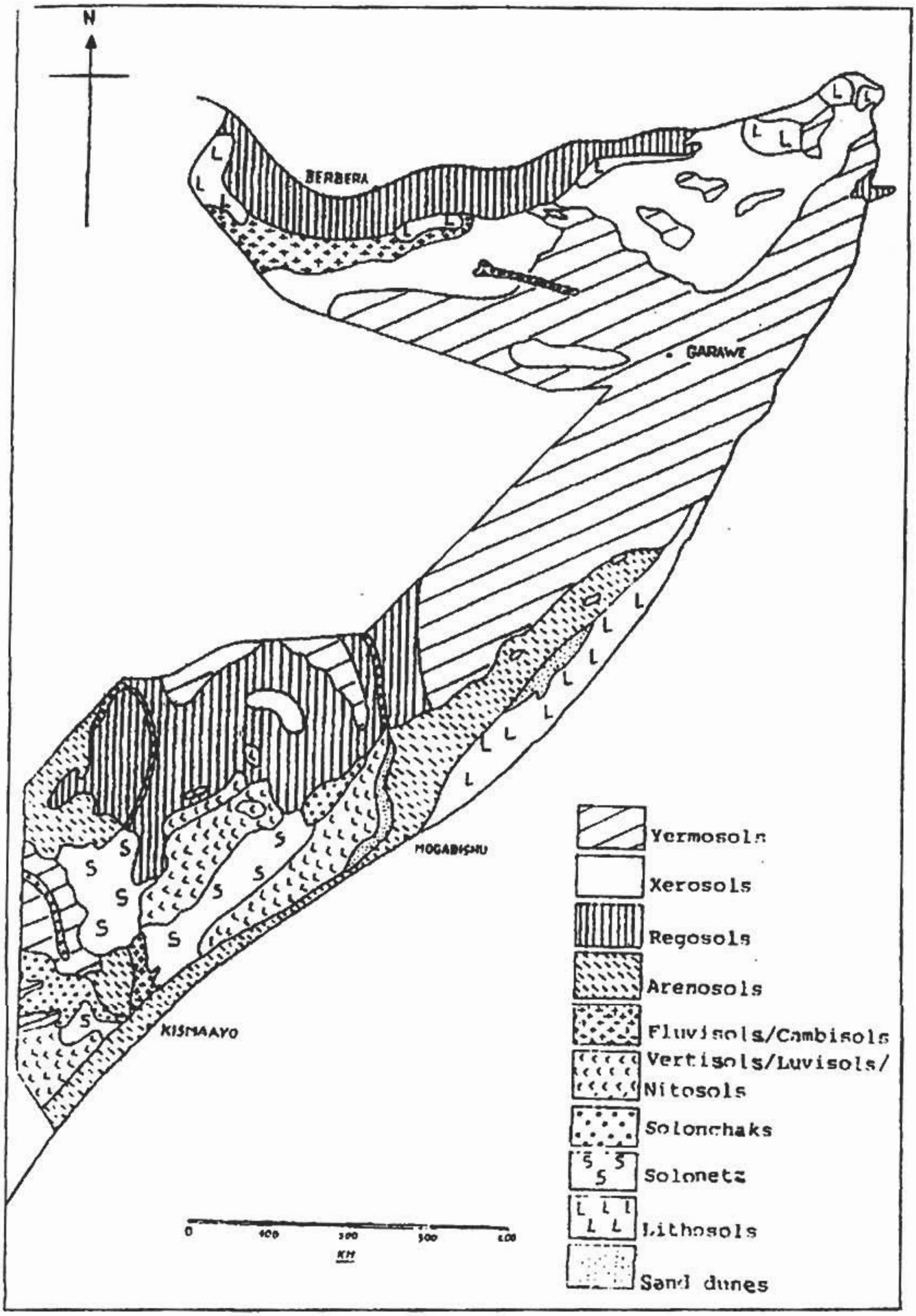
Within marginal agricultural areas certain soils have the capability of compensating, to various degrees, for the limited rainfall. For instance, sandy soils have good soil-plant-water relationships: fast infiltration by rainwater, protection of soil moisture from evaporation and easy access by plant roots, which give them the advantage over heavier textured soils in low rainfall areas. This may be one reason why, for instance, cowpeas are able to be cropped north of Mogadishu where the annual rainfall is only 200-400 mm but the soils are sandy.

2.5 Water Resources

In the prevailing dry environment of Somalia, the availability of freshwater is a major factor limiting land use. On the other hand, when present in sufficient quantity and quality, it may also lead to environmental degradation. A case in point is the rangeland areas which, without available water, are used only by camels and certain species of wildlife but with abundant water may be quickly overgrazed because of high concentrations of livestock.

Freshwater is obtained from two broad categories of sources. One type of source is surface water which includes rivers, pans (*wars*), cisterns (*barkads*) and dams *(balleys)*. The other is groundwater which includes boreholes, shallow-wells and springs.

Figure 4. Soil map of Somalia (MOA, 1989)



2.5.1 Surface water: rivers

Over most of Somalia, surface water is typically an ephemeral resource closely tied to the occurrence and amount of rainfall. The exceptions to this generalisation are the Jubba and Shabeelle rivers in southern Somalia which flow from the Ethiopian border southward to end either in the sea near Kisimayu (Jubba) or in wetlands behind coastal dunes below Janaale (Shabeelle). These rivers are the mainstay of irrigated agricultural production in Somalia and are the focal points for a large population of settled communities. Access to river water (as well as forage on the floodplain) is considered to be essential to the support of livestock in the Jubba and the Shabeelle River valleys during the long dry season (*jiilal*)(Deshmukh, 1990).

Both rivers originate in the eastern Ethiopian Highlands and their flows reflect the seasonal fluctuations of rainfall in their catchment areas. However, even though both rivers have similar catchment areas, the flows in the Shabeelle River are less than a third of those in the Jubba. Flows are highest from March to May and August to November and can cause extensive flooding as recently occurred in late 1997. They are at their lowest between December and February when the lowest reaches of both rivers may be dry. For instance, the flow of the Shabeelle River varies from a mean low of about 10 cumecs in February to around 125 cumecs in both May and September. This allows two main periods of irrigation and, therefore, two cropping seasons (Deshmukh, 1990).

During periods of flood, the Shabeelle River carries heavy silt loads, the downstream deposition of which, at least in recent years, has raised the bed of the river channel. This has caused a progressive migration of swamp several kilometres upstream, causing the loss of some farmland, and increased the risk of flooding and widespread salinization of other clay-soil farm lands (Douthwaite, 1987). The extent to which this is a normal part of the dynamics of the Shabeelle riverine system or the result of man-induced soil erosion in the catchment area is not known. However, the erosion (and potential for erosion) of riverbanks has certainly increased with reduction of the associated riverine forest which protects the banks from erosion (Douthwaite, 1987).

Prior to the civil war, flood prevention and water retention schemes operated on both rivers to protect farmland and facilitate irrigation. The lower reaches were bunded and seven barrages were constructed on the Shabeelle and one on the Jubba. An off-stream storage reservoir near Xawaddley and Jowhar on the Shabeelle covered some 110 km². However, much of this infrastructure was destroyed during the war or has been poorly maintained since (Howard, *pers. comm.*).

2.5.2 Other types of surface water sources

Apart from the two main rivers (Jubba and Shabeelle), surface water sources are, with a few exceptions, typically small in size and ephemeral. Sometimes naturally occurring, they are more usually man-made dams (*balleys*) or sub-surface cisterns (*berkads*) that are dependant on seasonal rainfalls and surface runoff or, as occasionally happens for *berkads* , tanker trucks. *Berkads* and *balleys* must be carefully sited with regard to the soil (relatively impervious), size of the water catchment and exact position within the catchment if they are to be efficient collectors of water. The bottoms and sides of *berkads* are cemented and occasionally the *berkads* are covered to reduce loss through evaporation and minimise pollution.

Typically, *balleys* hold water for up to six to eight months of the year while *berkads* can store water all year round if refilled by tanker trucks. Deepening, lining and covering them increases the length of use although the amount of water they hold is still dependant on the amount of seasonal rainfall.

From the viewpoint of the natural resource manager, if not the pastoralist, *berkads* and *balleys* are an ideal way of increasing access to rangeland grazing areas while at the same time minimising risk of localised overgrazing. This is the result of livestock only being able to graze an area as long as there is water in the storage structure; once dry the livestock must move away. Of course, as the structures become larger, their density for a given area increases and the water they contain lasts longer this generalisation becomes less applicable. For instance, the substantial increase in water storage facilities, such as berkads used mainly for human use, has increased sedentarisation of human populations and expansion of rainfed agriculture in suitable areas. Examples include the *Haud* plateau in N.W. Somalia and the interior coastal plains of Middle Shabeelle and Galgadud Regions (Vetaid, 1997; Lard and Potterton, 1997). In addition, numerous large water catchments and thousands of private and cooperative small water catchment (together with deep wells) have changed traditional migration patterns of livestock in southern Somalia (Janzen, 1988).

2.5.3 Groundwater: boreholes

A considerable amount of information, most of it dealing with the south and centre of the country, exists on the hydro-geology of Somalia (e.g. National Water Centre, 1988) although little of this information is currently located in Somalia and what is available is scattered between various international institutions. Based on a review of hydro-geology information, Johnson (1978) concluded that: "Considering the availability of potential aquifers in conjunction with the overall population of the country, it's distribution and the distribution of it's primary industry, Somalia does not appear to be short of water".

However, the experience of the Somalia Central Rangeland Development Project during the 1980's was that the successful tapping of groundwater, even with deep boreholes, was not a uniformly successful event. Boreholes (and shallow wells) which produced adequate amounts of water of the proper quality generally showed a patchy distribution.

Boreholes with engine-driven pumps are often a major capital investment made by the livestock industry and they also provide water for human consumption in towns and villages. However, this type of water supply carries with it important implications regarding the sedentarisation of pastoralists, conflicts over rangeland use and environmental degradation. In addition, boreholes with engine-driven pumps, especially if communally owned, are often unreliable suppliers of water because of difficulties in maintaining them and obtaining reliable supplies of fuel.

2.5.4 Groundwater: shallow-wells and springs

Shallow wells are a traditional means used by pastoralists to obtain water. They vary from constructed structures lined with rock and protected at the surface by a circular masonry wall to simple temporary holes dug into the sandy surfaces of dry river beds. The latter fill with sand when the stream regains it's flow. Near the sea on the coastal plains of Central Somalia. pastoralists deliberately refill wells with sand when the water becomes brackish and re-dig them again only after they have been recharged with fresh water (Laird & Potterton. 1997). Shallow wells are numerous throughout Somalia's rangelands although they are often patchy and widely scattered in occurrence. They can only be located where groundwater is near the surface. Typically, groundwater levels vary seasonally with the rainfall with a certain lag time involved. It is not uncommon for some to dry up completely during periods of drought. The rehabilitation of existing shallow wells proved to be one of the more successful interventions of the Somalia Central Rangelands Development Project in the 1980's because it (a) required relatively little investment, (b) was greatly desired by the local pastoralists and (c) required their physical and financial cooperation (Herlocker, 1989). This remains a successful intervention under the EC Rehabilitation Programme for Somalia (Forbes, pers. comm.).

Conditions are favourable for the rehabilitation and construction of hand-dug shallow wells along the coastal strip, in sandy river beds and alluvial sites within mountainous areas, in the Darror Valley, Ceerigaabo Plateau, and the Nugal Valley. It is also possible to construct other types of ground water sources, such as infiltration galleries across major seasonally flowing stream beds (*toggas)*, sand storage dams and underground dams across water courses in the mountains. Water stored in these sand reservoirs can be tapped by hand dug wells. At least in northern Somalia, it is possible to develop much of the surface and shallow groundwater sources with simple technologies (Faillace and Faillace, 1986), which is the approach presently being taken by EC-funded water sector rehabilitation efforts (Forbes, pers. comm.).

2.6 Water balance

The relationship between rainfall and the demand placed on water by direct evaporation and transpiration from plants is a more effective expression of the relative degree of aridity than rainfall alone. Annual average rainfall in Somalia ranges from 63 mm to 386 mm (Fig. 1). Potential evapotranspiration, which ranges from 1500-3000 mm/yr, far exceeds this amount. However, when expressed on a monthly or seasonal basis, which more closely reflects potential plant growth, some areas, such as that around Baidoa and Jilib, are seen to have a few months of water surplus (Fig. 5). Nonetheless, water surpluses are not typical of Somalia as a whole (Fig. 5) and the imbalance between rainfall and potential evapotranspiration remains the most important constraint to agriculture in the country.

The greater the water demand the sooner plants will exhaust the existing soil moisture and cease growth. Natural vegetation communities have adapted to long term levels of potential evapotranspiration through certain adaptive mechanisms, such as short growing seasons, leaf loss, small stature and widely scattered plants in areas of high potential evapotranspiration and longer growing seasons. In areas of low demand, plants are larger, more closely spaced and often evergreen. In agriculture, crops must be selected so that their growing seasons either reflect the demand for water or the deficits must be met through irrigation.

2.7 Vegetation

The vegetation of Somalia has been extensively studied in the past, with a mass of information in unpublished reports and published articles commissioned and produced by a range of administrations and organisations (Glover, 1946, Hemming 1966, Pichi-Semolli, 1957, RMR during the 1980'ies, Thulin, 1993). Pichi-Semolli (1957) produced the first vegetation maps for Somalia using ten main types which were described. Hemming (1966, 1972, 1973, 1997) has documented extensively the northern and central vegetation types based on field surveys, and classified areas according to soils, geomorphology, and climate.

For the purpose of providing an overview of the Somali vegetation, White's (1983) classification of the vegetation of Africa, which recognises seven major vegetation types in Somalia is used (Fig. 6).

A comparison of Fig. 6 (Vegetation Map) with Fig. 1 (Mean Annual Rainfall), Fig. 2 (Coefficient of Variation of Annual Rainfall) and Fig. 5 (Regions of Aridity) shows a close relationship between these climatic parameters and White's vegetation types. Arrayed along the climatic gradient from driest to wettest, the vegetation types are:

- ***Absolute desert vegetation type:*** Although an anomaly under the White classification system caused by the presence of gypsic soils resulting in poor soil-moisture-plant relationships and climatic influences, this areas are mostly found within the deciduous bushland and thicket zone characterised by the presence of *Acacia etbaica* and a number of unpalatable *Aloe spp.*
- ***Coastal desert vegetation type:*** Raised coral reefs and ancient aeolian sand formations in very exposed areas along the N.E. coastal areas support very little soil formation. Hence vegetation is sparse and dominated by *Limonium spp.* but also *Sclerostephane adenophora*, *Acacia edgeworthii* and *tortilis* among others.
- ***Coastal and sub-coastal semi-desert grassland and shrubland:*** Within this vegetation type exists a wide range of vegetation species which reflect localised geomorphology, climatic and soil characteristics. Estuarine sea-water pools and sand bars support mangrove areas consisting of *Avicennia marina*, *Rhizophora mucronata* in the N.W. around Zeila and *Rhizophore mucronata*, *Ceriops tagal* and *Bruguiera gymnorrhiza* strands in the south around the Jubba River outlet. The coastal plains in the north support scattered clumps of grasses, the most prevalent being *Lasiurus scindicus* and after the rains a number of annual grasses (e.g. *Aristida adscensionis*, *Eragrostis sp.*, *Cenchrus ciliaris*). Scattered woody species include *Balanites orbicularis*, *Acacia tortilis*, *Boscia minimifolia* and *Dobera glabra*. The sub-coastal areas consist mainly of perennial grasses such as *Dactyloctenium robecchii*, *Panicim turgidum*, and the genera's of *Salcola*, *Limonium*, *Atriplex* and low *Acacia edgeworthii*. In specific geomorphologic sites such as the Karin Gap in Bari region and coastal togga areas, *Conocarpus lancifolius* are found along with other large trees including *Zizyphus mauritiana*

Figure 5. Regions of aridity based on the ratio of mean annual rainfall (mm) and potential evapotranspiration (Etp) (mm) (UNESCO, 1979). Each region is characterised by a climatogram which relates rainfall and temperature (an index of Etp) to the amount of rainfall needed to grow crops (Janzen, in Baumann, 1993).

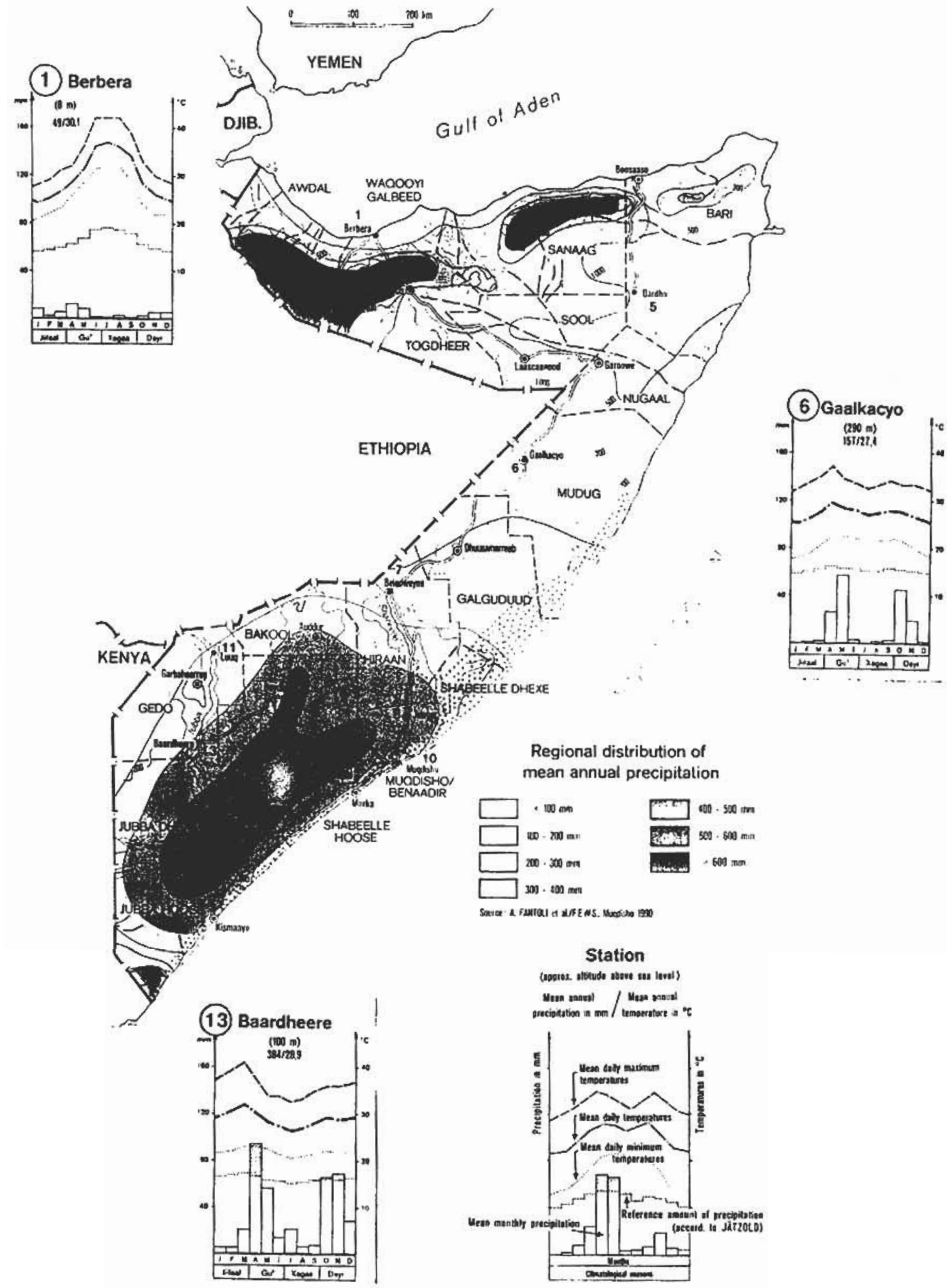
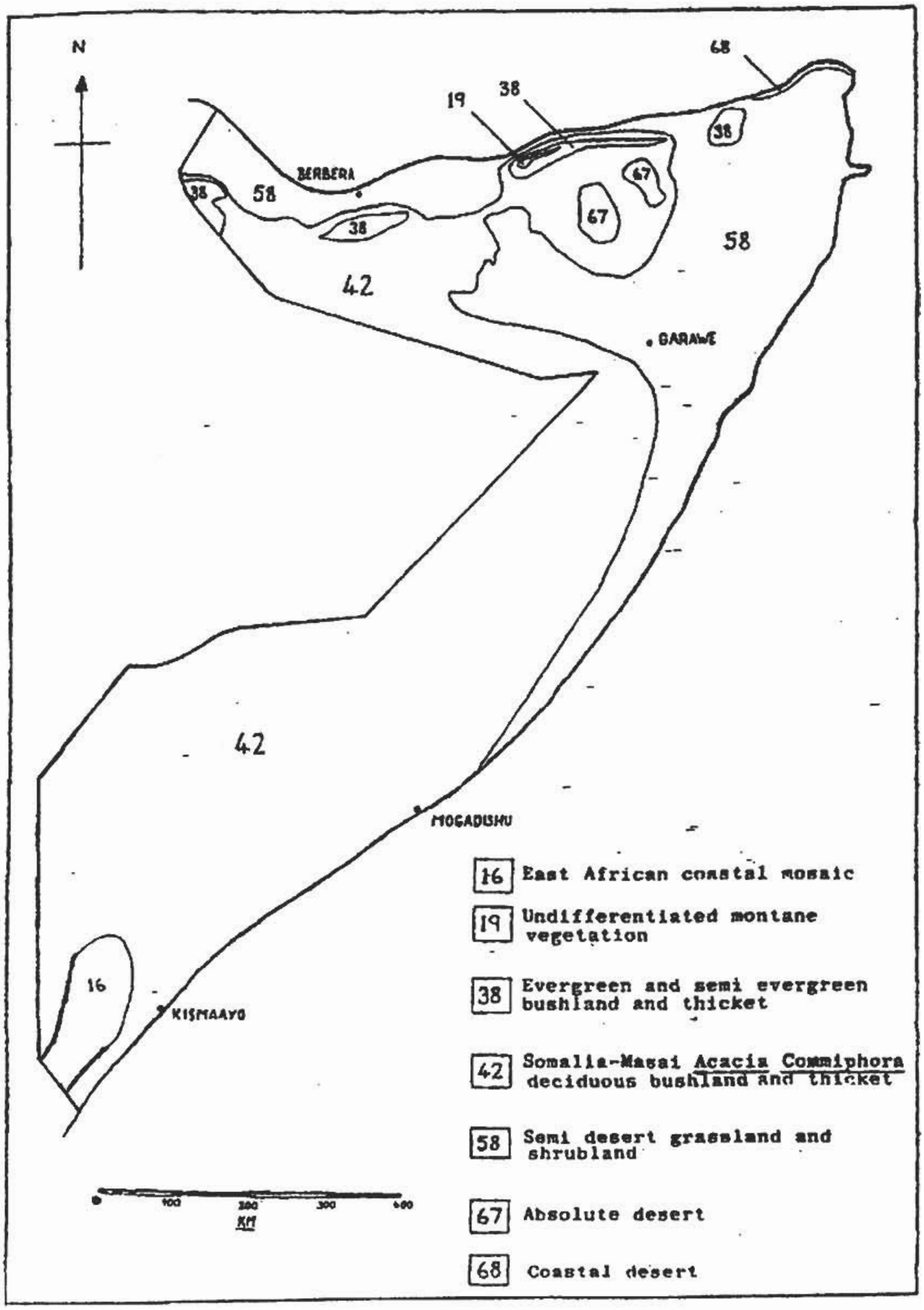


Figure 6. Vegetation map (White, 1988)



and *Acacia tortilis*. In oases and other sites where water is close to the surface, stands of palms *Phoenix reclinata*, *Hyphaene reptans*, and *Livistona carinesis* are found. Other areas include the Dharoor and Nugal depressions where plant species are adapted to gypsic soils. In the transition zone with the deciduous bushland and thicket *Acacia mellifera* is common.

- ***Acacia and commiphora deciduous bushland and thicket:*** The dominant species over extensive areas of Somalia are *Acacia* and *Commiphora spp*. These include *A. Bussei*, *A. mellifera*, *A. tortilis*, *A.senegal*. Dominant grass species include *Chrysopogon plumulosus*, *Dactyloctenium*, *Sporobolus ruspolianus* and *Andropogon*. Important areas that are not represented in White's classification for this zone are the riverine areas of the Shabeelle and Jubba, and the narrow coastal area south of Mogadishu to the Kenyan border. The riverine areas support forests on the natural levees formed by the rivers. The main tree species include *Ficus sycamorus*, *Afzelia quanzensis*, *Acacia robusta*, *A. goetzei*, *Newtonia erlangeri*, *Parkia filicoidea*, and *Sorindeia madagascariensis* among others.
- ***Evergreen and semi-evergreen bushland and thicket:*** Found just below the higher elevation montane vegetation zone, the dominant species include *Acacia etbaica* with *Acokanthera schimperi*, *Hypoestes hildebrandtii* and also *Aloe scobinifolia and Amegalacantha*.
- ***Undifferentiated montane vegetation:*** The predominant species in the montane zone is *Juniperus procera* which extend over the higher elevations of the Golis mountain range in northern Somalia. Other evergreen species in the montane zone include *Buxus hildebrandtii*, *Dodonaea viscosa*, *Cadia purpurea* and *Euclea shycimperi*.
- ***Coastal forest mosaic:*** This vegetation type is the northern limit of the moist evergreen forest of Kenya's Coast Province. Dominant taller tree species include: *Atiaris toxicana*, *Nesogordonia holtzii*, *Afzelia quanzensis*, *Erythrina suaveolens*, *Cussonia zimmermanii* and *Combretum schumaniia* among others. Lower storey tree include *Tamarindus indica*, *Trichilia emetica*, *Sterculia appendiculata*, *Oldfieldia somalensis* among others.

Along the same gradient from dry to wet the vegetation typically gradually becomes denser, taller, less deciduous, compositionally more complex and more productive. Change occurs within as well as between vegetation types and is especially obvious when travelling across the width of the Acacia Commiphora deciduous bushland and thicket area of central Somalia.

Each vegetation type, although having broadly similar physiognomic (such as dominant plant growth form) and compositional (dominant genera and, sometimes, species) attributes, actually consists of a number of smaller vegetation communities which are primarily related to soil type and are dominated by different combinations of plant species. These are the most important (i.e., basic) vegetation units with regard to vegetation dynamics, productivity and biodiversity.

Most vegetation in Somalia has been further modified, in terms of cover, density, and composition, by varying degrees of different types of land use. In some cases, such as the widespread cutting of riverine forests (Fig. 6), e.g. *Juniperus* and mangrove forests and of large areas of *Acacia bussei* for charcoal, the modification has been extreme (Madgewick, 1989; FAO,/UNEP, 1981).

Most of Somalia consists of deciduous bushland and thicket (42) and semi-desert grassland and shrubland (58). However, forests, despite the small overall area that they cover, play important roles in moderating the impact of flood waters on riverine farms (riverine forest) , stabilising soil, protecting watersheds and condensing moisture from mountain mists (montane *Juniperus* forests) and also provide a particularly productive marine habitat (mangroves). This in addition to their value as unique biological communities and as habitat for endemic (and sometimes endangered) flora and fauna. They also have the highest woody biomass per unit area of any vegetation type in the country: over 40 tons / ha (RMR, 1983/4).

2.8 Marine resources

The Somali maritime zone is one of the largest of any eastern African nation and one of the largest in the western Indian Ocean (WIO). It is also well known that this zone embraces one of the most important large marine ecosystems (LMEs) in the Indian Ocean, namely the Somali Current Marine Ecosystem, with its nutrient-rich seasonal upwelling resulting in raised productivity and associated high biodiversity with rich fisheries resources.

The coast of Somalia has various biological and physical attributes. It edges on two distinctly different seas, the Gulf of Aden and the Indian Ocean. In general, the coastline is straight with few bays, natural shelters or islands. Exceptions to this are to be found near Kismayo in the south (2°S) near the border with Kenya where the string of Bajuni Islands run parallel to coast. Off the Horn are the Socotra Islands, claimed by Yemen. Maydh Island lies 12 km offshore about halfway between Bossaso and Berbera and is an extremely important nesting and roosting site for seabirds. Closer to Djibouti, the Saad ed Din islands are rich in coral reefs and nesting seabirds. The coastline facing the Gulf has sandy bays with rocky promontories and at several places there are sheer sea cliffs up to 100 m high. Rocky shores comprising Pleistocene fossil coral reefs, now exposed due to lower sea levels, are also evident at many places. At Haafoon, south of the Horn, there is a large shallow bay which is one of few sites that provides shelter against prevailing winds and sustains rich marine life.

The Jubba River, having a permanent flow, supports significant estuarine and mangrove systems. Many toggas, which flow intermittently, have inlets and tidal creeks that provide sheltered water and easy access to resources for coastal communities, especially during rains. Along the Indian Ocean coast rocky outcrops are more frequent and wave action is more dynamic, often quite severe during the monsoon periods. Long-shore sand movement and wind-blown dune fields appear more prevalent.

The oceanographic conditions of the region are unique and complex, strongly influenced by a combination of boundary currents, seasonal monsoons and physical conditions. The South Equatorial Current that flows across the Indian Ocean towards Africa, splits into the southward Mozambique (Agulhas) Current and northward Somali Current. These are amongst the most powerful boundary currents in the world, shifting large volumes of water at velocities up to 7 knots. Towards the Horn (5°N to 9°N), the Somali current leaves the coast and retroflects, creating a powerful gyre known as the "Great Whirl". This gyre induces significant upwelling that creates a range of unique physical water conditions. These include lower water temperatures and oxygen levels with higher levels of nutrients. This in turn raises productivity with resultant plankton blooms and associated fish aggregations.

The Somali Gyre is not persistent and has its greatest strength from June to September. This is followed by a period when Northeast Monsoons work against the Somali Current so that current reversal is known to take place and the upwelling reduced or absent.

The Gulf of Aden also has a seasonal current regime, influenced by the variability in monsoons. During the Southwest Monsoon (March to October), the general flow in the Gulf is eastward while during the rest of the year the prevailing current is westward. Nearer the northern shore of Somalia there may be currents counter to these general directions.

Clearly these dynamic and variable oceanographic conditions impact on the region's biota, both as elements affecting biodiversity and productivity as well as a factor in zoogeographic boundaries and distribution patterns of living marine resources in the western Indian Ocean and the Gulf of Aden. Moreover, the prevailing climatic and oceanographic conditions also pose limitations over accessibility to the resources, so that the primary fishing seasons are between November and March.

The marine biodiversity is of value not only to Somalia but also to neighbouring countries and the Western Indian Ocean as a whole. The dispersal of nutrients, larvae and juveniles of numerous marine animals as well as highly migratory species such as the tuna, swordfish, sharks, cetaceans and turtles, are all directly influenced by the health and status of the ecosystems in the Somali region.

2.8.1 Major Ecosystem Components

Sandy shores

Sandy beach ecosystems make up a large proportion of the coastal environment, often interspersed with rocky outcrops and edging onto shallow reef platforms encrusted with corals, seaweeds, seagrasses and other sessile organisms. These beaches are dynamic ecosystems, and are of vital importance to the sea turtle populations of the Indian Ocean and Arabian Sea, in providing extensive nesting sites. They also form barriers behind which tidal lagoons and inlets form.

At many places, especially around the shallow coastal lagoons, such as at Ras Bimma and the Haafoon region, the beaches are important sites for thousands of waders, gulls, terns, and cormorants. The beaches are also intensely colonised by ghost crabs. These prolific animals are important components of the sandy beach ecosystem and, like the turtle hatchlings, highly vulnerable to oil pollution or similar impacts.

Rocky shores

Considerable sections of the coast comprise rocky shores and at places steep cliffs, that may extend offshore as extensive shallow shelves, covered by algae. Sessile plants and animals grow on these rocks, both inter- and sub-tidally. At many places the rocky substratum provides the base for encrusting corals and extensive algae beds. The sea cliffs west of Alula and the Horn are white-washed for kilometre after kilometre and support thousands of roosting cormorants.

Mangrove and estuarine systems

As Somalia has only one permanent river entering the sea, the prevalence of estuarine systems is moderate, but clearly important. Besides the considerable estuarine and mangrove systems around the Jubba River complex, there are smaller patches of mangroves associated with coastal lagoons and tidal creeks throughout the region, for instance around the Saard ed Din Island in N.W. Somalia. These mangroves are monospecific, supporting only *Avicennia marina*. It is also important to note that the estuarine ecosystem is not always confined to actual estuaries and river mouths, but that the offshore banks created by these rivers represent very important 'estuarine' ecosystems of great value. In the western Indian Ocean, examples are the Tugela, Rufiji and Sofala Banks, all of which support unique biodiversity and valuable prawn fisheries. The offshore bank of the Jubba River is likely to be equally important and needs special attention. In particular future fresh water extraction and probable damming of the Jubba River will inevitably impact on this ecosystem.

Mangroves have a high primary productivity (Table 1). Mangrove detritus (fallen leaves and other litter) supports both estuarine and other near shore fisheries. Mangroves are also efficient nutrient traps. Therefore, they not only support highly productive fisheries but are also essential to the maintenance of healthy populations of seagrass and coral reefs, both of which are threatened by waters with high nutrient levels (Ruwa, 1996).

Table 1. Primary productivity in various tropical marine ecosystems (as grams of carbon) (Ruwa, 1996).

ECOSYSTEM	PRODUCTIVITY ($gC/m^3/yr$)
Mangrove forest	5112
Mangrove leaf litter	366-1464
Phytoplankton	
Open ocean	50
Continental shelf	100-150
Upwelling areas	300-500
Seagrass / algae beds	900-4650
Sandy beach	5

Coral Reef and Communities

Although the typical fringing coral reef systems found in Kenya extend north into southern Somalia, they are generally not prevalent along the rest of the coast. However, there are specific sites of coral wealth and diversity (Carbone et al 1994). Coral diversity decreases west across the Indian Ocean away from the Australasian area, which is the area of highest coral diversity, and then increases again toward the African mainland as a range of WIO endemics contributes to the diversity (Salm, 1995). A further decrease in diversity occurs north along the east coast of Africa into Somalia. Somalia is generally considered to fall into a low coral diversity region (Riegl, 1996). However, recent studies by IUCN in the reefs of the Saad ed Din Islands refutes this, and produced a total of 99 shallow water coral species (McClanahan & Obura, 1997). When this total is combined with deeper water and east coast species, it is likely to increase the total coral list for Somalia to a regionally significant level. This, yet again, confirms the little research done on Somali marine biodiversity. What is clear is that the Somali region comprises a major ecotone between the coral faunas of the WIO and the Red and Arabian Sea as components of all three coral fauna attain their distribution limits in Somali waters.

While the details that would emerge from further surveys would be useful in elaborating management procedures for development of the reefs, certain facts are already clear. Somalia does have coral reefs that are a valuable natural resource with potential for development. They constitute productive ecosystems of ecological importance in the regional food chain and contribute to local artisanal fisheries. However, they are typically sensitive to damage and perturbation and the absence of a tourist industry centred around them provides an opportunity for their zonation for use before development, or even complete closure as fishery replenishment zones. Surveys are recommended so that appropriate management strategies can be instituted and the most sensitive areas protected.

It should be noted that there are likely to be considerable sub-tidal coral reefs. On a previous visit, two mission members dived on shallow coral reefs near Berbera and concluded that they were exceptionally rich and unspoiled with no significant incidence of broken coral. Both team members had extensive dive experience throughout the western Indian Ocean. Concentrations of several species of fish, such as the speckled snapper (*Lutjanus rivulatus*) were the highest ever seen by the team, this in stark contrast to most other regions of eastern Africa. Thus, some of the most valuable coral reef systems may well be located at depths of 5m to 20m. These need to be studied and could well be providing the habitat for the considerable diversity and abundance of reef associated fishes.

Coastal shallows and seagrass beds

At many places along the Somali coast, there are coastal shallows that are not exposed at low tide and that sustain especially luxuriant stands of seagrass and seaweed beds. This is especially true in the area of the Bajuni islands which supports dense beds of the seagrass *Thalassodendron ciliatum* among a range of other species. Sparse scattered beds of *Halodule* and *Halophila* occur around the Saad ed Din Islands and in the Berbera area, and are probably widely distributed along the warmer parts of the Somali coast. These seaweed and grass beds are not only a significant site for primary production (generating seaweed drifts) but they are major sites for turtle foraging.

The huge trapped seaweed drifts along the rocky shore of the Northeast coast, especially between Mogadishu and Hobio as well as the coast north of Ras Bimma and Haafoon were noteworthy. These dislodged plant remains have been studied in detail (e.g. in KwaZulu-Natal) and shown to form the basis of the inshore nutrient cycle through a process of physical maceration, natural bacterial decay and filter feeding animals (Schleyer, 1981).

Coastal shallows are also of major importance to the dugong, a seriously threatened marine herbivorous mammal. Though some were sighted during the air survey, it should be noted that the areas covered by the survey were not great dugong habitats. Further south along the East Coast, in association with extensive seagrass beds behind the fringing reef, dugong may well be more common. This region was not considered safe during the mission visit. However, the possibility of by-catch problems associated with gill netting for sharks may also have contributed to the low count.

At several places along the NE coast, dense phytoplankton blooms can be visible, some green but others thought to be brown diatoms.

Pelagic systems
The upwelling system off the Horn is special and its considerable size makes it unique. It provides the nutrients and dynamics for high primary and secondary productivity. These pelagic fish concentrations are known to fluctuate considerably, in association with the variability of the upwelling system (Stromme, 1987). Also evident are the massive concentrations of fish eating seabirds such as cormorants, gulls and terns. Of further significance appears to be the presence of dolphins and whales (mostly noted to be Bryde's or possibly minke whales), which were seen to be feeding on these sardine-like fishes. Studies by Small & Small (1991) confirm a high species diversity of cetaceans, with at least 398 sightings involving 14 species during a 20 month survey period in 1987. These were seen to be seasonally abundant, in close correlation with the upwelling events leading to increased productivity.

Compared to the other regions, this is a less complex, less stable but much more productive ecosystem based on large schools of herbivores, such as rabbit fish, parrot fish and surgeon fish, and pelagic (free-swimming) plankton feeders, such as mackerel, sardines and scads. These, in turn, are preyed upon by larger pelagic species, such as tuna, big mackerel and skipjack (Appendix 3). The pelagic species, which are migratory, are abundant only seasonally during the time of upwelling.

2.8.2 Biotopes (coastal environmental regimes)

The coastline can be divided into five biotopes (coastal environmental regimes) (Stromme, 1987).

The North Coast from the Djibouti border to Raas Surud (Biotope "A", Fig. 7).
Dominated by sandy beaches broken at intervals by rocky outcrops and cliffs, and togga outlets. In the western extremity, the Saard ed Din Islands support extensive coral reefs. Localised sub-tidal coral reefs are found in protected areas such as immediately west of the Berbera natural harbour. Biodiversity of this area is very high as it contains elements of fauna from the Indian Ocean, Gulf of Aden, Red Sea and Arabian Sea (McClanahan, 1997). Overall fishery productivity is lower compared to the eastern coast since it is only moderately affected by the "Great Whirl" (Stromme, 1987).

The North Coast from Raas Surud to Ras Asir (Biotope "B", Fig. 7).
This is a transition zone between the major area of upwelling to the east and the stable tropical reef ecosystem to the west. It is characterised by rocky reefs covered with algae. This area receives some seasonal influxes of nutrient and phytoplankton-rich waters from the major area of upwelling further east. Seasonal blooms of phytoplankton, which occur during these incursions of upwelled water are exploited by migratory pelagic fish. Year round carrying capacity is not high because the upwellings occur only seasonally during the time of the Southwest monsoon.

The North-east Coast, from Ras Asir to Ras Mabber (Biotope "C", Fig. 7).
Primary productivity is very high during the s.w. monsoon because of upwellings of nutrient-rich cold water. The upwelling waters are oxygen-depleted, often causing mass fish kills. The waters are also quickly carried off the continental shelf so that only a small fraction of the

Figure 7 : Marine Biotopes (Stromme, 1987)

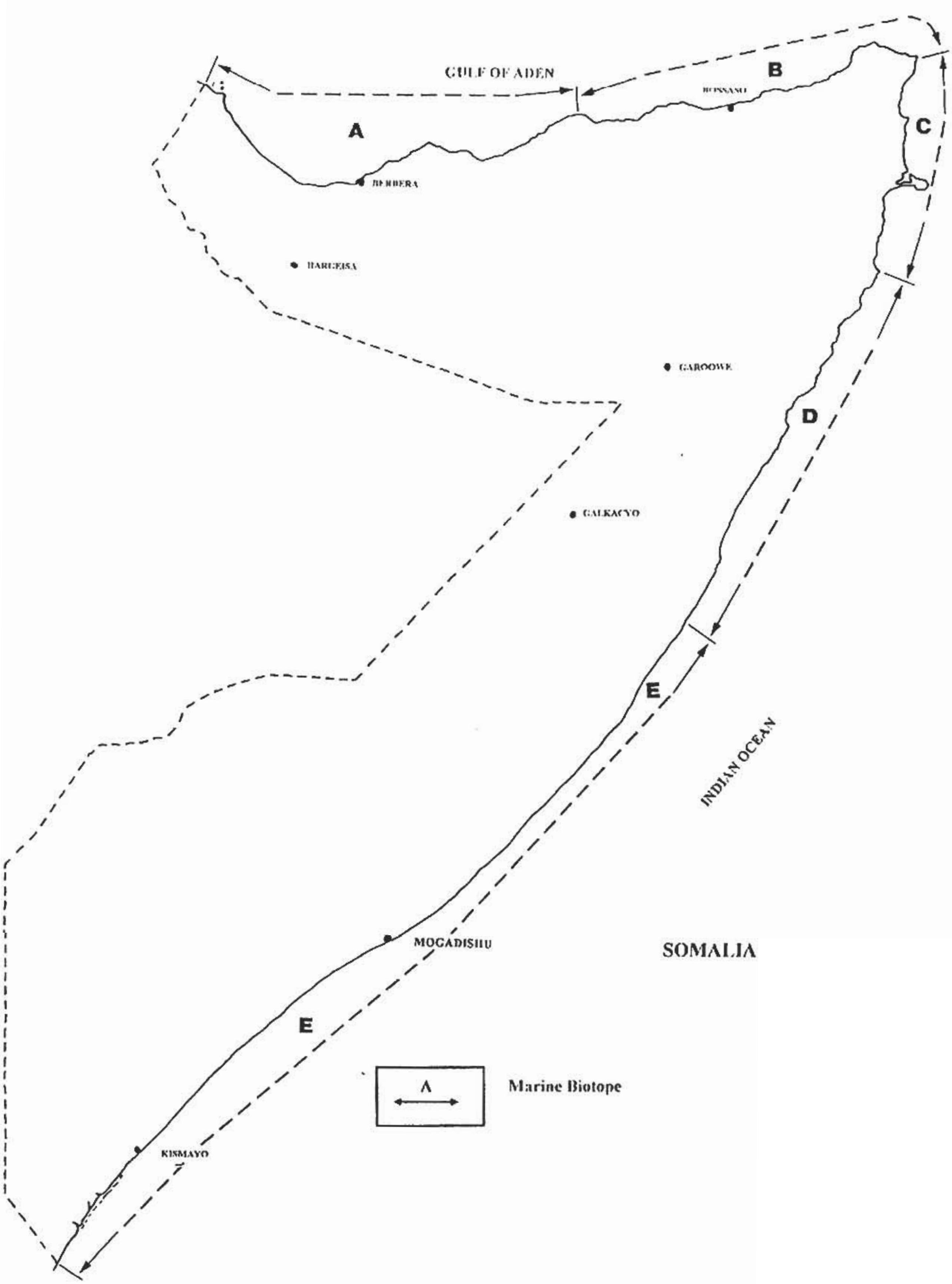
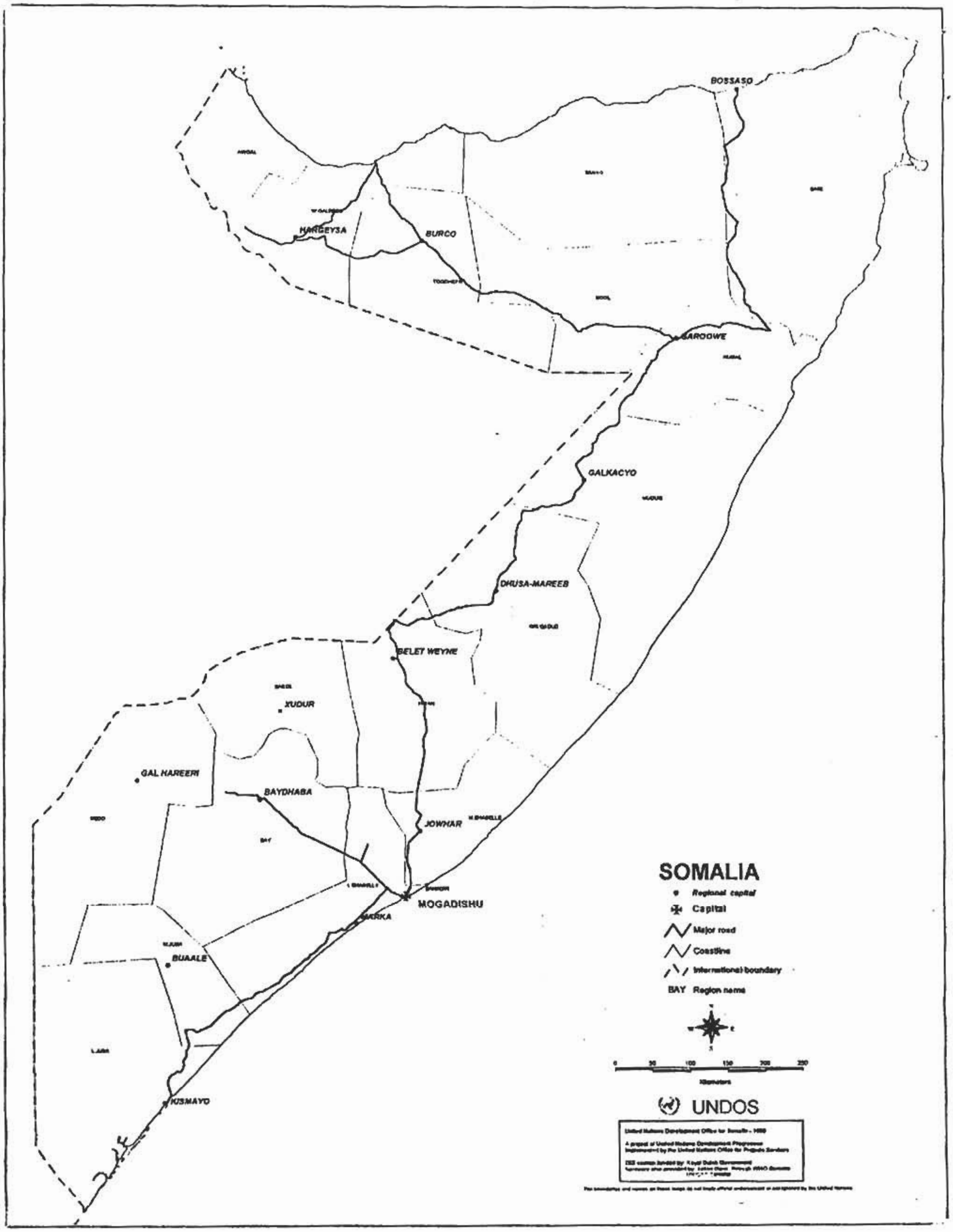


Figure 8. Administrative regions and districts (UNDOS, 1997)



phytoplankton feeding on the nutrients is converted into pelagic fish. Nonetheless, the fish densities in this area during this time are amongst the highest in the world.

The Central-east coast, from Ras Mabber to Hobbio (Biotope "D", Fig. 7).
This is a transition zone between the area of upwellings and the tropical reef ecosystem typical of the east coast of Africa. Sporadic local upwellings hinder the establishment of coral reefs. However, because of the large annual fluctuations in upwelling, the area does not support high fish densities on a permanent basis. There are sporadic incursions of small pelagic fish from the north.

The South-east Coast, from Hobbio to Chiamboni (Biotope "E", Fig. 7).
This coral reef ecosystem is essentially the same as that which occurs all along the tropical portion of the east coast of Africa (Salm, pers. comm.). It is also similar to the coral reef ecosystem on the north coast between Djibouti and Ras Suruud. Typically, there are no major seasonal variations in the marine environment as would occur if there were upwellings of cold water. As is the case with tropical reef ecosystems further south, biological productivity is low. The biodiversity of this area (reflecting the fauna of the Indian Ocean) is high, but probably still less than that of the otherwise similar ecosystem between Djibouti and Ras Suruud on the north coast because the latter area has a mixture of several different faunas.

2.9 Biological Diversity

Somalia includes two of Africa's major biomes or centres of endemism (White, 1983). Climatic changes and biogeographic isolation over thousands of years have produced an exceptional degree of endemicity. Depending on the type of life form, from 1.5% (birds) to at least 19.6% (freshwater fish) of all species found in Somalia are endemic (Table 2). The relatively high rate of endemism reveals the significant conservation value that exists in Somalia but also the economic value of biodiversity towards Somali production systems and the economy in general.

Table 2. Total number of species, number of endemic species and proportion of endemic species by life form (see the relevant sections for references).

	Total No. of Species	No. of Endemic Species	Percentage of the Total (%)
Flora	3,000	500	16.7
Mammals	--	30	--
Birds	389	6	1.5
Herpetofauna	232 (species)	5 (genera)	2.1 (minimum)
Fresh water fish	46	9	19.6
Marine Environment			
Corals	99 (minimum)	--	--
Reef fish	132 (minimum)	--	--

2.9.1 Flora

The flora of Somalia reflect influences from Asia and the Mediterranean as well as other parts of Africa. Somalia has about 3,000 species of vascular plants of which about 500 (16.5%) are endemic (IUCN, 1990). Within sub-Saharan Africa, only South Africa has a higher number of endemic plants (White, 1983). The Somali flora, and in particular the succulent scrub, is widely threatened by desertification processes. In the arid central rangeland, a very important and endangered fodder plant, *Cordeauxia edulis,* should be given priority attention. This leguminous shrub, which is endemic to Somalia and Ethiopia, is an important source of forage in the dry season and produces an edible nut. For these reasons, its regeneration is very limited and it survives only near Adawilif. This species is listed as endangered in the IUCN Plant Red Data Book (Marshall, In press). Other endangered species include *Euphorbia cameroni*, a very rare shrub from the northern mountains, *Whitesloanea crassa*, a succulent from the same area, which is possibly extinct, and *Livistona carinensis* - the Bankouale palm, which is found in very small numbers in north-eastern Somalia (Marshall et al. 1996).

Somalia is a key centre of botanical diversity for the genus *Acacia*, with 25% of all Somali *Acacia* being endemics (Marshall et al., 1996). *Acacia bussei* is the dominant species used for the production of charcoal while *Acacia senegal* is found in central Somalia and tapped for gum Arabic (although of low quality).

The northern mountains support *Juniperus procera* forests which are valued for timber. Also valued in the Golis mountain range are *Boswellia* and *Commiphora* spp. which produce frankincense and myrrh respectively. These tree grow in the rugged and dry lower slopes of the mountains and are tapped for their resin. *Boswellia* peaks in diversity along the Golis mountain range in northern Somalia and *Commiphora* in central Somalia (Kuchar & Gillett, 1987). In the northern part of the mountain areas, riverine forest is found along seasonal rivers, and is mainly composed of *Ziziphus mauritiana* and *Conocarpus lancifolius* (Marshall et al., 1996). Both species are threatened due to forage and timber utilisation.

Five areas in Somalia are recognised as being of particular botanical importance in terms of species richness and endemism, namely: bush/woodland on limestone in the Ogaden and Cal Madow in "Somaliland"; fixed dune vegetation in southern Somalia; the coastal area near Hobyo (Obbia); and the Nugaal Valley (Davis et al., 1994). The coastal grasslands of central Somalia are considered to be an ecologically isolated island (Laird & Potterton, 1997). Many plant species found in the few small and widely scattered forests of Somalia are restricted to these forests within Somalia. At least 3 species are endemic (Deshmukh, 1990). These forests also provide habitat for many rare species of fauna (Ash & Miskell, 1983; Madgewick, 1989).

2.9.2 Fauna

Mammals: Thirty taxa, including some races and other species whose taxonomic status is unclear, are endemic to Somalia (Whittaker, 1985). See Appendix 4 for a listing of endemic mammal species. Some endemic mammals, such as the Beira gazelle (*Dorcatragus megalotis*), Hirola (*Damaliscus hunteri*) and Somalia wild ass (*Equus asinus somalicus)* are endangered by uncontrolled hunting and loss of habitat (Simonetta and Simonetta. 1983). The wild ass is also an endangered species due to interbreeding with domestic donkeys (Duncan. 1992) and uncontrolled hunting. Unconfirmed reports from Sool Region indicate that numbers could be fewer than fifty (Forbes pers. comm.)

Pre-1991 records indicate that little concrete data from surveys on Somali mammals was available. However, it was known that at the turn of the century wildlife numbers were high and Somalia was an important hunting ground for elephants, lions, and gazelles. Uncontrolled hunting during the 1970's and 1980's and loss of natural habitat have all contributed to a severe decrease in mammals species. For instance, an estimated 20,000 elephants were killed between 1979 and 1984; this was at least two-thirds of the 1979 population (Sale, 1985). Others, such as Speke's and Soemerlings gazelles (*Gazella spekei* and *G. soemmeringi)* and the Dibatag *(Ammodorcas clarkei)*, were widespread within, and endemic to, the drier areas of Somalia and the Ogaden of eastern Ethiopia. A few endemic species, such as the Beira and Pelzeln's gazelle (*Gazella pelzelni*), were confined to extremely limited distributions within northern Somalia (Dorst and Dandelot, 1990). Hunter's hartebeest (or Hirola), occurred in very small numbers along the Kenyan border (Gedo and Lower Jubba Region). Crocodiles are found in the Shabeelle and Jubba rivers and associated wetland areas.

Since 1991 there has been no current data on the status of mammals of Somalia. However, use of mammal products have continued, for example Ostrich eggs are collected and sold in Djibouti along with Leopard skins also reportedly caught in N.W. Somalia (Forbes pers. comm.). There are also reports that local Administrations in Somalia offer wildlife products to wealthy individuals from Gulf states who capture and export live mammals.

The wildlife resource have also been severely depleted as a result of loss of habitat caused by overgrazing, tree cutting, clearance of land for agriculture and, in some cases, soil erosion (Simonetta and Simonetta, 1983). Destruction of their habitat by overgrazing is said to be a particularly serious threat to Dibatag (Dorst and Dandelot, 1990). The blue monkey (*Cercopithecus albogularis*) is restricted to riverine forest in Somalia (Madgewick, 1989). In Somaliland, where ostrich and bustard are used to prepare traditional medicines, they are now so scarce from hunting and loss of habitat that practitioners of traditional medicine are concerned about diminishing supplies (Marshall, in prep.).

Birds: Six hundred and forty-nine species have been recorded of which 389 are resident, 66 are intra-African migrants and 119 are Palaeartic migrants (Collar et al., 1994). Eleven species have very restricted ranges and six of these are endemic to the country (Appendix 5). Eight, or possibly nine, species are considered "threatened" (i.e., critically endangered, endangered or vulnerable) and 11 are "near-threatened". Only three of these are Palaeartic migrants, and the rest are residents.

Although much of the country is dry semi-desert, there are a number of significant concentrations of waterbirds, particularly breeding populations of seabirds, on off-shore islands, and in wetlands associated with the Jubba and Shabeelle rivers, as well as other types of wetlands close to the Djibouti and Kenyan borders. The forests of Somalia are home to a number of endemic bird species (Ash & Miskell, 1983; Madgewick, 1989). The last remaining blocks of floodplain forest along the Jubba River (<900 ha in area) are home to a spectacular range of birds, many very rare and extremely localised. Up to 20 species, dependant on riverine forest, could be lost from Somalia if these last relicts of forest are cleared for agriculture or degraded (Madgewick, 1989).

Herpetofauna: A total of 29 amphibian and 203 reptilian species have been recorded in Somalia (Lanza, 1988). Four species of amphibians (14%) and 78 species of reptiles (40% - the 6 marine species excluded) are endemic to the country. Five genera are endemic: the frog *Lanzarana,* the agamid *Xenagama,* the scincid *Haackgreerius*, and the colubrids *Aeluroglena* and *Brachyophis.*

The marine reptiles include four species of Chlomiidae, a species of Dermochelyidae and a species of Elapidae.

Lanza (1988) presents species occurrences by administrative region and provides no information on population status. Therefore, no conclusions regarding resource potential or conservation need can be drawn.

Freshwater fish: Forty two freshwater species have been recorded from the Jubba and Shabeelle rivers, but the fish faunas are distinctive and only 19 species are common to both (National Tsetse & Trypanosomiasis Control Project, 1985). Twenty seven species have been found in the Shabeelle and 34 in the Jubba. Three species, *Barbus gananensis, Varicorhinus* sp., and *Pardiglanis tarabinii*, are endemic to the Jubba River basin while *Synodontis geledensis* and *Nothobranchius patrizii* are endemic to the two rivers.

The only other freshwater fishes in Somalia live underground and all four species are endemic and also blind (Poll, 1961). These include the catfish *Uegitglanis zammaranoi* from Iscia Baidoa, the cyprinids *Phreatichthys andruzzi* and *Barbopsis devechii*, from Bud Bud in central Somalia and the Taleh wadi in the Nugal Valley respectively, and the gobiid *Gobius scorteccii* from Wadi Merero in the north. Only three other blind cave fish are known from the rest of Africa, making the Somali fauna quite exceptional..

Marine organisms: Information on the biodiversity of Somalia's marine waters is limited (McClanahan & Obura.1996; Lovatelli, 1997). However, what few data that exist indicate that biodiversity is very high (McClanahan & Obura, 1997). For instance, McClanahan (1997) states that the coral reef ecosystem of the Aibat and Saard ed Din islands off the north coast of Somalia near Djibouti may have a higher biodiversity than reefs in the western Indian Ocean. In a survey of the area, he found 99 coral species, which he considers to be a conservative estimate because of the small area and time involved in the sample (Table 2). He also found 132 reef fish species, which is comparable to other undisturbed coral reefs of the Indian Ocean and Red Sea. These latter are, in turn, among the most diverse marine ecosystems in the world (McClanahan & Obura, 1997).

The Aibat and Saard Din islands coral reef ecosystem may, in fact, be unique because it occurs in an area where there is a mixing of fauna from different marine biogeographic regions (Red Sea, Gulf of Aden, Arabian Sea and Indian Ocean) (McClanahan, 1997). However, coral reef ecosystems, such as those which fringe much of Somalia's coastline, are in general, very high in biodiversity. For instance, they are often referred to as the "ultimate ecosystem" because of their high numbers of species, productivity and complexity of species interactions (McClanahan & Obura, 1997).

But, biodiversity is also high outside the coral reefs as can be inferred from the fact that there are several hundred demersal (bottom feeders) fish species found on Somalia's continental shelf waters (Stromme, 1987); approximately 50 sardine spp. (sardines are small pelagic fish) (Lovatelli, 1996) and over 30 fish species of commercial importance (Elst,1997).

3 CLASSIFICATION OF LAND UNITS BY THEIR PRODUCTIVE POTENTIAL

Natural resource management planners need to be able to visualise the link between the resource base and it's use, both existing and potential. At the simplest, broadest level this can be done by mapping both general categories of the resource and of the existing type of land use. Or, the probable type of land use may be inferred from maps of the major environmental factors, such as the amount and reliability of rainfall. The more information on the nature and status of the resource, land use and environment the better planners are able to carry out their work. However, in developing countries, natural resource management planning is often based on limited information. This section presents three different approaches toward classifying and mapping natural resources and land use in Somalia which can in themselves serve as useful tools towards setting thematic and geographic priorities, and also for planning rehabilitation and development actions.

3.1 Eco-climatic Classification

Hutchinson and Polishchoul (1988) applied an eco-climatic classification developed by FAO to Somalia. This classification, the development of which is based on the experience of agro-climatologists across Africa integrates climatic, biological and agronomic information to define areas of potential land use. The system links climate and land use patterns over the entire country. The classification is based on the following factors:

- Rainfall distribution patterns (monomodal or bimodal)
- Precipitation (average annual amount)
- Annual distribution of rainfall (average number of days and rainy months)
- Temperatures (occurrence of frost)
- Land use (pastures, crops, forest)
- Nature of crops
- Livestock species and breeds
- Distribution of tsetse flies

Seven zones are recognised by the classification of which four occur in Somalia (Tables 3 & 4; Fig. 9).

Figure 9. Eco-climatic Zones (Hutchinson & Polishchoul, 1988)

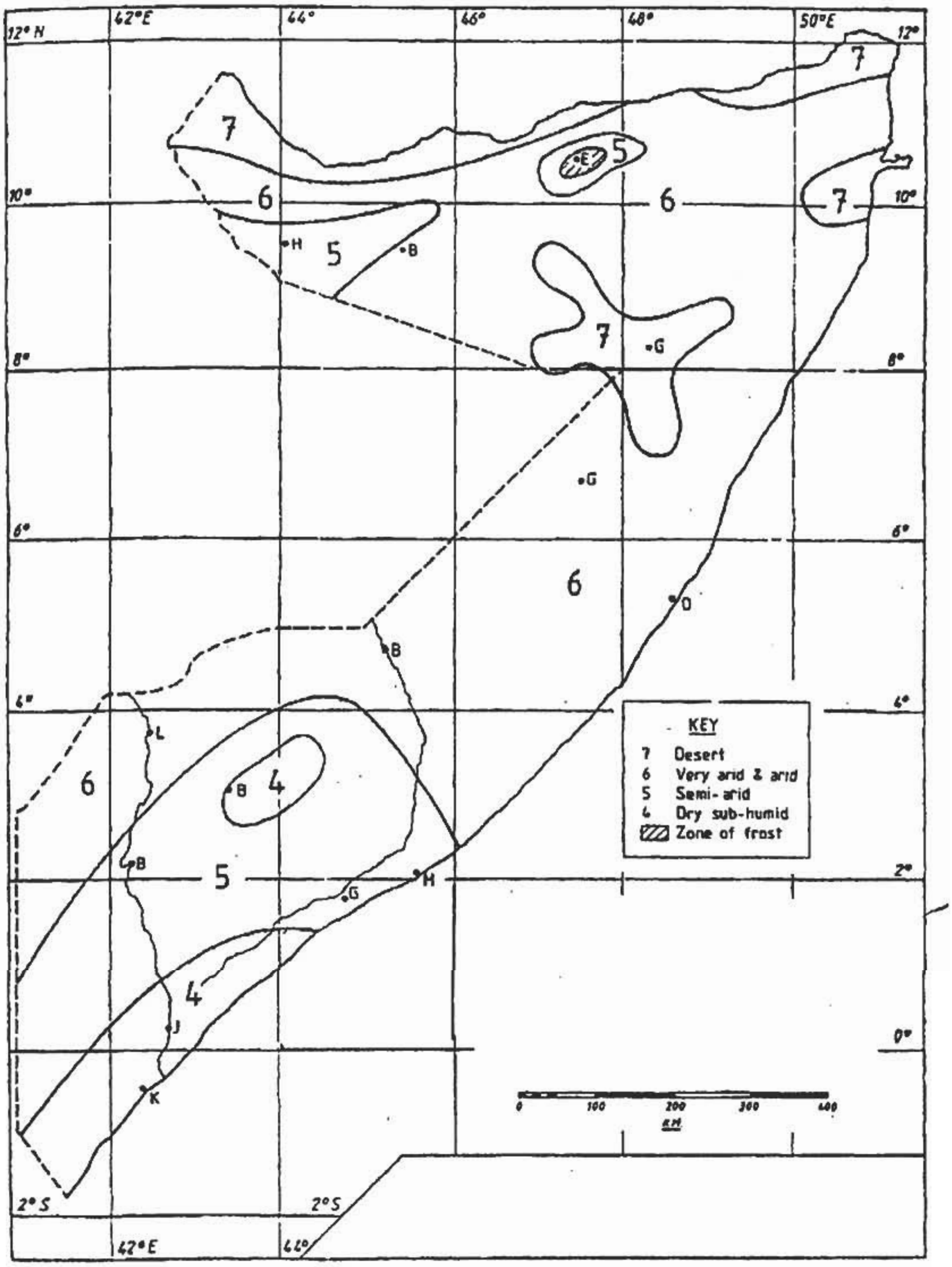


Figure 10. Food Economy Zones (FEWS/Somalia, 1997)

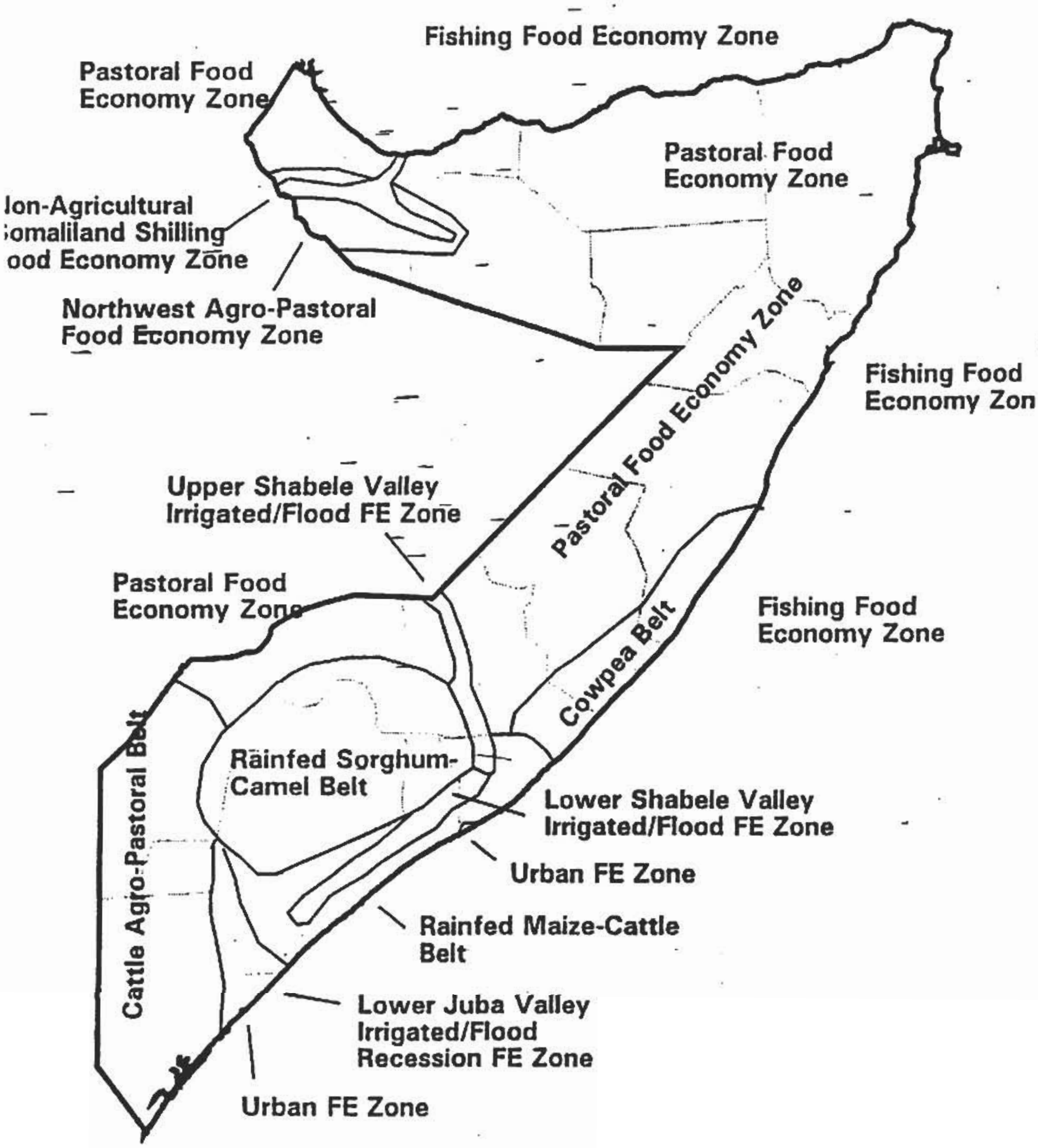


Table 3. Eco-climatic zones of Somalia (rain and number of rainy months)

ZONE/CLIMATE	AVERAGE RAINFALL (mm/year)	AVERAGE NUMBER OF RAINY MONTHS (months/year) *
(7) Desert	< 100	0
(6) Very arid & arid	100 - 400	1 - 3
(5) Semi-arid	400 - 600	4 - 5
(4) Dry, sub-humid	600 - 800	5 - 6

* The actual lengths of the rainy seasons are calculated according to the water requirements of the crops. A month is "rainy" if monthly rainfall exceeds one-third of potential evapotranspiration, which corresponds to the water requirement of a newly sown crop.

Table 4. Eco-climatic zones of Somalia (vegetation and land use). White's (1983) classification of vegetation (Fig. 6) is included here for comparative purposes.

ZONE	VEGETATION (White, 1983)	VEGETATION/ LIVESTOCK	LAND USE
(7)	(68) Coastal Desert (58) Semi-desert grassland and shrubland	Annual grasses. Camel, goats, some sheep, rare cattle	Gazing nomadic pastoralism. No cultivation without irrigation
(6)	(67) Absolute desert (58) Semi-desert grassland & shrubland (42) Deciduous bushland & thicket	Diffuse shrubland and Grazing, open bushland with perennial grasses. Camels, goats, sheep, some cattle	nomadism, virtually no rainfed cultivation
(5)	(42) Deciduous bushland & thicket	Bushland and open woodland, perennial grasses. Cattle, sheep, goats, rare camels.	Grazing nomadism and settled pastoralists; some farming (millet, sorghum, cowpeas)
(4)	(42) Deciduous bushland & thicket (16) Coastal mosaic(forest)	Woodland, savannah, grassland, crop land. Tsetse infestation locally. Cattle, sheep goats.	Settled agro-pastoralism. Millet, sorghum, cowpea, groundnuts, sweet potatoes, pigeon peas; sown pasture and range reseeding possible.

This classification shows a somewhat different range of annual rainfall for Zone 4 in Somalia than actually exists (400-700 mm rather than 500-800mm) and woodland is said to occur within the same zone whereas it is not mentioned in White (1983). On the other hand, RMR (1983/4) does show woodland in this zone. However, overall, the information provided by Tables 3 & 4 seems to fit the situation very well. For instance, compare the information on land use in Table 4 with the map of tentative food economy zones in Somalia, 1997, shown in Fig. 10.

3.2 Food Economy Zones

Food economy zones (FEWS/Somalia, 1997) (Fig. 10) were developed for use by the Food Security Assessment Unit (FSAU) of the World Food Programme (WFP) to help determine appropriate relief responses to seasonal occurrences of lack of food. The zones, which reflect the characteristic mode of production of the areas concerned, are rough approximations based on the experiences of field personnel. Although Food Economy Zones are based on present-day production systems, which could, conceivably, change over time, they are probably good rough approximations of real land use regions and of the relative levels of productive potential of these regions.

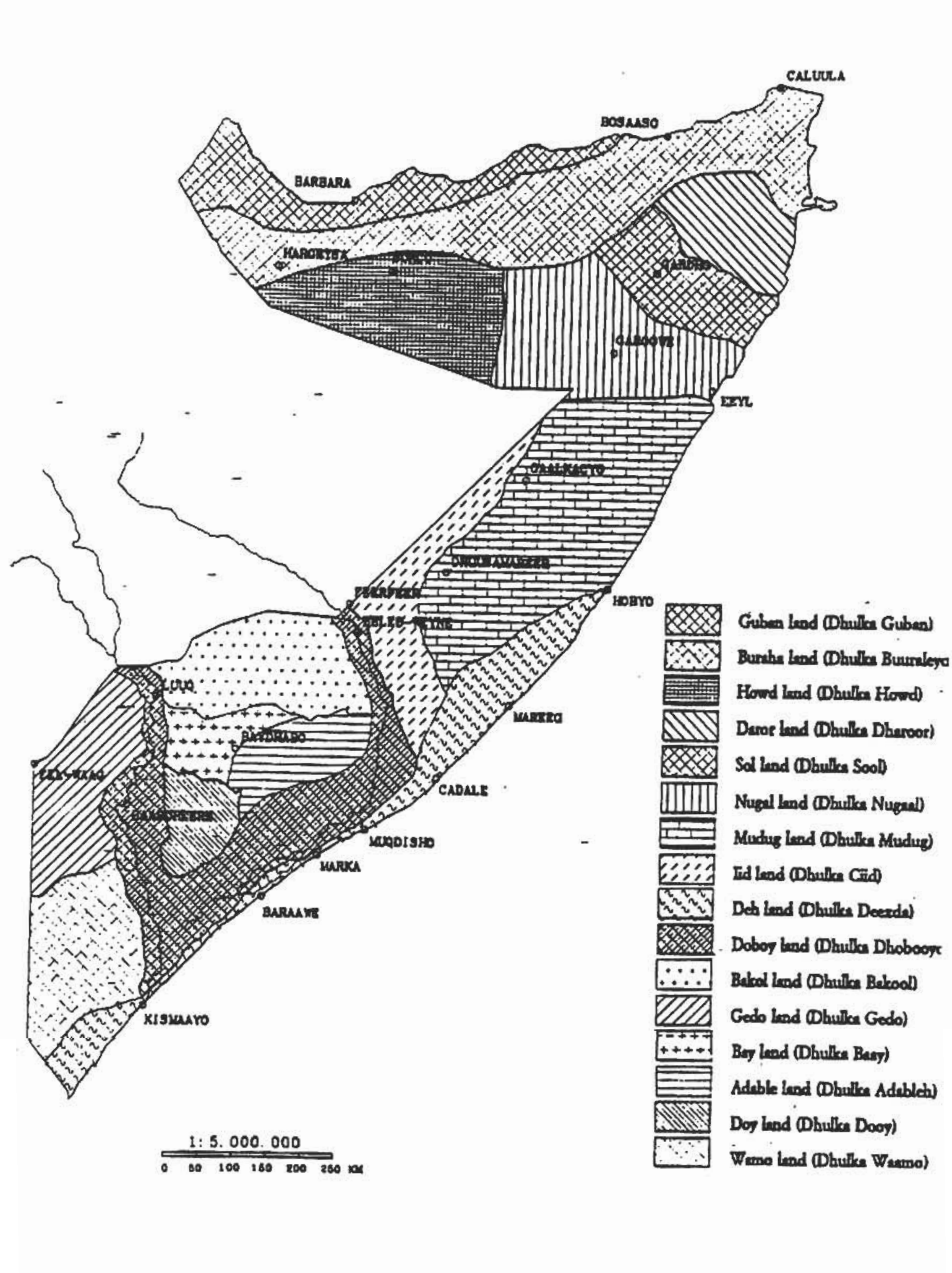
3.3 Somali Ecological Land Unit Classification

The Somali people-pastoralists and farmers, through many years of experience, have developed a functional classification of ecological land units *(deegaans)* with characteristic landforms, soils, vegetation, ecological potential and land uses. The land units also have relevance to Somali social and political structure (Barkhadle, 1993).

The scale of classification is larger (i.e., smaller land units) than that of the eco-climatic units making it more applicable at the local level. All of the relevant information regarding the location, name, characteristics and ecological, sociological and political implications of the various land units *(deegaans)* exists within the local Somali pastoral and farming communities. Use of this classification allows extensionists and development planners to both learn from, and better communicate with, Somali pastoralists regarding the landscape and all of it's rehabilitation and developmental implications.

Fig. 11 shows a map of the major deegaans within Somalia which is taken from Barkhadle (1993). Barkhadle also provides information with development implications on each land unit's name, environment, physical and biological characteristics. However, experience with a similar classification in the Somali speaking areas of Kenya (Touber, 1992) indicates that most of these land units are apt to contain yet further information of value to development and resource management. An example of the extent to which this may occur is given by Laird and Potterton (1997), in Central Somalia, where the *Deh deegaan* is broken down by the local people into at least a further nine land units related to one or more of the following features: vegetation, land use, variation in climate and soil characteristics: infiltration rate, colour, impact on by heavy sand dunes.

Figure 11. The Somali traditional *deegaan* (ecological) classification map (Barkhadle, 1993)



The Somali ecological land unit classification system based on *deegaans* offers a valuable tool for illustrating linkages between natural resources and production systems (i.e. land use). and for planning rehabilitation and development activities that integrate production system enhancement and sustainable use of natural resources (Laird and Potterton. 1997).

4. PRODUCTION SYSTEMS

An understanding of the Somalia's natural resources and their biological diversity is crucial in order to focus on and plan for rehabilitation and development activities that sustainably use these resources for the benefit of current and future populations. Sections 2 and 3 have provided an overview of the Somali natural resource base and biodiversity. and classification systems linking natural resources with economic production systems respectively.

This section examines in detail the existing systems of economic production within Somalia that are dependant upon and utilise the natural resource base. As can be seen from Table 4 and Fig. 10. the production systems of Somalia are primarily agricultural, rangeland and marine-based. For each production system, the linkages with the Somali natural resource base is presented. Strength, weakness. threats and opportunities associated with each production system in terms of sustainable use of natural resources are also explained and discussed. The information and analysis for each production system enables the identification of common issues between systems government use and access of natural resources. Based on this information and analysis, important issues in natural resource management and conservation are identified. and which sets the stage for setting thematic and geographic priorities for action.

4.1 Livestock

Livestock husbandry is the major economic production system in Somalia (Tables 3 & 4; Figs. 12 & 13). Prior to 1991, livestock contributed to around 47% of GDP and 80% of total foreign exchange earnings (IUCN, 1990). It was estimated in the early 1980's, 60 -90% of the population of Somalia was involved in livestock production (IBRD, 1981; Holtzman, 1982).

Somali pastoralists raise cattle, sheep, goats and camels, primarily for subsistence although large numbers of stock are also sold and marketed in the Arabian states. For instance, 2,228,777 head were exported from northern Somalia in 1995 and 426,878 head were shipped from the Northeast region of Somalia in 1996. Sheep and goats comprised 68% of the total biomass in both instances. Most were sent to Saudi Arabia for which Somalia is still the principal supplier of small stock (Stockton & Chema, 1995; Stockton, 1996).

No concrete data exist regarding the present numbers and distribution of the various types of livestock. The latest available information (Baumann, 1993). which probably reflects the situation a few years earlier, shows the national herd at that time to be about 12,000,000 heads (all species) or equivalent to 13,132,975 tropical livestock units or 3.283 billion kgs). While goats. sheep, cattle and camels comprised 15.2%. 9.1%. 38.6% and 37% of the total biomass respectively. goats and sheep were, however. the most numerous species.

Figure 12: Rangelands of Somalia: Major dry season grazing areas and areas where livestock husbandry is threatened by other uses (Baumann, 1993)

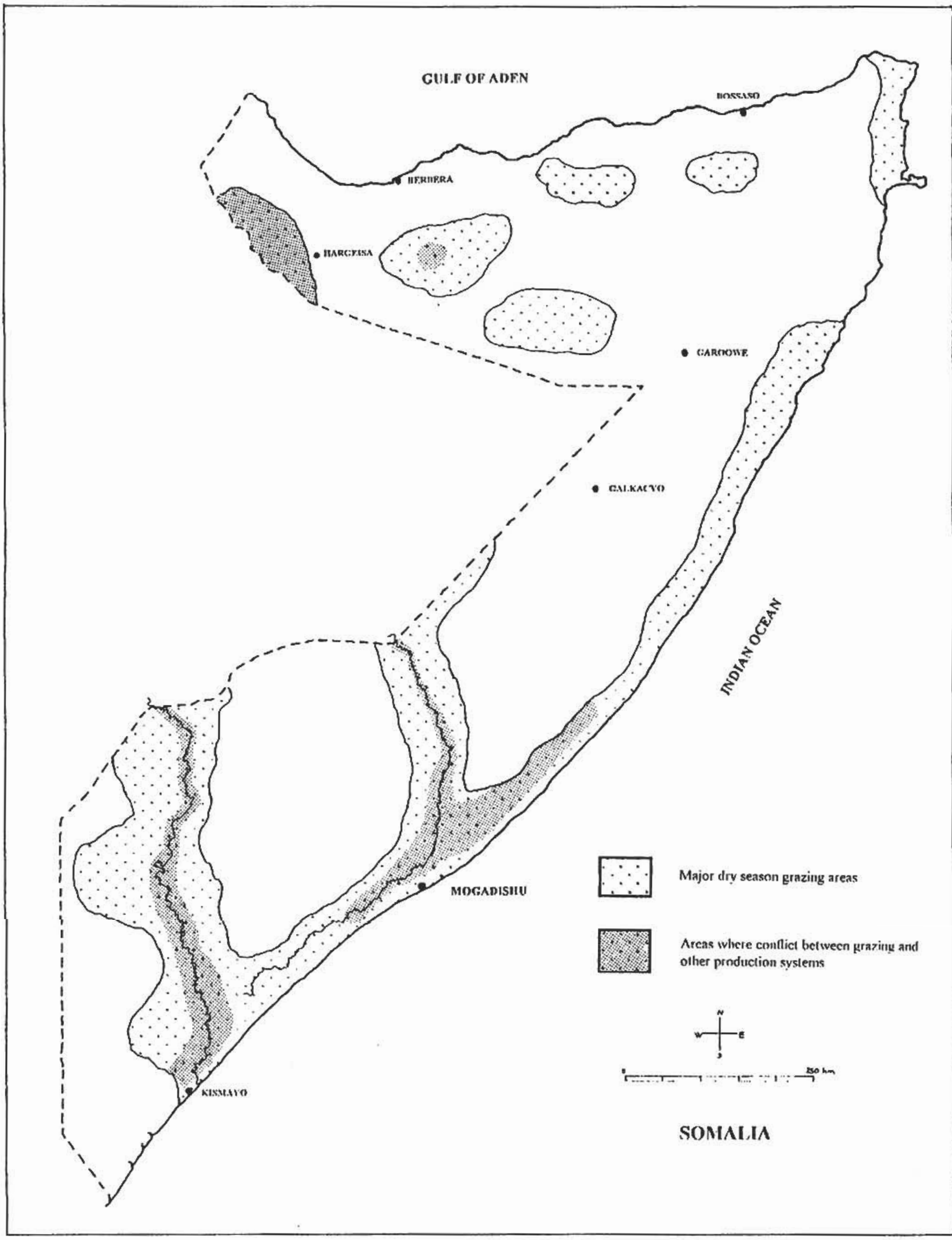
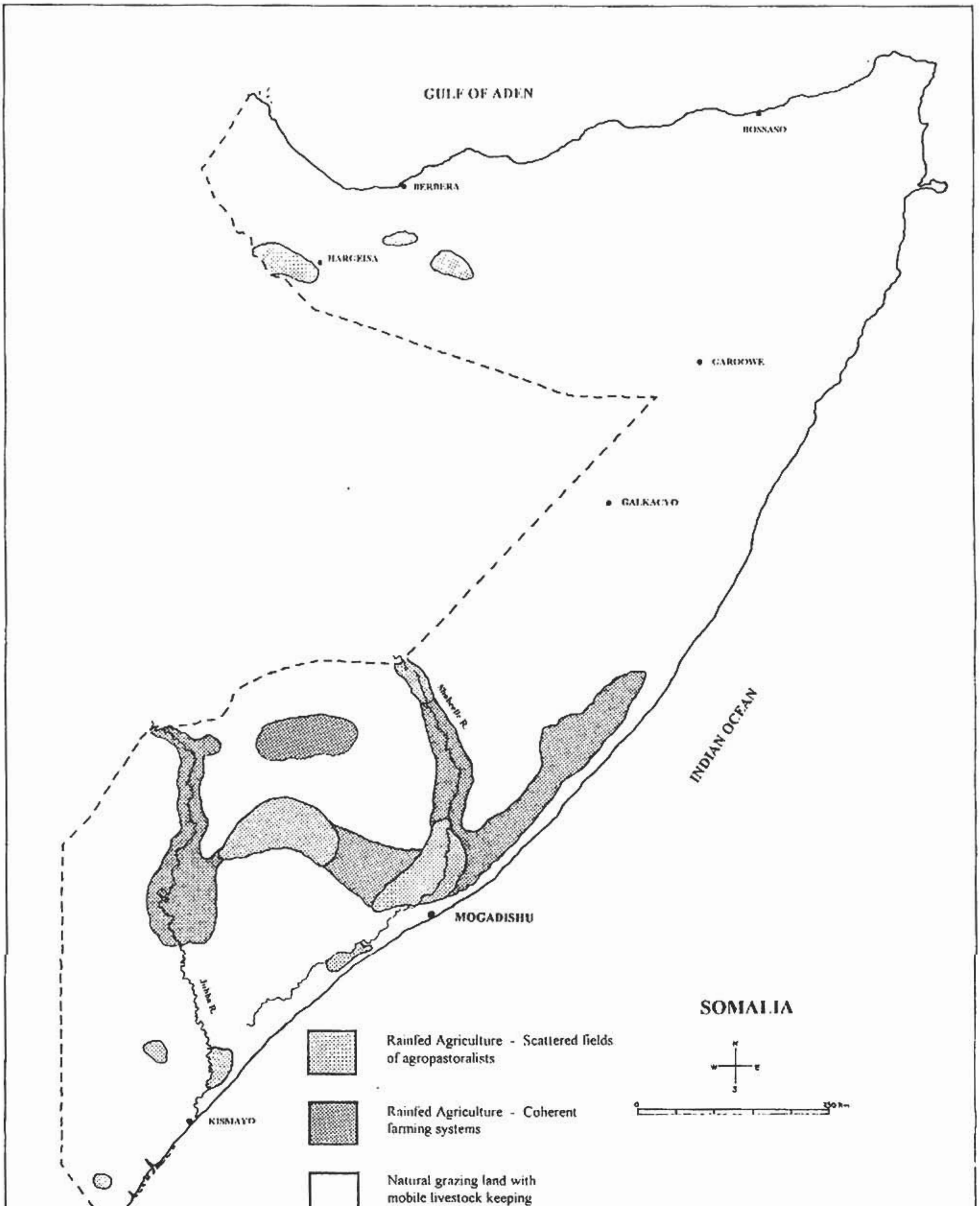


Figure 13: Areas of pastoralism and rainfed agriculture (RMR, 1984; Baumann, 1993)



Traditionally, the most important livestock product is milk and livestock played an important social role which also indirectly impacts on the economy (e.g. splitting of herds within families, dowry, etc.). Whilst these values for livestock remain, certain changes have occurred during the past decades which have impacted on the livestock system. Increasingly the pastoralist diet comprises of grains (e.g. sorghum and maize), estimated at 45%, and greater numbers of livestock exported to Gulf states reflecting a gradual shift from subsistence to a cash economy.

Nonetheless, production of milk is still the mainstay of the pastoralists along with hides and meat. While cattle and camels are the major milk producers, small stock (sheep and goats) are more apt to be eaten by pastoralists and sold for cash (Laird and Potterton, 1997; VETAID, 1997; Stockton & Chema, 1995; Stockton, 1996).

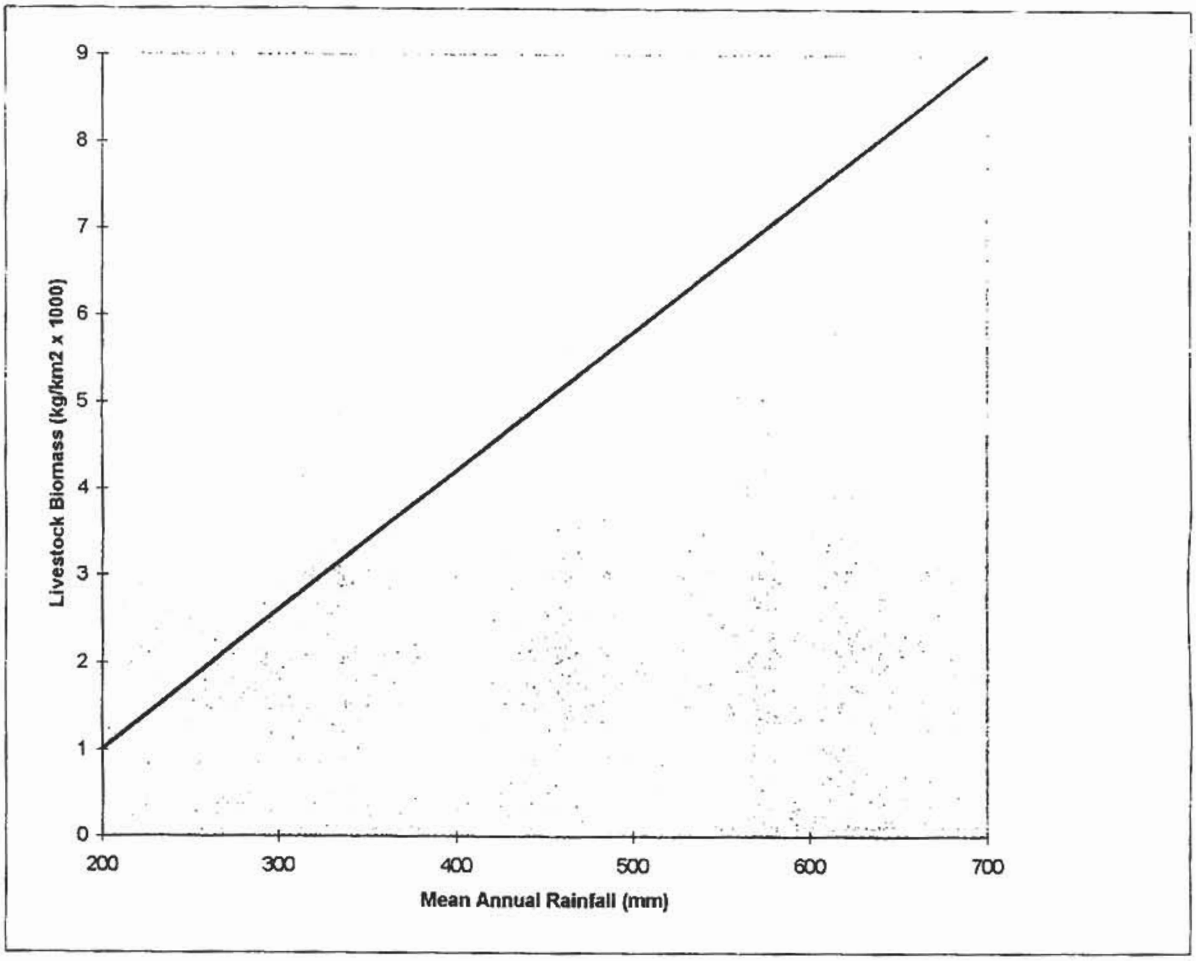
Baumann (1993) and Barkhadle (1993) provide some insight into the distribution and relative abundance of the major livestock species throughout the country. Generally, all four types of livestock are present. However, cattle are most abundant in the south where rainfall and forage production are highest, camels more so in central Somalia, where woody vegetation is common and water points are typically 20-60 miles apart and sheep and goats are most numerous in the north, but especially in the dry areas of Guban and Nugal and on the coastal plain of central Somalia.

Livestock biomass increases with the amount of mean annual rainfall (Fig. 14). Therefore, it is highest in southern Somalia and lowest in the Northeast and along the coast of the Gulf of Aden. The major exceptions to this pattern are the river flood plains which support exceptionally high numbers of animals during the *jiilal* dry season (Deshmukh, 1990). This points up the value of these latter areas as dry season sources of water and forage.

Livestock production in Somalia is rangeland-based. Rangelands are areas of natural vegetation, capable of supporting livestock and wildlife, which are not being used for other purposes. This also includes fallowed agricultural fields. Rangelands are the most widespread terrestrial resource in Somalia (Tables 4, Figs. 12 & 13). The productivity of rangelands is a reflection of vegetation productivity and species distribution.

The degree to which pastoralists are nomadic reflects their environment and social structure. Those who live in very arid rangelands where rainfall is low and highly unreliable and droughts frequent and long, are, by necessity, nomadic as they must move frequently and over long distances - sometimes hundreds of km (Janzen, 1988) - to find adequate forage and water for their stock. As rainfall amount and reliability increase and, therefore, also forage production and the carrying capacity of the land, the frequency and distance of livestock movements decrease until, theoretically, in the most favoured of rangelands, pastoralists become almost sedentary. For instance in Central Somalia, the area required by Somali pastoralists to support themselves in non-drought situations ranged from 400 sq. km on the coastal plain to 6,000 sq. km in the drier hinterland (Herlocker, 1989).

Figure 14. Relationship between rainfall and livestock biomass in eastern Africa (pastoral Kenya and non-riverine regions of Somalia. However, livestock biomass on the Jubba River floodplain ranged from 3,000 kg / sq. km (wet season) to 44,100 kg / sq. km (dry season (Deshmukh, 1990).



The development of water resources during the past decades through provision of surface storage (balleys and berkads) and boreholes has also impacted on the degree of nomadism of the pastoralist. Increasingly, access to water resources is no longer a driving force behind mobility as water sources are fairly well distributed within the country.

In Somalia today livestock production methods range from pastoralism (including nomadic - or nearly so), through agropastoralism, when pastoralists also farm, to sedentarised pastoralists who primarily depend on other means (farming, charcoal making, labour etc.) for their subsistence.

4.1.1 Pastoralism

Features

Pastoralists, but especially those who are nomadic pastoralists (over 50%), live primarily on the products and sales of their livestock (Janzen, 1988). Herd composition not only reflects the rangeland environment (see above) but is also influenced by market opportunities, as on the coastal plain grasslands of central Somalia, as well as in "Somaliland", where sheep and goats are emphasised because they sell well in Gulf states (Laird and Potterton, 1997; VETAID, 1997). In some areas the high export value of small stock is reducing the importance of camels to pastoralists. Associated factors are the increased availability of water sources, relative ease of selling small stock compared to camels, better grain availability (less reliance on camel milk) and decreased utility of camels as a commodity to store capital (compared to money, trucks, reservoirs etc.). On the other hand, camels have replaced cattle in importance in some parts of southern Somalia following large cattle losses during drought (Thurow, et al., 1989).

Traditionally, pastoralism (again, especially nomadic pastoralism) was well adapted to, and in balance with, it's environment. Its flexibility (the ability to use a variety of strategies depending on the situation), mobility (required to quickly locate and use ephemeral flushes of forage), use of several livestock species (which allowed use of a wide array of habitats), emphasis on large herds (which ensured that at least some would be left at the end of a drought), herd splitting (so that loss of one herd did not wipe out the owners' entire holdings), the use of social safety nets to keep poorer pastoralists from starving, as well as the labor-intensive care it gives to it's animals, enabled nomadic pastoralism to survive as a subsistence system for thousands of years.

In addition, the growth in human and livestock populations was kept in balance by disease, limited availability of water, drought and, availability of forage during dry seasons (Thurow et al., 1989; Steinfeld et al., 1996).

Strengths

Pastoralists are skilled and knowledgeable husbandrymen, and nomadic pastoralism is the most efficient way of exploiting patchy and ephemeral forage, and water resources. Their livestock are, in different ways, well adapted to local conditions, enabling owners to spread risk and optimise the exploitation of temporally and spatially varied conditions.

In addition, with certain exceptions, grain, meat and milk prices are such that pastoralists can now obtain more calories by selling livestock produce and buying grain than they could get from directly consuming the protein-rich products of their herds (Behnke and Kerven, 1994). Grain now comprises up to 45% of the Somali pastoralists' diet (Thurow et al., 1989). Somali pastoralists, especially in "Somaliland", are pursuing this option by taking advantage of a flourishing market for livestock in Gulf states. Indeed, Somalia's livestock export trade has made a dramatic recovery since the civil war (Stockton & Chema, 1995).

Weakness

Increasingly, over the past few decades, the primary traditional checks on human and livestock population growth no longer apply to the extent they once did. Improved health and veterinary facilities and the provision of permanent supplies of water over large areas, as well as drought relief supplies, support increased human populations, and consequently livestock numbers. As a result the limited availability of forage is now a major reason why it is more difficult for the Somali pastoralists to survive on pastoralism alone (Awale and Odowa, 1997; VETAID, 1997).

Another effect of rising human population has been herd fragmentation caused by dividing herds among increasing numbers of heirs. Thus, although the total herd size is increasing, the individual herd size is decreasing (Thurow, et al., 1989), often to the point where it no longer provides an adequate subsistence.

In specific certain rangeland sites, especially those with year-round supplies of water, rangeland carrying capacity has been exceeded. In this case, rangeland carrying capacity is the inherent ability of an area of land to support a certain number of livestock and humans in a subsistence economy over the long term. Permanent sources of water allow livestock to utilise rangelands continuously throughout the year, which, on communal lands, generally leads to overgrazing, rangeland degradation and, eventually, soil erosion. This in turn leads to further reduction in livestock production.

However, over utilisation of rangelands also reflects: (a) increased human and livestock populations for a given area; and, (b) loss of more productive rangelands to other land uses which forces livestock onto smaller areas of less productive rangeland (thereby exacerbating overgrazing). For example, conversion of land to agriculture and fenced enclosures is threatening to remove much of the dry season grazing lands in western "Somaliland" and along the Jubba River (Fig. 12) from use by livestock (Deshmukh, 1990; VETAID, 1997). It also reflects lowered forage production (and, therefore, livestock production) caused by rangeland degradation, which, of course, is both caused by, and further exacerbates, the impact of overgrazing and other unsuitable land uses.

In some cases rangeland degradation is driven primarily by other land uses even when the rangeland is still used by livestock. For instance, rainfed farming initiates soil erosion on cropped fields and, through it's reduction of soil fertility, organic matter content and rainfall infiltration. This in turn leads to increased susceptibility to erosion, slows recovery of natural vegetation and, therefore, heightens susceptibility to overgrazing on fallowed fields. The inhabitants of some areas of central Somalia and Somaliland feel that rangeland degradation is caused more by rainfed farming than by overgrazing (Laird & Potterton, 1997; VETAID, 1997).

Habitat biodiversity (which, in this case translates into habitat quality) of rangelands is significantly lowered on fallowed fields and where *Acacia bussei* trees have been cut for charcoal, because of the removal of valuable forage plant species. In southern Somalia cutting is followed by rapid growth of undergrowth. This reduces grass and access by animals (Janzen, 1988).

In some areas the consequences of exceeding the land's carrying capacity have been dramatic. For instance, up to 50% of the rangelands of "Somaliland" have been badly degraded on steep topography; serious gully erosion exists in the Erigavo area (VETAID, 1997). A combination of melon farming and overgrazing contributed to massive destabilisation of coastal dunes south of Mogadishu (World Bank, 1987). Overgrazing has also contributed (together with an increase in groundwater levels and the elimination of elephants) to a 23 year increase in woody vegetation and, subsequently, tsetse fly, in the lower Shabeelle Valley, an area which was originally an extensive grassland (Rose-Innes and Trump, 1983). A similar change from grassland to woody vegetation has occurred over wide areas in "Somaliland" (Bally & Melville, 1973). Overgrazing retards the regeneration of *Boswellia*, the source of Frankincense; Juniper (*Juniperus procera*), and the shrub *Cordeauxia edulis* (Yicib Nut), which produces both quality forage and edible nuts. A non-palatable grass (unnamed in the report) has been establishing itself in Somaliland for decades now (SADO, 1994), and the similarly unpalatable *Aloe megalocantha* and *Solanum incanum*, have become well established in certain areas (Awale & Odowa, 1997), classic signs of the effects of long term rangeland degradation. Other examples from central Somalia and Somaliland are presented by Hemming (1966, 1973); Herlocker (1989), Laird & Potterton (1997), Stockton (1996) and Awale & Odowa (1997).

However, by comparison, only 2-10% of the rangelands in Central Somalia were found to be seriously degraded, mainly around villages and water points (Herlocker, 1989). Parts of the coastal plains in central Somalia showed no clear signs of degradation in the late 80's (Herlocker, 1989; Thurow, 1995) and this appears to still be the case today (Laird & Potterton, 1997). "Some" degradation was also apparent in the upper Jubba and Bay regions (World Bank, 1987; Deshmukh, 1990). Therefore, while serious problems exist with regard to rangeland degradation, this sort of situation is not yet uniformly distributed throughout the country. In some areas at least the availability of water continues to limit rangeland use by either livestock or farmers (Laird and Potterton, 1997). Tsetse fly infestations along some parts of the Jubba and Shabeelle river valleys (Fig. 7) also constrain use by livestock (Janzen, 1988; Deshmukh, 1990).

The quality of exported livestock and livestock products is often poor. For example, 15% of total live animal exports from Somalia are rejected by the veterinary authorities in Saudi Arabia for reasons of poor quality (Stockton, 1996). Therefore, Somali traders are not getting full value for their stock. Transport is too stressful, causing losses and lower prices; livestock marketing infrastructure is poorly developed (Stockton & Chema, 1995). Marketed hides and skins are also generally low value products because of poor handling and processing techniques (Laird and Potterton, 1997).

The apparently increased emphasis on small stock husbandry could lead to overgrazing and rangeland degradation if not carefully managed. Their sharp hooves, close grazing and high numbers, make small stock much more likely to cause rangeland degradation than the more environmentally friendly (and fewer) camels that they are replacing (Thurow, et al., 1989). The situation could be further exacerbated by the clearing of trees and shrubs to produce grassland needed for grazing sheep (Behnke, 1987).

Threats

The major factors threatening the sustainability of the livestock production system are:

a) agricultural encroachment on wetter dry season rangelands thereby reducing overall range resources for livestock and reducing long-term ability for regeneration of rangeland resources;
b) increased human population in general but also general reduction in pastoral populations at the expense of sedentarised agro-pastoralists and urban dwellers;
c) uncontrolled water development through *berkads*, *balleys* and boreholes in traditionally wet and dry season grazing areas enabling year round grazing and decreasing regeneration ability of range resources; and,
d) loss of palatable grasses and shrubs due to soil erosion and overgrazing.

Livestock production in southern Somalia, much of which is dependant upon use of river water and dry season forage grown on the floodplain of the Jubba (and probably also Shabeelle) River (Fig. 12), will be drastically affected once all land along the rivers is taken for irrigated and rainfed agriculture. Forage grown on the floodplain of the Jubba River is 2-14 times as abundant as elsewhere and is also more resilient (Deshmukh, 1990).

Land enclosures in northern Somalia for the purpose of fodder production for export is also creating conflict between the pastoralists and the traders for access of fodder resources. Continued trends in fodder enclosures will reduce range resources for pastoralists.

Opportunities

A number of opportunities exist which allow development planners to build on the strengths of the pastoral system and to overcome weakness and threats to the production system. These include:

(a) reduce the level of water development to place emphasis on widely scattered small, seasonal and/or low output stockwater sources, such as small pans (balleys) and shallow wells;
(b) emphasise rehabilitation of existing seasonal and/or low volume water sources;
(c) base future water development interventions on the results of surveys of rangeland degradation of the surrounding area and environmental impact assessments (EIAs) - do not improve water supplies in degraded areas;
(d) improve water sanitation through raising awareness;
(e) learn and build on pastoralists' traditional knowledge of plants and plant uses, ecological land units and their implications regarding land use practices as well as traditional management practices;
(f) integrate the use of enclosures (used to produce fodder for sale) and dry season grazing (or browsing) requirements of livestock, such as by allowing camels to graze shrubs within enclosures once the grass fodder has been cut and sold to traders;

(g) provide pastoralist groups with communal ownership of certain high potential rangeland areas so that subsequent enclosure are profitable to the group as a whole;
(h) improve livestock marketing systems to, for instance, reduce the number of animals that are rejected by Saudi veterinary authorities; and,
(i) improve the processing and marketing of hides so that they provide more profit to the herder and trader.

Behnke and Kerven (1994), referring to Africa as a whole, suggest improving livestock marketing systems so that they can absorb fluctuations in throughput created by livestock sales during droughts. This would involve: (a) low cost techniques of meat preservation; (b) improved transit infrastructure; (c) access to the largest possible consumer market; and, (d) elimination of subsidised international competition.

Despite it's apparent vitality, the entire Somali trading and marketing infrastructure (applicable here not only to livestock but also to other commodities, such as tree gums and resins) needs to be upgraded. This includes:

a) developing traders associations;
b) strengthening communications systems;
c) making market information available to traders (especially small traders);
d) improving the quality of livestock (and other commodities) exported (which could be done with an internationally recognised Somali veterinary authority);
e) diversifying markets (presently, livestock traders are too dependant upon the market in Gulf states);
f) accessing modern banking systems;
g) using larger carriers; and,
h) privatising public marshalling yards (Stockton & Chema, 1995).

There are also some other, more indirect, possibilities which would affect livestock production through interventions within production systems that access and use the same natural resources. For instance, improvement in the productivity of rainfed farming through intensification on existing lands could reduce the need for rainfed farmers to expand further into marginal agricultural areas (often dry season grazing areas) which are inherently less productive and ecologically more sensitive rangeland areas.

Improvement of opportunities for subsistence and income earning for the poorer pastoralists in production systems, such as tree gum collection, collection and marketing of "traditional" plant products, honey and efficient charcoal production and wildlife conservation, would serve the same purpose while, hopefully, improving the management and productivity of the relevant systems.

4.1.2 Mixed farming systems - Agropastoralism

Features

Mixed farming or agropastoralism consists of both livestock husbandry and settled farming practised by the same family unit. The quantity and composition of livestock herds depend on the specific areas where mixed farming takes place. Mixed farming is predominantly based on rainfed farming in northwest Somalia (Haud plateau), interior coastal plains, riverine and inter-riverine areas, and the wetter regions in the south. Main rainfed crops are sorghum, maize and cowpeas while livestock herds tend to emphasis small stock and cattle, although camels might be owned by wealthier agropastoralists. Livestock are herded in adjoining rangeland areas and on agricultural residues.

From the early 1970's to prior 1991, the Government of Somalia's policy emphasised increased rainfed and irrigated agricultural production. For example, sedentarisation, which is to say, mostly farming, increased during the 1970's and 1980's, especially in large parts of Bay Region and in the eastern part of Middle Jubba Region. In large part this was because of several serious droughts which caused significant losses in livestock, but especially cattle (Janzen, 1988). Since 1991 internally displaced people returning to their home areas have taken on rainfed farming in suitable rainfall areas in order to survive. Consequently, there has contributed to an increase in mixed farming in some areas. The area of rainfed mixed farming has increased in "Somaliland" in recent years (Awale & Odowa, 1997, VETAID, 1997) and returnees from Mogadishu fleeing the effects of the civil war, have increased the amount of farming in Middle Shabeelle and Galgadud Regions (Laird and Potterton, 1997).

Strengths

Mixed farming systems use crop residues as fodder and produce manure which can be used as fertiliser. Mixed farming maximises production during good rainfall areas and improves food security. Reliance on crops and livestock also reduces risks for the Somali agropastoralist during drought years.

Weakness

The expansion of mixed farming systems, in particular rainfed farming, has been at the expense of dry season grazing areas (i.e. the wetter rangeland areas). Consequently, in localised areas there has been a significant reduction in available rangeland resources for livestock production, which is particularly felt at times of drought.

The mixed farming system often uses dead fences, using branches of trees and shrubs, to demarcate land ownership. The resulting enclosures diminish mobility of livestock owned by pastoralists and regular cutting of shrubs to establish and maintain enclosures reduced forage for camels and goats. The construction of enclosures and introduction of land ownership furthermore contributes to conflict between agropastoralists and pastoralists (VETAID, 1997) and has the potential for contributing to shrub clearance and associated overgrazing.

Rainfed farming practices can also contribute to soil erosion. Land preparation results in bare soils increasing susceptibility to wind and water erosion while continued cultivation gradually reduce soil fertility and structure. Traditionally, shifting agriculture is applied whereby fields are put in fallow after five to fifteen years of use. In certain areas, the period of fallow has decreased due to limited land availability (Holt, 1985, Behnke, 1987, Potterton & Laird, 1997).

Threats
Continued emphasis by regional and local administrations on rainfed agriculture, in particular its further expansion, risks further exacerbation of the conflict between agropastoralists and pastoralists. Continued expansion of surface water storage facilities supports expansion of rainfed agriculture into marginal land areas. Continued sedentarisation of pastoral communities supports increased rainfed and irrigated farming at the expense of dry season grazing areas.

Without improved farming management systems, the long-term productivity of rainfed and irrigated agriculture will be jeopardised as soil fertility decreases and virgin land becomes scarce. The land's resilience and ability to revert back to productive range and woodland areas will also decrease.

Lastly, expansion of rainfed farming into other ecosystems and habitats will have negative effects on biodiversity and other economic production systems. For example, agricultural development has progressively removed riverine rangelands from the livestock grazing resource (Deshmukh, 1990), although the availability of crop residues, canal bank pasture and fallow land has compensated to some extent for this loss (Janzen, 1988; Deshmukh, 1990).

Opportunities
The introduction of improved farming practices, such as water harvesting, land preparation, agroforestry, soil and water conservation, and crop diversification can contribute to agricultural intensification as opposed to expansion. For instance, soil fertility and structure can be improved thus prolonging use between fallow periods. Current programmes by IRC in north-western Somalia and identified priorities of regional administrations (Odowa & Awale, 1997) illustrate the value of these methods towards sustainable natural resource management.

The realisation of the conflict between agropastoralists and pastoralists in "Somaliland" and reports that elders have arranged for land enclosures to be removed, provide valuable opportunities towards participatory land use planning initiatives that harmonise land-based production systems (livestock and agriculture) with the natural resource base.

4.2 Agriculture

Agriculture is the second most important production system in Somalia. Prior to 1991, agriculture contributed 19% to Somalia's GDP and 20% of it's employment. Thirty-one percent of Somalia's population were then settled rural people (mostly farmers but also some agro-pastoralists) (Janzen, 1988). A similar value was estimated for central Somalia by RMR (1979) for agropastoralists. Although production and economic value data on agriculture is not available since 1991, it can be assumed that, overall, agriculture remains the second most important production system in terms of land area and number of people involved.

Roughly 81,500 sq. km are suitable for cultivation in Somalia, including 250 sq. km along the major rivers suitable for irrigated cultivation (Ayan, undated). Southern Somalia contains most of the principle agricultural areas in the country, namely: the middle and lower reaches of the Shabeelle and Jubba Rivers - and some of the middle Jubba River, where both irrigated and rainfed agriculture are common: Bay Region and some of Bakool Region. The Borama-Hargeisa area of western Somaliland (Awdal and Waqooyi Galbeed regions), where rainfed agriculture predominates, is an other important agricultural area (FEWS/MOA, 1986/7) (Figs. 13 & 15). Limited oasis irrigated agriculture takes place in northern Somalia along the edge of *toggas* where ground water is close to the surface.

Agricultural productivity is dependent on the suitability and potentiality of the soils, amount and regularity of rainfall, and water quality for irrigation. Rainfed farming in semi-arid and arid environments is risky since productivity is susceptible to variable rainfall and periods of drought.

The major rainfed crops for Somalia are sorghum, maize and cowpea. Major irrigated crops include rice, sesame and maize. Prior to 1991, cotton, sugar cane, and bananas were major cash crops. Due to the breakdown in irrigation and processing infrastructure cotton and sugar cane production has not resumed. Export of bananas from Lower Shabeelle by private entrepreneurs resumed from 1994. Oasis farming is traditionally based on date palms, papaya, and citrus fruits. Since 1991, there has been an increase in vegetable (chillies, tomatoes, onions, watermelons, etc.) cultivation for urban-based markets.

The following sections provided a more detailed overview of the agricultural production systems found in Somalia.

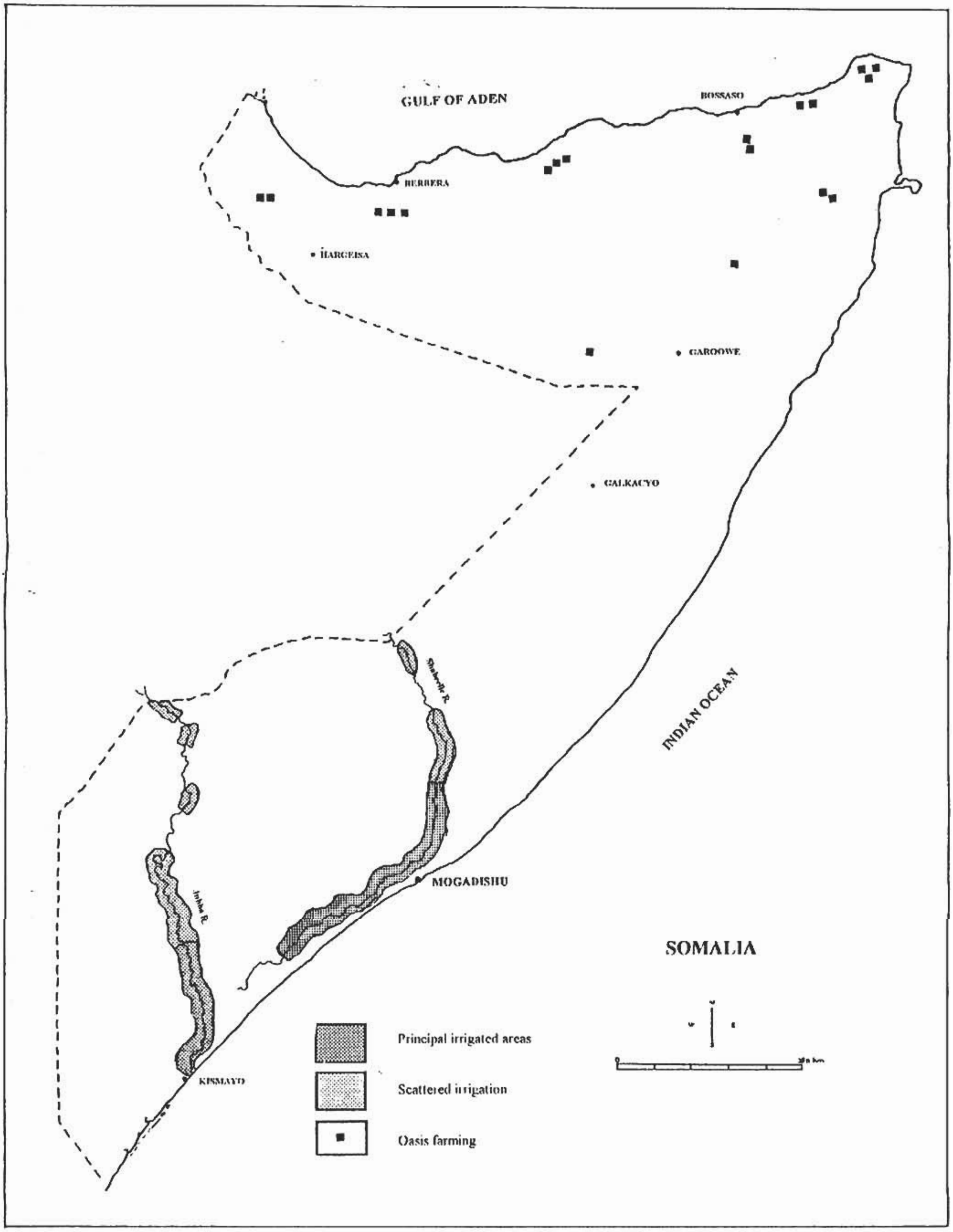
4.2.1 Rainfed farming

Features

Rainfed farming is a low input, high risk production system (Laird & Potterton, 1997) carried out under conditions of relatively low and highly variable rainfall. Therefore, it is less productive than irrigated agriculture and, subsequently, primarily supports only a subsistence economy (Janzen, 1988). Rainfed farming is primarily carried out in Bay and Middle and Lower Shabeelle regions of southern Somalia although adjacent regions also contain pockets of settled farms and larger areas of scattered fields of agropastoralists. In central Somalia the only areas where some cultivation does not occur are the sandy coastal plains, areas with dense surface limestone, the extremely dry far north and the area in eastern Hiraan Region where *Cordeauxia edulis* (Yehib nut) grows (Holt, 1989). Settled rainfed farming also occurs in Somaliland, on the *Haud* plateau in Waqooyi Galbeed Region (Baumann, 1993) (Fig. 13).

Maize, sorghum and cowpeas are the major crops grown on rainfed farms (Madany, pers. comm.; FEWS/MOA, 1986/7; Awale & Odowa, 1997; Barkhadle, 1993; Janzen, 1988; Holt, 1985; Laird & Potterton, 1997). In southern Somalia, maize and sesame are most likely to be grown in non-

Figure 15: Areas of irrigated agriculture (RMR, undated, FEWS/MOA, 1986; Baumann, 1993)



irrigated situations near the two main rivers whereas sorghum and cowpeas are generally grown further inland in drier areas (FEWS/MOA, 1986/7; FEWS/Somalia, 1997) (Fig. 11).

Rainfed farming systems in Somalia range from classic shifting cultivation through intermediary stages to settled mixed farming (Holt. 1985). In shifting cultivation small fields are fenced and farmed, especially during good rainy seasons, by a few members of a pastoral family. Most of the family, however, remain fully nomadic and involved in livestock husbandry. Traditionally, cropped fields in some areas are opened to livestock grazing after harvest (Behnke, 1987; VETAID, 1997) and little effort is made to maintain fenced fields once soil fertility is exhausted (Janzen, 1988). Shifting cultivation is more typically carried out far from permanent water, which in central Somalia at the time was at least 7-10 km (Holt, 1985; Behnke, 1987). In settled farming most of the family is involved in farming. Although the size of cropped fields is similar to shifting cultivation (0.7-2.8 ha) (Holt, 1985; Behnke, 1987; Laird & Potterton, 1997), fenced areas are larger, better maintained and more permanent and only a few family members are nomadic and continue to deal with livestock (Janzen, 1988). Fenced enclosures on settled farms tend to include fallowed fields and land not yet cleared for farming. Enclosed land is also more apt to be used to graze livestock during certain times of the year (Holt, 1985, Behnke, 1987).

Traditionally, land that is enclosed for cropping is considered to be "owned" by the farmer involved although ownership may not necessarily be transferred to fallowed fields and even cropped fields may be required by the community to be opened to grazing after harvest (Holt, 1985).

At least in central Somalia, which includes the floor of the Shabeelle valley in Hiran Region, rainfed farming typically has a relatively short cultivation period of 5-13 years and a longer fallow cycle of 10-50 years with 8 years and 30 years the average values respectively (Holt, 1985; Behnke, 1987; Laird & Potterton, 1997). Of course this varies with the type of soil and whether it has ever been cropped before and, if so, the extent to which it has recovered it's fertility through fallowing. For instance, if a fallowed field is cropped again before the fallow cycle is completed (and the soil has not completely regained it's original level of fertility) then it can only be used for 2-3 years before soil fertility is exhausted once again (Laird & Potterton, 1997).

Rainfed crop yields vary according to the amount and distribution of rainfall, type and status of soils, species and variety of crop plant and management techniques. For instance, on sandy soils in central Somalia Laird & Potterton (1997) report seasonal yields ranging from as low as 20 kg/ha (cowpeas) and 50kg/ha (sorghum) on soils that have been depleted of most of their fertility by farming, to 500 kg/ha (cowpeas) and 300 kg/ha (sorghum) on recently cleared virgin soils. These are low yields. However, very similar soils in an adjacent district have, at least in the past, produced an average of 880 kg/ha of sorghum (*dayr* season) and 1,140 kg/ha of cowpeas (*gu* season) over a 10 year period. In fact, in years of good rainfall surplus cowpeas grown in the cowpea belt (Fig. 11) have been exported all over Somalia (Holt, 1985). Rainfed cropping in the Jubba and Shabeelle river valleys can be expected to be even more productive because of fertile alluvial soils and (often) harvesting of surface runoff with micro-catchments. Many farms are a mix of rainfed, high groundwater and flood recession farming (Holt, 1989; Deshmukh, 1990).

Holt (1985) estimated that 6 out of 10 years provide good or excellent harvests on sandy soils in El Dhere District, Galgadud Region, despite rainfall being marginal for agriculture. The average crop yields shown in the above paragraph represent a significant proportion of a pastoralists diet. Furthermore, a very good season yields enough food to feed a family for 6 months to 2 years (Holt, 1985) and grain can be stored for several years in the dry climate (Janzen, 1988). Madany (pers. comm.) reports that Bay Region produces surplus crops in years of good rainfall. RMR (1979) estimated that up to a third of the pastoralists in central Somalia were supported by cropping. Shifting cultivation is at least 300-400 years old in central Somalia, even in waterless areas where water was over 60 km distant (Holt, 1985). Therefore, at least in some areas of Somalia, rainfed farming can be a sustainable subsistence enterprise.

Rainfed cropping requires fenced enclosures, built of cut thornbushes, to protect crops from livestock. Farms are unfenced only where no fencing material exists to use. However, over the past few decades enclosures, have become larger and more abundant. This is not only because the number of agropastoralists is increasing but also because enclosures are more and more being used for fodder production and livestock grazing, or as simple assets for resale, in addition to cropping. In many instances, especially in the drier rangelands where cropping is not possible, enclosures are used only for fodder and livestock grazing.

This trend, which began in Somaliland during the 1950's and has now spread throughout the rest of Somalia, is most apparent near permanent water. In order to remain settled near water farmers need larger units of land to allow them to stay in the area throughout an entire fallow cycle of several decades. Enclosed land near water is also useful for growing fodder for sale, especially during the dry season when forage elsewhere is in short supply and livestock are necessarily forced to frequently come to water. As land pressure increases private enclosures became more important as fall back grazing reserves for the owner's stock (Holt, 1985; Behnke, 1987). But, enclosures also reflect other influences. For instance, a trend in enclosure construction, which now covers extensive areas within parts of western Somaliland, was initiated by impoverished former pastoralist refugees returning from Ethiopia. Having lost all of their livestock they enclosed communal rangelands to grow fodder for sale (VETAID, 1997). Enclosures have been constructed by merchants/businessmen near ports in Somaliland to grow fodder for use by livestock being transported by ship to Saudi Arabia (Stockton & Chema, 1995). Large enclosures have been constructed near permanent water sources in central Somalia on which to grow sheep for export (Behnke, 1987). In the opinion of Holt (1985) agropastoralism (i.e., enclosure) is probably leading to the privatisation of rangelands.

Strengths

Under higher rainfall and on fertile soils, such as may obtain in certain parts of southern Somalia, rainfed farming is a more productive system than livestock husbandry. Under less advantageous conditions, such as lower, more variable rainfall, farming can provide agropastoralists with a useful dietary supplement and make their way of life more sustainable. For instance, in the 1980's farming provided agropastoralists in central Somalia with most of their food while their livestock provided both milk and money (through sales) (Holt, 1985). In the drier areas, rainfed farming may often be a fallback option for pastoralists who are unable to maintain their original way of life. Given that there is no undue population pressure on the land it can often be a sustainable production system, although usually only at the subsistence level and then easily susceptible to droughts.

Weakness

However, where there is excessive population pressure on the land, as is presently the case in Adale District (driven by clan returnees from Mogadishu), in western Somaliland and on alluvial soils of the middle reaches of the Shabeelle River, old cropland is being re-cultivated before it has been adequately fallowed, reducing soil fertility and, subsequently, crop production and sustainability. Therefore, the poorest families, who rely the most on farming, also need other income sources, such as the selling of charcoal and fuel wood, handicrafts, labor and remittances (LRDC, 1985; Laird & Potterton, 1997; VETAID, 1997).

Associated with increased population growth, water development, sedentarisation and commercialisation, is a trend toward increasing private enclosure, by agropastoralists and merchants, of formerly communal land, typically within important dry season grazing areas (Fig. 12) near permanent water (Holt, 1985; Behnke, 1987; Stockton & Chema, 1995; VETAID, 1997; Laird and Potterton, 1997). This withdraws land from use by other pastoralists, both inhibits access to water and increases grazing pressure on the limited areas open to grazing near water, forces livestock onto poorly watered, drier and less productive rangelands and is a source of conflict. In Somaliland and Adale District enclosures has sometimes occurred to such an extent that it has led to a breakdown in the traditional (more nomadic) pastoral production system (Laird & Potterton, 1997; VETAID, 1997). Even the use of crop residues during the dry season does not completely compensate livestock for the loss of rangeland to cropping and fallows (Laird & Potterton, 1997). Further, intensively enclosed areas near permanent water tend to be abandoned because of a lack of fencing materials (thorn trees from which to cut branches). This sometimes occurs even before the fertility of the soil has been exhausted by cropping. Abandoned farms and fallows are then heavily grazed, degraded and eroded. This has been shown to be a major cause of desertification not only in Somalia but also elsewhere in Africa (Holt, 1985).

Under low rainfall and on poor soils, rainfed farming is of low productivity and reliability (Laird and Potterton, 1997). However, regardless of rainfall and soils, cropping productivity and sustainability are reduced by the impact of droughts and poor management practices, such as a poor selection and quality of seeds, pests and lack of manuring. The integration of crop and livestock production, such as in the use of manure for fertiliser and crop residues for fodder and sale, is rather limited and there is generally no active management of fallowed areas. In Galgadud Region, some farmers crop at the very edge of sand dunes, which are common in the area, in order to make use of the increased soil moisture provided by the dunes (Laird & Potterton, 1997).

Biodiversity and forage/livestock productivity are lower on fallowed fields than on the original rangeland. This is caused by removal of the vegetation, loss of fertility during cropping and the subsequent invasion by a relatively few pioneer plant species of low forage value. Full recovery of the vegetation (post-cultivation succession), and restoration of the original biodiversity of plant species takes from 60-100 or more to complete (Herlocker, 1989), some years more than is required for an optimal fallow cycle. Subsequently, other production systems, such as honey, charcoal, gum, edible and therapeutic plants and wildlife, are also negatively affected.

Rainfed cropping, especially when minimum tillage is not practised, also increases the rate of soil erosion on both cultivated and fallowed fields. The low organic matter content of these soils encourages soil erosion. Indeed, Holt (1985) and Laird and Potterton (1997) report that clearing, cropping and grazing are considered to have caused more widespread damage to rangelands Northeast of Mogadishu than simple grazing by livestock. Rainfed cropping has been blamed for contributing to the extensive destabilisation of dunes south of Mogadishu and the serious gully erosion that has occurred in Borama, Baki and Sheikh districts in Somaliland. Erosion caused by rainfed farming is also responsible for the heavy deposition of sediment in the lower reaches of the Shabeelle River. Northeast of Mogadishu, where sand dunes are common, cropping has caused the formation of sand dunes in the past and may increase their rate of movement (Holt, 1985).

Subsequently increasing population, lowered soil fertility and cropping yields and increased rangeland degradation and soil erosion (which arise from poor farming practices) cause increased pressure on the land. Thus, following in the wake of water development, rainfed cropping encroaches more and more into increasingly marginal lands where it becomes even less sustainable and contributes even more to rangeland degradation (Holt, 1985; VETAID, 1997).

Threats

Increasing population pressure causing decreased fallow periods, depletion of soil fertility, increased soil erosion, and extension of rainfed farming into increasingly marginal lands, threatens this production system with increasingly lower yields, more frequent crop failures, increased conflict with pastoralists over use of rangeland areas and, ultimately, the creation of more impoverished pastoralists. Many of these people will then become rainfed farmers, thereby adding further to the problem. Increasing enclosure (for cropping, fodder production and livestock grazing) exacerbates overgrazing in some areas by removing other areas from communal use by livestock and also encourages conflict.

A steadily increasing human population, a more slowly growing livestock population, loss of former grazing lands and heavy pressures placed on rangelands have been tacitly acknowledged by pastoralists in a gradual shift in strategy, notably toward agropastoralism (Deshmukh, 1990).

Opportunities

Improvement of farm management practices, including crop diversification and integration with other production systems, would improve sustainability of rainfed farms located outside the zone where rainfed cropping is marginal. This emphasises "intensification" of rainfed farming rather than it's extension into other areas less capable of supporting agriculture. A number of practices are of potential value depending on the situation; a few are already locally implemented to varying degrees by some pastoralists. Examples of possible improved practices are rainwater harvesting, use of manure for fertiliser, improved seed quality, strip cropping and changing the shape and orientation of cropped fields to reduce wind erosion, introducing high quality and productive pasture plants into cropped fields (so that they can swiftly spread after the field is abandoned), introduction of more highly productive and drought resistant food and forage crops, live fences of multi-purpose tree/shrub species established by low input sowing techniques and protective cover of weeds on cropped fields in the dry season (Holt, 1989); increased use of crop residues for fodder and sale, pest management, burning of woody debris (to improve fertility), inter-cropping and better management of fallowed fields (Laird & Potterton, 1997) and naturally regenerated trees on cropped and fallowed fields to produce shade, fruit, browse and building materials (Bowen & Bird, 1988).

The results of three years of experimental trials of several practices in El Dhere District are published by Holt (1989). Madany (1992) presents the results of low-input sowing of *Leucaeana leucocephala* by farmers near Jilib in Middle Jubba Region for the production of stock fodder. Both authors recognise that a major constraint operating on rainfed farmers is the amount of time required to implement an intervention. Hence, the emphasis on low-input techniques such as sowing of seeds rather than planting seedlings.

4.2.2 Irrigated agriculture

Irrigated agriculture, although carried out to some extent along the entire length of both rivers, primarily occurs along the middle and lower reaches of the Shabeelle River and the lower reaches of the Jubba River (Fig. 15). Irrigated agriculture along the rivers is influenced by the variations in river flow which reflect rainfall patterns in the highlands of Ethiopia. For instance, the flow of the Shabeelle River varies from a mean low of about 10 cumecs in February to around 125 cumecs in both May and September. This allows two main periods of irrigation and, therefore, two cropping seasons (Deshmukh, 1990). Furthermore, the watershed of the Shabeelle in Ethiopia yields a very large amount of silt which has, over many years, been deposited on the river's floodplain to the extent that the river level is in some places higher than the surrounding plain. The river is kept to it's course by natural and artificial embankments (levees) (Howard, 1997).

The principal forms of irrigation practised along the rivers: flood recession irrigation and controlled gravity (or) pump irrigation. Oasis farming, which involves irrigation of small areas from wells and springs, occurs at scattered localities in northern Somalia.

- **Flood recession farming**

Features

In flood recession farming, crops are first planted in newly exposed soil away from the river and planting continues toward the river as the flood waters recede. Subsequently, crops mature at different times during the growing season depending on their positions relative to the river (Madgewick, 1989). This type of irrigated agriculture occurs along (and near) both the Jubba and Shabeelle rivers (LRDC, 1985; Janzen, 1988; Madgewick, 1989), at least on an opportunistic basis (Holt, 1989) and especially now that bunds broken during or since the civil war sometimes allow large areas of the Shabeelle Valley to flood (Howard, pers. comm.).

Along the Jubba River flood recession farming is often carried out in seasonally flooded natural depressions in the clay flood plain (*dhesheegs*). These may often fill not by flooding but by lateral infiltration from the river through the soil (Deshmukh, 1990). The principal crops are maize, sesame and beans with some cowpeas, other pulses and tobacco (Madgewick, 1989). Crop residues of sorghum and maize are increasingly used for dry season fodder supplies (Janzen, 1988). Sorghum and maize in floodplain areas produce 3-4 times as much stover (crop residue) as grains (i.e., up to 3-4 tons/ha/yr) (Deshmukh, 1990).

Strengths

As the soil is well and truly soaked before planting can occur, there is a good supply of soil moisture during the early growing season. As flood recession agriculture requires no infrastructure those engaged in it are mainly small holders. Therefore, a relatively large number of people can make their living in this way. Many of these farmers are (or were) minority Bantu people (Janzen, 1988).

Weakness

This type of irrigated agriculture is totally dependant upon the flooding patterns of the two rivers. Times of low rainfall in the Ethiopian highlands are apt to cause reduced flooding downstream in Somalia which will, subsequently, reduce the productivity of flood recession agriculture. This type of irrigation would be the most affected by upstream dams because of the reduction in downstream flooding (Deshmukh, 1990).

Threats

Planted fields may be flooded and destroyed by unexpected floods of the river, especially if the levees are not stabilised by a cover of riverine forest (Madgewick, 1989) or adequately protected by bunds/levees. Poor soil drainage may result in soil salinization and reduced crop productivity (Howard, pers. comm.). The amount of flood water available for this production system may be influenced in the future by water use further upstream, e.g., the planned damming of one or both of the two rivers in Ethiopia for generation of hydroelectricity. A land tenure problem is arising in that the land rights of Bantu small holders are often no longer recognised by other Somalis (Muthai, 1997, Madany, pers. comm.).

Opportunities

Productivity and sustainability is improveable through better farming practices, such as seed improvement and the introduction of animal traction (Muthui, 1997). Other possibilities are improved use of crop residues and agroforestry practices, such as sowing multiple use trees/shrubs for fodder, poles, shade, windbreaks etc. Ensuring that sufficient water is made available (from users upstream) for this type of irrigation is a long term requirement as is the regulation of river flood levels, whether by keeping adequate forest cover along natural river levees or by other means, so that unexpected floods do not destroy planted crops.

- **Controlled gravity (or) pump irrigation (smallholders)**

Features

This type of irrigated agriculture is also found along the entire lengths of both the Jubba and Shabeelle rivers (Janzen, 1988; Madany, pers. comm.; LRDC, 1985.). Controlled gravity irrigation operates by diverting riverine water from which it flows by gravity along canals to a farm or farms where it is spread over the farm area by smaller canals and ditches. Used water is drained from the farm by drainage ditches which lead back into the river further downstream. A primary aspect of irrigation management in the riverine areas of Somalia is the proper timing of water use and the flushing of used water out of the farm system back into the river to keep the amount of "salty" water to a minimum and to control the tendency of the poorly drained soils to become saline (Howard, 1979; pers. comm.). Controlled gravity irrigation especially requires a considerable amount of infrastructure (barrage, canal, bunds, bridges, etc.). Where farms occur adjacent to the river, pump irrigation requires somewhat less infrastructure because water can be pumped out of the river onto the farm.

On small-holder plots the principal crops grown by this type of irrigated agriculture are those grown by flood recession irrigation (maize and sesame) but also include fruit trees, such as mango, papaya, lime and bananas. In the past many riverine smallholders involved in this form of irrigated farming along both rivers have been Bantu people (Janzen, 1988; Muthui, 1997; Madany, pers. comm.). Prior to 1991, large commercial land holdings operated for the production of sugar cane, cotton, bananas and rice co-operatives.

Strengths

This is a potentially highly productive type of farming which furthermore is carried out primarily by small holders, thereby contributing significantly to food security for a relatively large number of people. The two riverine valleys together have the potential of making Somalia self-sufficient in food production, especially if they were to be given over to small holder production rather than to extensive plantations of cash crops (Madany, pers. comm.).

Weakness

Unfortunately, much of the original irrigation infrastructure, such as that of the old sugar scheme in the Jowhar-Balad area of Middle Shebeelle Region, has been destroyed during or following the civil war. What still exists has generally been poorly maintained (Howard, 1997; Muthui, 1997; Madany, pers. comm.). Much of the old sugar scheme has now been taken over by small holders. Subsequently, the levees built to contain the Shabeelle River in the same area (and some of the canals) have been breached by irrigators to get water onto their fields. The number of pumps has decreased significantly because of the difficulties involved in obtaining, maintaining and protecting them (Howard, pers. comm.; Madany, pers. comm.).

The Shebeelle floodplain is located over old sediments which retain Sodium Chloride (NaCl) at several meters depth. If irrigation is not accompanied by drainage of excess water, the moisture penetrates to the salt which then dissolves and adds to the salinity, and results in surface salt deposits through evapotranspiration (Howard, 1997). Some alluvial soils on the floodplain in Middle Shebeelle Region were already saline at least 10 years ago (LRDC, 1985). Increased soil salinity significantly reduces cropping productivity. Non-functioning irrigation infrastructure reduces the ability of the farmer to "flush" salts from the soil. This is especially pertinent during the period of low water when the river water becomes relatively salty and during first week's flood of the river when the river flushes this "salty" water out of it's system. During the pre-civil war period, farmers were warned not to use the river water for a certain number of weeks until it became sweet enough again for irrigation. This no longer happens. Some farmers even draw irrigation water from the ditches that are meant to drain relatively salty water off the fields and back into the river. Thus, they irrigate their fields with "salty" water (Howard, pers. comm.; 1997) to the detriment of crop growth. Ultimately, this will lead to soil salinization.

Riverine farming, but especially irrigated farming, has transformed most of the natural forests along the Jubba and Shabeelle rivers into agricultural land. The major blocks of remaining forest comprise a mere 900 ha (down from over 10,000 ha forty years ago) along the middle reaches of the Jubba River (Deshmukh, 1990). The reduction in riverine forest can lead to the weakening of levees and increase susceptibility to flooding.

A significant number of smallholders in the riverine area of Middle Shebeelle are newcomers (Muthui, 1997) and, therefore, probably, not as knowledgeable about irrigation methods as those they replaced.

Threats
Irrigated agriculture along the rivers in Somalia is ultimately dependant on rainfall and water use in the highlands of Ethiopia. Conceivably, the damming of one or both of the two rivers in Ethiopia could result in significantly less water available for use downstream in Somalia. Possibly even upstream users in Somalia may eventually reduce the amount of water available for use downstream. Potential problems stemming from enforced changes in smallholder land tenure (re: Bantu people) are the same as with flood recession irrigation.

Continued erosion of the river levees and banks increase susceptibility to flooding of adjacent land holdings thus decreasing productivity.

Opportunities
Improvement of farming practices to achieve sustainable production and food security are recommended. This is especially so with regard to proper methods of managing irrigation water: timing, flushing, draining etc. to guard against salinization of soils. Where feasible, work should be carried out with local individuals and/or communities to rehabilitate irrigation infrastructure. This might include investment in water pumps to draw water directly over the levees which would help maintain the embankments and could be managed by a few co-operating irrigators. The use of siphons is another possibility. Other potential ways in which to improve farming practices are mentioned under Flood recession farming.

- **Irrigated plantation cropping**

Features
Prior to the civil war this type of irrigated agriculture, which is simply a more extensive form of the gravity controlled and/or pump irrigation system discussed above, occupied about half of all

irrigated farmland. The major crops were bananas and sugar cane. There were also small areas of coconut palms. Now, however, irrigated plantation cropping appears to be restricted to along the lower Shabeelle River from about Afgoi to Qoryooley and concentrates on growing bananas as a cash crop for export to Italy (Fig. 15) (Howard, pers. comm.: Madany, pers. comm.). It uses water obtained by gravity irrigation from a barrage on the Shabeelle. The large pre-civil war sugar plantations in the Jowhar-Balad area of Middle Shabeelle have been destroyed and the land largely taken over by smallholders (Howard, 1997; Muthui, 1997. Similarly, the factory of the old sugar plantation on the lower Jubba River at Mareerey, which used to account for about 60% of Somalia's sugar production, has been gutted (Madany, pers. comm.)

Strengths
This is a potentially highly productive agricultural system, not only in terms of the type and amount of crops that may be grown but also the potential for earning substantial amounts of cash from the export market once political stability returns to Somalia. The irrigation infrastructure of the Lower Shabeelle banana plantations is apparently intact and maintained.

Weakness
The present banana plantations produce high quality fruit but at the cost of high inputs of water and fertiliser. Somalia could go far toward being self-sufficient in food production if this area were given over to small holder farming. The dumping of surplus grains (food relief) elsewhere in the country takes the pressure off having to put this area to a more sustainable use. Local farmers may be forced to work on the plantations whether they want to or not (Madany, pers. comm.).

For the previous irrigated plantations (sugar) to regain their original productivity political stability must be retained. Then, the question of land tenure must be settled (because of the numerous farmers who have taken up smallholdings) and, subsequently, the extensive infrastructure (roads, ditches, machinery, vehicles etc.) must be repaired. Soils that have become salinized must be flushed out with large amounts of water so that they return to normal productivity. This will require a large capital investment and subsequently high levels of maintenance. It will also probably require a reorganisation of water rights because of the large amount of water that will have to be diverted from other uses.

Threats
Soil salinization is a threat if poor management practices prevail. However, it is in the interests of the powerful group that run the existing banana plantations to ensure that proper management practices do prevail. Eventually, water use practices in Ethiopia or upstream in Somalia may affect the amount and quality (sediment load, salinity) of water available for use. The break-up of the old sugar plantations into smallholder plots may constrain future plantation agriculture in these areas.

Opportunities
In the long term political stability is required to realise full productive (and cash-earning) potential of this production system. In the short term the improvement of farming and irrigation practices, irrigation infrastructure and cooperation in water use among the small holder element would be desirable. This may actually also be the best long term objective as well because it

would go far toward supporting sustainability and food security for a relatively large number of people. There is some doubt as to whether the large sums of money earned by extensive plantations of cash crops would be put to a positive use in any case.

- **Oasis farming**

Features
What surface water sources are present in *toggas* and springs, oasis farming traditionally based on farming date palms, papaya, citrus fruits and vegetables. Predominantly found in northern Somalia. this type of farming has been on the increase in the northwest (Awale & Odowa, 1997) (Fig. 15). Date palm production is unable to meet demand and significant quantities are imported. Date palm fields are inherited by both men and women. The fields often have many proprietors, most of whom live elsewhere while one member of the extended family manages the field. Date palm leaves are used for fences, shades, baskets and mats, while part of the trunk is an ingredient of local paint (Janssen & Harries, 1997).

Since 1991, there has been an expansion in oasis farming for high value vegetables (onions, tomatoes. chillies, water melons and citrus fruits) for urban markets (Forbes, pers. comm.). Private farmers are investing in motorised water pumps and PVC piping imported from Gulf states.

Strengths
Oasis farming in western Somaliland has a good market in Somali urban centres. As a traditional crop, the methods for growing dates are well known. Also, the demand exceeds supply. Date palms are multi-purpose trees. Inter-cropping is active in oasis farming.

Weakness
Much of what little irrigation infrastructure that existed in Somaliland was destroyed during the civil war (Awale & Odwa, 1997). In the case of date palm farms, most farms are substandard. Subsequently, production is very small (10 kg/tree) due to (a) poor quality trees, (b) inadequate water supply, and (c) outdated farming methods. Also, many date palm farms are in coastal areas where water is brackish and not conducive to good growth of the palm trees. In addition, up to 50% of all stored dates are lost to insects and/or mould. Therefore, as demand for dates within Somalia exceeds the supply, large amounts of dates are imported (12,000 tonnes in 1989). The genetic material in-country (or at least in Bari Region) for the propagation of date palms is limited (Janssen & Harries, 1997). Where inter-cropping of vegetable gardens occurs the prices of oasis farming products is often unable to compete with imported produce (Forbes, pers. comm.).

Threats
The traditional date palm farming is being marginalised in favour of high value vegetable production. Contributing to this is the increasing loss in quality of Somali date palms.

Vegetable farming adjacent to oasis is increasing spreading to marginal land susceptible to flooding, in particular adjacent to *toggas*.

Increased surface runoff due to reduced water infiltration in watersheds and general soil erosion by water can lead to increased flooding within *toggas* and on to adjacent agricultural plots.

Opportunities
Improved date palm farming methods are needed, such as:
(a) removing offshoots from the trees for planting elsewhere;
(b) pruning;
(c) destroying poorly-producing trees;
(d) using superior trees to better advantage;
(e) spacing palm trees further apart to allow inter-cropping;
(f) planting vegetable gardens (or forage crops) between and below palm trees - this is already being done to some extent (Forbes, pers. comm.);
(g) improve water supply systems; and,
(h) import cloned date palm planting material (Janssen & Harries, 1997).

Explore options for improved inter-cropping of citrus fruits and vegetables in order reduce water erosion. Use dwarf palms for fencing plots which also serve as erosion barriers and can also be sustainably harvested for making craft products (e.g. mats).

4.3 Wood production

Features
The primary use of wood is for cooking fuel, either as fuelwood or after conversion to charcoal. Fuelwood and charcoal satisfied 92% of Somalia's total energy demand during the 1980's. Each Somali uses about 1 ton per year for this purpose. Based on biomass growth rates of native species, each Somali requires 2-10 ha of wood each year to satisfy his requirements. A much smaller amount (<0.1 ton per year per person) is used for house construction (Deshmukh, 1990) and an unknown but significant amount is used for construction and maintenance of fences (Holt, 1989; VETAID, 1997). Experience from northern Kenya indicates that use of wood for construction and maintenance of fences probably runs from around 0.11 tons/person/year in sedentarised situations where trees are scarce (Walther & Herlocker, 1983) to as high as 0.94 tons/person/year in nomadic situations where trees are abundant (Synott, 1979). Some trees species, especially in riverine areas, may also be cut for poles (Wieland, 1987).

Any tree species over 2 cm in diameter can be used as fuelwood, although denser, heavier woods, (e.g. *Acacia bussei*) are better fuels than softer woods, such as are typical of many *Commiphora* spp. Charcoal, however, is best made from hard, heavy wood which weighs at least 0.5 g/cc (air dry) and is at least 5 cm in diameter. Thus, a greater proportion of a tree's woody biomass can be used as fuelwood than charcoal - only about half of a tree is potential charcoal. However, the greater bulk and weight of wood significantly restricts the distance over which it can be carried (Western & Ssemakula, 1981). Charcoal, on the other hand, can be economically transported over large distances by truck.

Charcoal is produced for both local consumption and export. Charcoal has been exported for at least a decade and there still seems to be a strong overseas market for it. For instance, a substantial export trade in charcoal developed to fuel the civil war economy and the Kismayo area is presently being heavily cut over to produce charcoal for shipment to the Arabian states (Madany, pers. comm.).

There are no data available on the present degree of tree cutting, and fuel and charcoal production. However, it is known that during the 1980's annual charcoal production was in the range of 65,000-80,000 tons, of which about 43,000 tons were consumed in Mogadishu alone, and consumption was increasing at 5% per year. A rough calculation based on information in Western and Ssemakula (1981) and RMR (1983/4) indicates that, as a very conservative estimate, roughly 140 km² were being cut per year to provide these amounts of charcoal. At the time over 90% of the charcoal being produced came from a single tree species: *Acacia bussei*, which has two centres of distribution: in north-western Bay Region west of Baydhabo (Baidoa), in Bari Region and in western Somaliland (Fig. 16).

This heavy over harvesting severely depletes stocks of *Acacia bussei* so that by 1989 the remaining reserves amounted to only two years supply in Mogadishu (Bird & Shepard, 1989; Awale & Odowa, 1997). Subsequently, other tree species, such as *Acacia tortilis*, *A. reficiens*, *A. mellifera* and *Terminalia* spp., are now being used instead of *A. bussei* (Madany, pers. comm.; Deshmukh, 1990) and charcoal is becoming more expensive (Awale & Odowa, 1997). Mahony (1990) lists 11 native and 13 imported tree species that may be used to produce charcoal (Appendix 6).

There are two methods for making charcoal. In the central and southern regions a sub-surface kiln is built and covered with metal sheets; in Bay Region, it is extremely efficient with conversion rates of 40%, close to the theoretical maximum. The method used in the north is the much simpler, and less efficient (less than 20%) where wood is stacked on the surface and covered by soil and meal sheets on the top, and lit from the top (ETC, 1997, Robinson and Smith, 1986). Some pastoralists even use live trees (VETAID, 1977).

Tree cutting for various wood products also occurs within the small areas of forests in the country: building timber from *Juniperus* forest in the Golis mountain range, mangrove stands along the southern coast and riverine forest along the Jubba river: also, possibly, the Holawajiir Forest in southern Somalia (White's East African coastal mosaic, Fig. 6), although less is known about this forest. The cutting of forest trees produces a variety of products including poles and charcoal and is sometimes a by-product of converting forest into agricultural land.

Strengths

Wood provides for pastoralist's cooking fires and provides thornbush fences to corral their stock. Thorn fences protect the agropastoralists' fields of crops. Charcoal production provides employment to the poorest people (VETAID, 1997) and meets urban household energy requirements. Despite the widespread over harvesting that presently exists, the production of fuelwood and charcoal has the potential to be sustainably managed and even integrated with other production systems, such as the raising of livestock, tree gum collection and collection of plants for traditional uses. Indeed, according to Bowen and Bird (1988), more emphasis should be placed on managing woody vegetation on existing rangeland to ensure adequate supplies of charcoal and fuelwood.

The forested areas provide some commercially valuable wood products, such as electricity poles and other building materials. Some riverine tree species are noted for their long, straight, termite-resistant poles (Madgewick, 1989).

Weakness
Wood resources on heavily settled and farmed alluvial soils of the Shabeelle river valley are already scarce (Holt, 1985) and they are being over harvested around settlements and permanent water points. For instance, in the cowpea belt of central Somalia a 1-3 km radius around permanent water points is denuded of trees cut for local uses: fuel, fencing and clearance for cropping (Holt, 1989). The impact of tree cutting, for these purposes may extend (diminishing outward) as far as 15-20 km from permanent water (Herlocker et al., 1987, 1988).

Most, if not all, of Somalia's forests have been over harvested and degraded. For instance, the *Juniperus* forest has declined in area from 60,000 ha to 12,000 ha in area and only 900 ha of riverine forest remains on the Jubba River floodplain compared to over 10,000 ha roughly 40 years ago. No figures are available for mangrove cutting but it is known to be extensive enough to threaten the mangrove forest's value as habitat for commercial shrimp (FAO / UNEP, 1981; Madgewick, 1989; Deshmukh, 1990; Awale & Odowa, 1997)

The rate of harvesting of trees for the production of charcoal has been unsustainable for many years. The slow growth of tree species cut for charcoal limits their ability to replace trees lost to cutting (Robinson, 1988). In some areas this situation is exacerbated when, after trees are cut, regeneration is inhibited by grazing. Although other hard wood species than *A. bussei* are now being cut, it is likely that they also will eventually be depleted faster than can be renewed through natural processes if the present rate of cutting continues.

The removal of trees for charcoal has increased erosion in the mountains of eastern Somaliland (Stockton, 1996) and destabilised sand dunes in Ceel Dheer District in Central Somalia (Laird & Potterton, 1997). Extensive cutting of trees lowers biodiversity and reduces the potential for honey production (Douthwaite, 1987). VETAID (1997) considers tree cutting for enclosures, fencing and charcoal production to be more serious than overgrazing as a cause of rangeland degradation. Except within some enclosed areas, trees are open access resources so there is no incentive to replant.

Charcoal production activities can cause hardship to local people. This occurs through the loss of the trees themselves, which may have many local uses. For instance, *Acacia bussei* is used to make rope, twine, camel harnesses and mats, sleeping mats, woven sacks, bandages, bows, clubs, grainstore tops, well tops and housing hoops. It's wood is termite resistant and it's leaves, pods and flowers provide good forage. *Acacia bussei* flowers, in particular, are an important part of the dry season diet of camels (Trump, 1986). *Acacia bussei* can also be used for honey production (Mahoney, 1990).

Hardship is also caused by the loss of pasture as happens in southern Somalia when rapid growth of dense stands of understory trees and shrubs following removal of *A. bussei*. On-going tree cutting activities also hinder use of rangeland areas by livestock. Subsequently, charcoal production activities sometimes lead to conflict with pastoralists (Janzen, 1988; Bird & Shepard, 1989). Pastoralists are generally aware of the environmental problems arising from extensive charcoal production. They are, however, sometimes forced by circumstances to take part..An example of this is in Sanaag Region where charcoal traders ask pastoralists to burn trees in exchange for providing them with trucked water during the dry season. In the words of Yusuf (pers. comm.): *It is a very calculated and tricky bargain that the nomads can not refuse. Hence the whole country side is filled with smoke from burning forest, dust from dust storms and the hundreds of big trucks commuting water to the country and commuting back full of charcoal to the cities.*

Threats

Sustainability of wood production (for use as fuel and fencing) is threatened in heavily settled and farmed areas in the river valleys and near settlements and permanent water points. In some areas lack of fencing materials has led to abandonment of fenced enclosures near water and, subsequently, to rangeland degradation and soil erosion (see Section 4.2.1). Sustainability of charcoal supplies from rangeland areas (for both local use and export) and the production of other wood-based products from forests are threatened by an imbalance between over harvesting and the regeneration and growth of the tree species being utilised. In the case of *Acacia bussei* it may not be possible to re-establish the commercial productivity of this resource for some years. In addition, both rangelands and forests are degraded through a loss of biodiversity, some practical features of which are soil erosion, reduction of forage quality and productivity, and loss of wildlife habitat.

Loss of soils on steep mountainous slopes in Somaliland, once protected by healthy *Juniperus* forest (Fig. 16), will result in irreversible losses in potential productivity. Access by livestock to some rangeland areas harvested for charcoal may also become limited for some years following regeneration of dense stands of woody undergrowth.

Opportunities

If the rate of cutting is brought into balance with the abilities of tree species to replace themselves through regeneration and growth, sustainable harvesting of rangeland areas for fuelwood, charcoal, fencing and other wood products is possible. The management of rangeland areas for this purpose is recommended by Bowen & Bird (1988), Deshmukh (1990) and Laird & Potterton (1997). Such an effort, which will require control over the use of fairly large areas, will require strong efforts by local communities in order to succeed. However, some communities have already taken limited steps in this direction by stopping cutting in certain areas (Laird & Potterton, 1997). An aspect of such management might be to use only dead trees for fuelwood and charcoal production. This would allow some use to be made of protected areas although it would provide only relatively low yields. Deshmukh (1990) reports that one charcoal producer, who collected only dead wood over an area exceeding 50 sq. km, produced 1.2 tons of charcoal per year on a sustainable basis, roughly the annual requirements of one person. Deshmukh also recommends collecting dead wood over wider areas.

Agroforestry measures offer opportunities for improving not only agricultural productivity but also wood-based products to meet forage, poles and fuel needs (Deshmukh, 1990; Madany, 1992).

Improving the efficiency of the existing methods of making charcoal would reduce the need to cut such large amounts of trees. Improved kilns and methods to existing techniques are available in order to improve efficiency (ETC. 1997). The efficiency of many existing stoves can be improved and/or the ability of pastoralists to effectively use their stoves is improveable. Apparently, many pastoralists who use fuel-efficient stoves are unaware of their capabilities and use them in such a way as to negate their useful features and, therefore, potential for improved efficiency (ETC. 1997).

Other energy sources, such as kerosene, should be emphasised. Another, probably more limited, alternative, is solar power. Eventually, once political stability is attained for the country as a whole, electricity is another alternative energy source.

Forests, because they are so limited in area and ecologically important, require special attention. It is important to work at the local level to raise the awareness of local communities of the short and long term implications of serious degradation and/or loss of each type of forest. This is particularly applicable in Somaliland where the loss of *Juniperus* forests can have serious consequences regarding the loss of soils and groundwater reserves. Awale & Odowa (1997) recommend that these forests be protected from unmanaged use as they were before the civil war. In this area it might be useful to investigate the feasibility of introducing and managing some other useful but faster growing trees in order to attract the interest of local users, thereby making conservation of the entire *Juniperus* forest more attractive.

Madgewick (1989) proposes a community based sustainable use forest conservation plan for the remaining blocks of riverine forest (Fig. 16). This would include local land tenure provisions so that local residents could continue honey production and fishing activities but would restrict tree cutting - they would have to learn a new way of cooking. Deshmukh (1990) recommends that the last remaining blocks of forest on the Jubba River floodplain be zoned so as to completely protect the best stands and allow only minor use of the less pristine areas. Degraded areas should be planted with forest species. In some areas simple protection may be all that is.needed to restore riverine forest. For instance, Howard (pers. comm.) notes that old, abandoned fruit tree stands along the Middle Shabeelle are being re-colonized by natural forest species. Regeneration of many important canopy tree species, however, is restricted to the seasonally inundated zone along the river's edge (Madgewick, 1989). The possibilities of integrating certain forest (but especially riverine forest) tree and shrub species into agroforestry systems of nearby farms and villages should also be investigated.

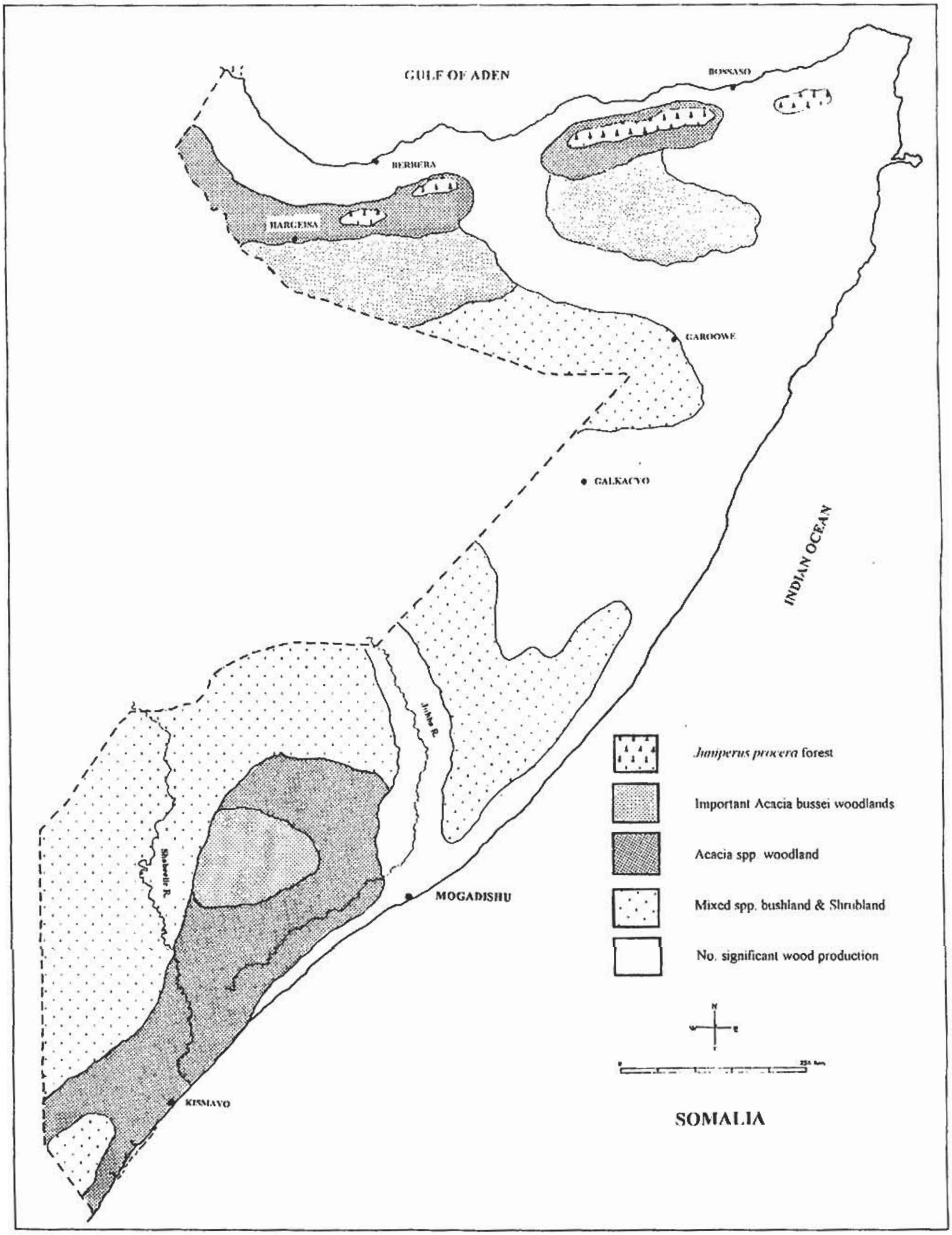
4.4 Tree gums

Features

Another product of Somalia's rangelands are tree gums and resins. Tree gum or resin is the hardened sap exuded by certain types of trees when they are cut or slashed. The Genera *Boswellia* and *Commiphora*, which occur throughout Somalia, provide Frankincense and myrrh respectively.

The major gums produced in Somalia are *maydi*, or "chewing incense", obtained from *Boswellia freereana*; *beeyo*, or Somali-type olibanum, from *Boswellia sacra*; *myrrh* from *Commiphora myrrh*; opoponax and *haggar* or "low grade myrrh". The latter two gums are thought to be from *Commiphora erythraea* and *C. guidotti*, although there is some confusion as to which gum comes

Figure 16: Wood production zones (approximation) (Flemming, 1966, 1973, RMR, 1979, Baumann, 1993)



from which species (Coulter, 1987). *Acacia* spp., in particular *Acacia Senegal.* produce gum Arabic and the gum is collected and sold in central regions for medicinal purposes. Indications are that the gum quality do not meet export requirements.

Boswellia trees are primarily exploited in the mountainous areas of Sanaag and Bari regions (Fig. 17). *Boswellia* trees belong to extended Somali families of local origin and are exploited by three systems: direct exploitation, share cropping and rental. However, in recent years there has been a shift from share cropping to rental arrangements. Although subsidiary to herding, collection is a vital mainstay of the local economy in a very poor region and, for many collectors, is the principal source of income. The collection and processing system in the two regions supports collectors, graders and traders who probably number over 10,000 people.

Commiphora trees occur in dry inland locations throughout much of Somalia as well as in adjacent regions of Ethiopia and Kenya where trees are common property and are exploited by nomadic herdsmen as a subsidiary source of income. Barkhadle (1993) and Janzen (1988) note that collection of tree gums by pastoralists is an important extra-pastoral activity in Bakool and Gedo regions in southern Somalia whereas Laird & Potterton (1997) mention it as a very low level activity in southern Galgadud and northern Middle Shabeelle regions in central Somalia (Fig. 17). In the former area, although *Commiphora*, *Boswellia* and other types of gums and resins are collected, the primary product is myrrh (*Geed malmal*) of which several hundred tons/year were collected during the 1980's (Janzen, 1988).

Tree gums are Somalia's third most important source of export revenue after livestock and bananas. Frankincense alone contributes about half of the income of Bari and Sanaag regions. Production of *maydi, beeyo* and Commiphora gum in the late 1980's was estimated at about 2,300 tons per annum, which was valued at US$ 15.5 million. The gums were exported to processing countries in Europe, the Far East and Arabia (Janssen & Harries, 1997). More recently, over a 7 month period in 1996, gums valued at US$ 20-23 million were exported from Bari and Sanaag regions (Stockton, 1996).

Strengths

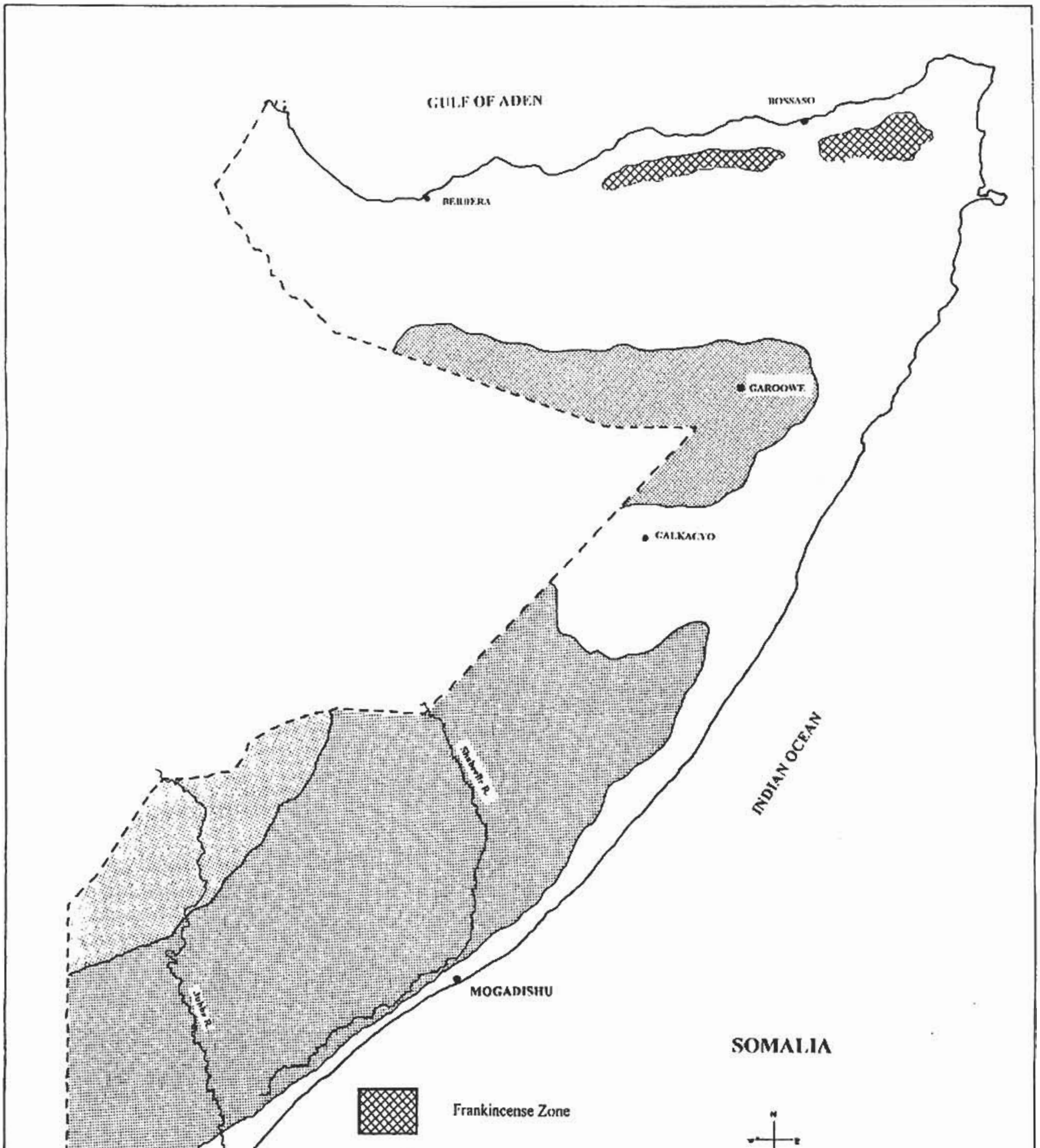
Uniquely amongst wild plant resources in Somalia, wild *Boswellia* trees are privately owned and highly valued. *Commiphora* species are widespread throughout Somalia and the collection of gums is an important source of income for pastoralists. Women grade the gums and resins before they are exported. Furthermore, if done correctly, gum collection, is a non-destructive use of the rangeland vegetation resource.

Weakness

In Bari and Sanaag regions the production system is characterised by poor:

(a) working conditions;
(b) transport infrastructure linking collection areas to villages;
(c) processing and storage conditions; and,
(d) marketing organisation and infrastructure.

Figure 17: Tree gum and resin production areas (approximation) (Janzen, 1988; Baumann, 1993)



For instance, those who collect gums and resins are primarily impoverished pastoralists who often must take out loans to support themselves while in the field. Steep slopes and lack of water make collection activities both difficult and dangerous. Since the recent influx of people into the area during the war rental fields have become in greater demand and are, therefore, now scarce. The gums and resins are poorly graded resulting in low quality products being exported. Frankincense sometimes melts in high temperatures during storage and transport. Collectors, traders and exporters are poorly organised and the latter have inadequate sources of information regarding existing prices, supply and demand (Janssen & Harries, 1997).

The present market for *Commiphora* and *Boswellia* tree gums may presently be saturated although Awale and Odowa (1997) flatly state that the overseas demand for Frankincense presently exceeds supply. Throughout Somalia poor tree tapping practices aimed at short term profits can over utilise trees in easily accessible areas (Janzen, 1988).

The extension of gum collecting activities away from the traditional exploitation areas in the north necessarily involves much preparation, such as in the identification of the correct tree species. location of stands of trees, testing the quality of the gum, training pastoralists in the proper collection methods and developing a marketing system (Laird and Potterton, 1997).

Threats
Overgrazing may threaten the regeneration of wild trees although this was not noted as a major constraint by Janssen and Harries (1997).

Opportunities
Investigate the potential for expanding tree gum collection into other areas of Somalia. In those areas outside Somaliland where some collection is already carried out to some extent, investigate the potential for improving collection and marketing procedures. Also look into the opportunities for artificial propagation and plantation cropping. Another possibility is to integrate tree gum cultivation into the fallow cycle of rainfed cropping as is done in the Sudan. Mahony (1990) recommends that *Commiphora myrrha* be widely planted as a live fence. Investigate collection of other types of tree gums, such as gum Arabic (from *Acacia senegal*) and sweet gums from other trees.

In Bari and Sanaag regions there is a need to improve the working conditions of the collectors by providing water within the collection areas and making credit more available. Roads need to be built into the collection areas. Improvements are needed in the processing (grading, certification, packaging), storage and transport of the gums in order to be able to export higher quality materials. Marketing can be improved through better: (a) organisation of producers and traders, (b) information on existing prices, supply and demand and (c) by better access to European markets (Janssen & Harries, 1997). Better processing and marketing may lead to greater sales. At present Somalia produces less than 2% of the world's marketed tree gum (Laird & Potterton, 1997). There may also be a need in this area to investigate the feasibility of artificial propagation and improvement of collection techniques. However, *Boswellia* is apparently difficult to grow in nurseries and transplant (Forbes, pers. comm.).

4.5 Honey production

Features

Honey is produced in Somalia primarily by two races of the honey bee (*Apis mellifera*): *Apis m. scutella*, the African honey bee, which occurs between 500 and 2400 meters elevation; and, *Apis m. yemenitica*, a drought-resistant lowland bee (Fichtl & Adi, 1994). Rural Somalis obtain honey by hunting, bee-having and bee keeping (Carroll, 1997). In bee-having, swarms are attracted to pots, boxes or hollow log hives, but further management is impossible whereas in bee keeping, hives with moveable frames allow husbandry of the colony and honey combs.

Bee having, in traditional hollow log hives, is important in riverine areas of the south (Douthwaite, 1985). For instance, in 1984, approximately 1,800 bee keepers owned about 45,500 hives along the Shabeelle and 1,400 bee keepers owned 38,500 hives along the Jubba south of Barecre. Over 90% of the hives were lodged in areas of riverine forest. The conservation of this habitat - and it's rich flora - is seen as essential to support the rehabilitation of this production sector.

Honey production by gathering wild honey is also important in the Golis Mountains of "Somaliland" and, in recent years, bee having in hollow log hives has developed on a small scale at Sheikh. Honey production is a very minor activity at present in central Somalia (Laird & Potterton, 1997). The honey is exported to Arabia and urban centres and is also used locally for medicinal purposes. Use of traditional hollow log hives limits both quality and quantity of honey produced. Bee keeping, using Kenya top bar hives, was restricted to a Government farm at Afgooye in 1983. Although no current data is available on quantities produced, current production does not meet demand as import honey from the USA is found for sale in Mogadishu (Laird & Potterton, 1997).

Strengths

Honey production is a non-destructive use of forest and rangeland resources. It is produced for food and medicinal purposes rather than for brewing and is of high quality. In the south, significant quantities were marketed locally or sold to traders for sale in urban centres or for export to Arabia. Honey production was a significant source of income in some of the villages along the Shabeelle and Jubba rivers. Carroll (1997) recommends development of bee keeping at Sheikh to generate income and give added value to trees threatened by charcoal production. Traditional bee-keeping is actually a very efficient undertaking as little or no monetary investment produces sufficient yields of honey. Harvest is increased simply by adding more hives (Fichtl & Adi, 1994). This statement refers specifically to Ethiopia but is probably also largely applicable to parts of Somalia.

Weakness

Techniques for honey collection by hunting and bee-having are inefficient and often are one-off activities since bees leave (abscond) the hive after honey collection. Honey hunting also involves use of fire and smoke to render the bees docile and enable honey collection; at times this leads to the whole tree burning down and, in a worst case scenario, to wild bush fires.

Threats
In southern Somalia, the loss of the rich flora of riverine forest will strongly limit honey production in that area (Douthwaite, 1985). The removal of large areas of trees in rangeland areas, such as *Acacia* spp. for charcoal production, and for shifting cultivation, will reduce honey production in many areas.

Opportunities
Expand honey production into other areas of Somalia which have the proper combination of rainfall, temperature, tree species and market. One such area may be Ceel Dhere and Adale districts Northeast of Mogadishu (Laird & Potterton, 1997). Another area recommended by Carroll (1997) is Sheikh District in "Somaliland". There is need to ensure the provision of sufficient nectar and pollen sources (proper plant species) such as by protecting remnants of riverine forest, and provide Somalis involved in honey production with a better knowledge of the practical implications of pollination and environmental protection (Fichtl & Adi, 1994).

Improved bee-keeping skills, especially with regard to more efficient use of bees wax and propolis, and introduction of low-cost frame hives are required. Propolis is a high value brownish, waxy substance collected from the buds of certain trees by bees to cement and caulk their hives. Integrate honey production into agroforestry activities by using tree and shrub species valuable for honey production as live hedges, shade trees, windbreaks etc. Mahony (1990) provides a list of 7 native trees, 10 foreign trees and 2 foreign fruit trees grown in Somalia that are valuable in honey production and which also have other uses (Appendix 6). Fichtl & Adi (1994) have documented a large number of trees, shrubs and herbs that are used for honey production in Ethiopia. Many of these species also grow in Somalia.

4.6 Traditional plant uses

Features
Most, if not all, rangeland and forest plants are noted by the local people as having some kind of value, such as food and medicinals for humans and livestock or building material. Some plants have many uses as was shown with *Acacia bussei* in Section 4.3. Traditional uses of native plants have been reported by a number of authors. For instance, Elmi et al. (1983) and Elmi (1983) indicate 151 and "several hundred" native plant species respectively to have traditional medicinal values while Samuelsson, et al. (1991, 1992ab,1993) found 209 to be used for traditional medicine. However, for the most part, only 30-40 species are actually used by traditional healers (Marshall, in prep.).

Herlocker and Kuchar (1985) and Kuchar and Herlocker (1985) reported on the forage palatability ratings of 299 range plants in two districts in central Somalia; Mahony (1990) recorded traditional uses for 21 native Somali trees, and Deshmukh (1990) noted 196 uses of wild plants in
the Jubba Valley: 32 human food, 55 fodder, 40 building materials, 32 utensils, 24 medicine and 12 miscellaneous. Madany (1984,1987) categorised 40 woody plant species in Middle Jubba Region according to 15 different uses and found 20 different forest tree and shrub species to be used as quality building material. Native plants may also be used as indicators. For example,

agropastoralists in central Somalia use the relative size/age and abundance of certain tree and shrub species , such as *Acacia nilotica. A. horrida. A. reficiens. Dichrostachys* sp. and *Solanum incanum.* to decide when to re-cultivate old fallowed fields (Holt. 1985).

An example of an important multi-use (non-medicinal) rangeland plant species that happens to be relatively well known to resource scientists and managers is *Cordeauxia edulis* (Yehib nut). which provides a much sought - after edible nut for humans and forage for browsing livestock. It is also a good fuelwood and a purplish dye can also be made from the plant (Mahony. 1990). This species is of such importance to local pastoralists that the local land unit. in which it primarily occurs has been named for it. This is the *lid deegaan* (Barkhadle. 1993) which extends in a wide band southward parallel to. and just east of. the Shabeelle River (Fig.8).

Strengths

The rangelands and forests of Somalia contain. in the diversity of their plant species, a resource that provides a multiplicity of uses to the local people. And. of course. they are also the primary support for the country's livestock and wildlife as well as of the production of honey, tree gums and resins, and wood products. Native plants seem to be particularly important to the local people for their medicinal uses. As most of Somalia's population is rural and poor and modern medical services are often not available, especially since the civil war, traditional medicine is the only type to be available to most Somalis. From 80-90% of all rural Somalis use traditional healers and many people medicate themselves (Elmi, 1983; Yusuf, et al., 1983; Marshall, in prep.). Use of native plants for such purposes as medicine, human food, local building materials, dyes etc., while quantitatively small, are often qualitatively important (Deshmukh, 1990).

Weakness

Much information needs to be collected yet on native plant species and the uses to which they can be put and, if found to be commercially valuable, how best they can be grown. Over exploitation and degradation of rangelands and forests (overgrazing, charcoal production etc.) may adversely affect plant species which have important traditional uses. This has occurred with *Cordeauxia edulis* due to heavy over browsing. *Cordeauxia* is listed as endangered under the IUCN Plant Red Data Book (Kuchar, 1985, pers. comm., Mahony 1990, Marshall, in prep). Loss of species with medicinal value could be seriously detrimental to the health of local people. Reduction in plants bearing wild fruit could adversely affect the dietary balance of local farmers and pastoralists (Deshmukh, 1990). Over exploitation of certain valuable medicinal plants near major population centres is a possibility. However, Somalis usually take great care not to harm medicinal plants and, at least in some areas of the country, there seems to be no evidence of decreasing stocks in medicinal plants (Marshall, in prep.).

Threats

Indigenous plant species may be strongly affected by rangeland degradation, loss of habitat through overgrazing, over harvesting, and conversion of rangeland and forest to agriculture or by destructive exploitation for other uses.

Opportunities

Investigate, through local pastoralists, the occurrence and ecological and economic status of potentially useable "traditional use" plant species. Where feasible, integrate these species into agro-pastoral systems. Determine if the products of the more valuable species can be marketed, thereby bringing in cash income. Investigate the actual status of the Yehib nut (*Cordeauxia edulis*) with regard to whether the rangeland it dominates is ecologically degraded. In general, manage rangelands so that they do not degrade and, thereby, lose biodiversity.

The value of indigenous plant species is highly recognised by Somalis. Consequently, their conservation and management for sustained use has been made a priority by some regional administrations (Odowa & Awale, 1997).

4.7 Wildlife

Features

Traditionally, use of the wildlife resource has been mostly a subsistence activity (Sale, 1989) although relatively few people fully depend on it (Deshmukh, 1990). Some animals, such as porcupine (*Hystrix cristata*), striped hyaena and spotted hyaena (*Hyaena hyaena* and *Crocuta crocuta*), ostrich (*Struthio camelus*) and bustard (Otididae) are still widely used in traditional medicine (Marshall, in prep.). Hunting for sport was allowed under the Italian trusteeship (Simonetta & Simonetta, 1983). However, guns (and poison) were also used to control predators. At least a decade ago predators (lion, hyena) had been so successfully eradicated from some parts of central Somalia that pastoralists could let their livestock range freely without herders. Poaching of the more economically valuable species, such as elephant and rhino, increased in importance during the last few decades. Subsequently, the abundance of guns during the recent troubles within Somalia resulted in large numbers of wildlife being killed, often simply for target practice rather than economic gain or subsistence (Ayan, 1994).

Strengths

A small portion of the population subsist on hunting. The Somalis are generally tolerant of wildlife. In some areas of the country, where peace and reconciliation have emerged, populations of some wildlife species are slowly beginning to increase. An example is populations of gazelles in Sanaag Region (Ayan, 1994).

Under proper management certain wildlife species (through sports hunting, cropping and tourism) can probably generate significant income on a sustainable basis.

An international willingness to pay for biodiversity conservation provides hope for future support of wildlife conservation and management activities in Somalia. For instance, Birdlife International is presently identifying Important Bird Areas (IBA's). The 26 IBA's identified so far for Somalia contain populations of all threatened and restricted - range species, 95% of all Somali-Masai biome species and all East Coast biome species known to occur in Somalia. Several of the threatened species are not only endemic to Somalia but are only known to occur at single sites, emphasising the need to work with rural communities to ensure their protection.

Weakness

There is a profound lack of national awareness of the wealth (and practical implications of) the biodiversity found within Somalia - and of it's international importance. Continued hunting and the loss and/or degradation in quality of important habitats threatens the survival of certain species, especially (most probably) the more restricted endemics. A lack of opportunities for tourism provides no obvious excuse to local Somalis to support wildlife conservation. In any case, with the possible exception of the work being done by Birdlife International (see above), very little information exists on the present status of biodiversity in general and wildlife specifically within Somalia so it is difficult to determine priorities and develop practical approaches to conservation and management.

Threats
Continued hunting, the degradation of important habitats or their conversion to other uses are the greatest threats to the wildlife within Somalia. Because some of the endemic species, such as the Beira (*Dorcatragus megalotis*)and Pelzeln's gazelle (*Gazella pelzelni*), have extremely restricted habitats, they are disproportionately affected by these factors.

Opportunities
Involve local and international conservation groups, who have both interest, enthusiasm and funds, in local level conservation-oriented activities. It may be possible, on a limited basis and over the long term, to involve local communities in cash earning efforts, such as eco-tourism (coastal areas, special endemic species, birdwatching tours etc.). However, Deshmukh (1990) feels that the opportunities (in the Jubba River valley) for self-financing wildlife management activities through tourism are minimal. Financial support from donors is essential. He recommends emphasising the biodiversity and national heritage aspects of wildlife in general and specifically concentrating on two types of habitat that are very limited in area: the swamps of the lower Shabeelle River and the few small remaining blocks of riverine forest on the Jubba River. Another possibility is the cropping of crocodile for the sale of skins.

Marshall (in prep.) recommends that top priority be given to the conservation of ostrich and bustards which are known to be diminishing in numbers, at least in parts of Somaliland.

4.8 Freshwater fisheries

Features
Fish are the main source of animal protein for many non stock-owning residents of the riverine zone (Douthwaite, 1985). Fishing is mainly a subsistence activity, with the surplus given away or sold. Three or four species predominate in catches. The catfish *Clarias gariepinus* is preferred on the Shabeelle, and, perhaps on the Jubba too, not only for it's size but for it's reputed prophylactic and therapeutic properties against malaria. It is also said to be used for inducing abortions (Funaioli & Roncati, 1964). On the Jubba, *Bagrus urostigma* and *Eutropius depressirostris*, are equally important for food.

Fish are caught by a variety of methods depending on the season and situation (Funaioli & Roncati, 1964). Fishing with hook and line is most widespread, but passive funnel-entrance basket traps, hand held basket traps, spears and poisons are also used. At barrages, *Labeo niloticus* is caught with horizontally suspended fish nets as it attempts to leap the barrier.

In 1984, the most important commercial operation involved a cooperative of about 75 fishermen based at the Cabdicali and Arbowoheerow barrages on the lower Shabeelle. The potential of the Xawaadley dam and the Jubba River for commercial fishing was also under investigation.

Fish stocks are threatened by dams and flood control structures used for irrigated agriculture which restrict up-river breeding movements. The release of "slugs" of stagnant water from the Xwaddley reservoir at the end of the dry season killed large numbers of fish downstream.

Strengths
This is an existing and, at least potentially productive, system near heavy settlement which provides, at least in the long term, a potential market. Presently, it provides subsistence to people would otherwise be forced into the use of some other natural resource, such as dry season farming in marginal areas or charcoal production.

Weakness
Fish stocks are sensitive to obstructions in the river (barrages) variations in river flow and water quality that result from other types of land uses. The main constraint on this production system is that few non-Bantu Somalis like fish. As a result, the local market is limited.

Threats
Rehabilitation of irrigation barrages and other irrigation infrastructure possess the risk of reducing the regeneration of fish stocks. Uncontrolled rehabilitation of the freshwater fishery can also lead to over harvesting of fish stocks.

Opportunities
Fresh water fisheries offers the potential for providing a source of income to Somalis, in particular those who do not have access to land or livestock resources. There also might be the possibility to raise tilapia in some of the water courses, thereby diversifying the fishery and income possibilities.

4.9 Marine fisheries

Features
Within the Somalia Economic Exclusion Zone (EEZ) which extends 200 n.m. offshore, fishery resources are extremely large due to the "Great Whirl" found off the Horn. However, the predominant production systems supporting Somali livelihoods are terrestrial-based which partially explains why fish comprise only 0.5% of the average Somali's diet, as compared to 28% in Tanzania and 60% in Senegal (Elst, 1997). Thus, only 20% of the fish caught in Somalia's waters are eaten locally (McClanahan,1996).

In response to the effects of the droughts during the 1970's and 1980's, the Government of Somalia, with donor support, embarked on expanding capacity for fishery production and processing. Although the projected maximum potential Somali catch is estimated to be between 120,000 and 200.000 tons/yr (McClanahan, 1996; Elst, 1997;Stromme, 1997), the actual catch was nonetheless only 25,000 tons/yr prior to the beginning of the civil war in 1991(McClanahan. 1996).

The Somali fishery sector falls in three categories: artisanal, industrial near-shore, and industrial off-shore. Each category has different targeted species, markets and stakeholders.

4.9.1 Artisanal fisheries

Features

Artisanal fishing uses fishing gear and boats which are traditional and/or require a relatively low investment. Artisanal fisherman usually stay within 2-3 km off shore in order to keep fish from spoiling before they get to market. However boats may go further out when catching fish, such as shark and mullet, which are salted and dried before use. The artisanal fishery infrastructure was severely damaged during the civil war, ice production and fish processing centres destroyed and boats vandalised; and fishing gear is now in short supply.

However, the fishing effort is resuming (Elst, 1997) and post war catches have often been very high due to the respite given to fish populations by the civil war (McClanahan, 1997). Presently, there are 50 fishing centres along the coast used by approximately 4,800 Somali fishermen. The greater number of fishermen are in Bari Region and on the south coast where there is better infrastructure (Lovatelli, 1996). Estimated artisanal catch was approximately 14,850 tons in 1993 (Lovatelli, 1996).

Inshore fisheries are frequently more productive due to shallow waters and high nutrient content supporting large demersal populations. The narrow continental shelf allows pelagic fish to come closer to shore so that artisanal fishermen can catch smaller tuna, larger mackerel, waho and billfish (Elst, 1997). Traditional, artisanal fishing was carried out to supply immediate and export markets but the civil war and loss of processing facilities significantly reduced the local market and ability to access the export market. Currently the artisanal sector targets two high value species: sharks and lobsters.

Sharks are fished primarily for their fins which fetch high prices (range between US$ 25 -40 per kilo), and require only sun drying and are easily stored. Shark fins are exported via Gulf states to the Far East for the production of shark fin soup. This fishery, which is present along the entire coast (but especially on the north coast and in the far south), takes hammerhead (Sphyrnidae), grey (Carcharhinidae) and mako (Lamnidae) sharks from water over 20 meters deep with long lines and nets (Salm, pers. comm.). The commercial catch of shark was from 1320-1980 tonnes/year (Campbell & Abdirahman, 1990).

The other major artisanal fishery is for spiny lobster (*Panulirus* spp.). The main area of this fishery is along the Indian Ocean coastline from Bari District down to Mudug District. Lobsters are caught by divers, traps, and nets (Stromme, 1987). The investments in small refrigerated trucks, boats and gear needed to run this booming industry have probably been made possible by the political stability of the area, a functioning seaport and airport (Bosasso) and high prices for lobster (Lovatelli, 1996). One hundred and forty tons were exported to the UAE in 1995 (Lovatelli, 1996).

Other types of catches reported for artisanal fisheries include by-catch of the green turtle (*Chelonia mydas*) and hawksbill turtle (*Eretmochelys imbricata*) of which high numbers are caught on both coasts. For instance, on the south-eastern coast each artisanal fisherman catches from 2-3 turtles per day (Stromme, 1987). Turtles are harvested for their meat shells, oil and penises. The meat and eggs (and sometimes oil) are consumed locally but the other products are exported (Campbell & Abdirahman, 1990; McClanahan, 1997) although international trade in turtle products is illegal under the CITES convention. Also caught by artisanal fishermen are tuna - those caught off the north coast are smoked to produce *haniid*, a product popular with nomads in the interior; crabs, shrimp and sea cucumbers (Laird & Potterton, 1997; McClanahan, 1997) and a large number of demersal fish, such as groupers, snappers, sea breams, grunts and scavengers (Stromme, 1987).

Strengths
The inshore marine fishery is extremely productive in demersal fishes, including species especially vulnerable to fishing such as grouper, which were found in large numbers in the Gulf of Aden (fish sizes are also large). This indicates low levels of fishing. Generally the level of utilisation along the coastline is far below the potential sustainable capacity for these waters (Lovatelli, 1996; Elst, 1997; McClanahan, 1997).

The monsoon weather pattern which results in heavy winds and rough seas for six months of the year provides a natural "Closed" fishing season and supports the regeneration of lobster and demersal fisheries.

Weakness
Shark and spiny lobster populations have probably been overexploited, at least locally. However, there are no data to back up such judgements (Stromme, 1987; Lovatelli, 1996; Elst, 1997; McClanahan, 1997). Generally, there has been a lack of stock assessment and catch monitoring and mechanisms for preventing overfishing are missing. A lack of training, equipment and infrastructure are constraints on the development of the fishing industry (Elst, 1997; Lovatelli, 1996).

The sea bed has been damaged by trawlers, reducing it's suitability for lobsters. Overall, the narrow continental shelf, several areas within it with rocky or coral reef bottoms, limit the area suitable for trawling (Stromme, 1987). Unlicensed fishing by foreign boats may be a problem locally. Overfishing near-shore can impact on artisanal fisheries (Elst, 1997).

Sharks are fished mainly for their fins resulting in substantial wastage of other shark products. shark liver, meat, jaws and skins have economic value but due to a lack in processing and accessing markets they are often wasted.

Threats
The potential of the shrimp fishery may be damaged by destruction of mangrove forests, which are an important habitat of the shrimp. Loss of mangroves causes excessive erosion of soil within

the inter-tidal area and, because mangroves are efficient nutrient traps, may also negatively affect nearby coral reefs which do best under low nutrient conditions. Inter-tidal and shallow water organisms, as well as coral reefs, are also negatively affected by the silt loads caused by heavy inland erosion (Ruwa, 1996).

Uncontrolled expansion of fishery production and processing without application of the FAO Code of Conduct for precautionary fisheries could lead to continued over harvesting of sharks and lobsters, and possibly other targeted demersal fishes.

The use of fishing gear, in particular mono-filament and small mesh size nets, threatens indiscriminate exploitation of fishery stocks and by-catch of turtles, dolphins, and other threatened marine species.

Unconfirmed reports of toxic waste dumping in Somali waters indicate a possible other risk to artisanal fisheries.

Uncontrolled and unmanaged near-shore trawling can also negatively impact on the artisanal fisheries.

Opportunities

Overfishing might be reduced and the production and management of the lobster fishery improved through collaborative management of stocks by local communities linked to access to blast freezer and cold storage facilities and given marketing assistance. Communities would have to agree to regulate harvesting, kill males only, in traps, outside of the breeding season, in exchange for access to freezer facilities and the high value export trade, where lobster would command values 3-4 times higher than currently obtained. Protection against over-utilisation of artisanal fisheries can be further approached through the establishment of fishing ground rights by local communities. Some fishing communities are already beginning to develop rules of access to inshore fisheries (Elst, 1997). Development of artisanal fisheries should, in any case, concentrate on strengthening activities begun by local fishing communities and traders (i.e., the lobster fishery and trade in dry and salted fish products) (Lovatelli, 1996). However, the cost of artisanal fisheries development activities should be primarily borne (or "self- internalised") by the local communities and traders in order to assure their long term success (Elst, 1997). Therefore, development should build from a modest base and create an awareness of the value of the resource (McClanahan, 1997).

The generally good ecological condition of Somalia's beaches, coastal islands and coral reefs could be taken advantage of to assist local communities to establish sustainable management programmes from which they will benefit. One possibility is to identify turtle nesting and feeding grounds and involve international conservation agencies in working with local communities to develop management programmes. The communities might benefit from the programmes by, for instance, harvesting turtles for local use. Or, they might, as suggested by McClanahan & Obura, (1996), manage an area for the production of ornamental fish for export. Another opportunity is provided by the Saardin Islands off Zeila near the Djibouti border which are associated with a diverse array of coral reefs and related sea and bird life . Management in this case might include some form of limited tourism including SCUBA diving and use of non-fishing zones. The latter assure visitors of something to see and also act as nurseries for juvenile fish that eventually move into the surrounding area to live.

A component of a community resource management program could, as mentioned above, include the protection of relatively small areas of coral reefs from fishing so that they may serve as breeding grounds for fish that are caught over larger areas of the reef. Or, it might involve the management of mangrove stands to produce a sustained yield. This is important not only because mangrove is a valuable wood product but also because mangrove stands play an important role in the maintenance of productive near-shore fisheries, including healthy coral reef ecosystems (Ruwa, 1996). The general approach to conservation and management of marine resources discussed above could benefit from cooperation with Kenyan marine resource managers in applying management regimes already proven successful in Kenya. Kenya has a great deal of experience in this regard because it has been fulfilling it's obligations under the Nairobi Convention to sustainably manage marine areas and species and address marine pollution (Salm, pers. comm).

Regarding fisheries assessment and monitoring, Stromme (1987) stresses the priority need for a systematic data gathering from fisheries activities in order to set rational harvest levels. Elst (1997) recommends a method of fisheries monitoring that can be carried out primarily with local fishermen and with relatively simple equipment. Also, a survey of the condition of inshore fish populations should be carried out as soon as possible in order to record their present "near pristine" state for use as a baseline for future surveys. Stock should be monitored both inside and outside of reefs because shallow areas within reefs are probably nurseries for juvenile fish which mostly inhabit the outer side of the reef (Stromme, 1987). Both the catch and underwater community structure of coral reefs should be monitored (McClanahan, 1997).

4.9.2 Industrial near-shore fisheries

Features

Open sea fisheries take demersal fish and crustaceans which feed on the sea floor and pelagic fish which exploit the water column and are driven by plankton productivity. Fishing for demersal fish occurs on the continental shelf, primarily by trawling.

Estimates of abundance of the various elements of the marine fisheries resource on the continental shelf are presented by Stromme (1987) based on the results of several fisheries surveys made since the mid-1960's. Conservative exploitation rates of 30%/yr (small pelagic fish) and 20%/yr (demersals) are expected to yield on the order of 75,000 tonnes of small pelagic and from 0.65-1.3 thousand tonnes (north coast) to 5-10 thousand tonnes (east coast) respectively per year of commercial demersal fish. Small pelagic fish, which are often associated with environmental regimes of high productivity (upwelling areas) can usually be harvested at a greater rate than demersal fish, which usually have longer life spans and lower growth rates.

Between 1980 and 1985, industrial near-shore trawlers hauled in from 4,000-12,000 tonnes of fish (type not stated but probably mostly demersals) and from 440-1,800 tonnes of deep-sea lobster from the continental shelf (Stromme, 1987). Small quantities of penaeid shrimp are caught by foreign trawlers off the mouth of the Jubba River. Catches vary with the flows of the River. Mangrove forests are an important habitat for these shrimp.

Lobster fishing is based on five species of spiny lobster (*Panulirus spp, Puerulus spp.*), which occur in both deep and shallow water and occur along the entire coast. The fishery is among the world's "Top Five" with a potential value of 30-40 million US$ per year. Catches are exported to Dubai where they are chemically "freshened" before export to the USA.

Currently, two separate near-shore trawling operations are now said to exist. One consists of a Kenyan/Italian/Somali consortium operating out of Mombasa and concentrating its operations on near-shore fishing grounds off the north-eastern coastline. The other operation, run by a Yemeni/Italian/Somali consortium operating out of Aden, also concentrates its operation on the near shore fishing ground off the north-eastern coastline.

Strengths

Inshore marine productivity is extremely high in demersal fishes, including species especially vulnerable to fishing such as grouper, which are found in large numbers in the Gulf of Aden (fish sizes are also large). The indicates low levels of fishing. Generally the level of utilisation along the coastline is far below the potential sustainable capacity for these waters (Lovatelli, 1996; Elst, 1997; McClanahan, 1997).

The monsoon weather pattern which results in heavy winds and rough seas for six months of the year provides a natural "Closed" fishing season and supports the regeneration of lobster and demersal fisheries.

Weakness

The industrial near-shore fishing activities are operating illegally according to the UN Law of the Seas although the private companies might have an agreement or license with regional Somali administrations. The incidence of capture of foreign registered trawlers indicates that Somali administrations have not always sanctioned near-shore fishery activities.

The sea bed has been damaged by trawlers, reducing it's suitability for lobsters. Overall, the narrow continental shelf and several areas within it with rocky or coral reef bottoms, limit the area suitable for trawling (Stromme, 1987). Unlicensed fishing by foreign boats may be a problem locally. Overfishing near-shore can impact on artisanal fisheries (Elst, 1997).

Threats

Uncontrolled expansion of fishery production and processing without application of the FAO Code of Conduct for precautionary fisheries could lead to continued over harvesting of demersals and targeted crustaceans.

Unconfirmed reports of toxic waste dumping in Somali waters also indicate a possible further risk to artisanal fisheries.

Opportunities
The increased capacity of regional administrations to develop and implement fishery policies and regulations offer an opportunity for management of near-shore industrial fishery activities. Formal licenses and permits can in the foreseeable future be issued by the regional authorities and their observers placed on the trawlers for purposes of monitoring.

International interest in the Somali fishery sector towards sustainable use (i.e. application of the FAO Code of Conduct for precautionary approach to fishery development) and equity in distribution of benefits can provide the catalyst for undertaking a stock assessment of the Somali near-shore fisheries and development of sustainable management systems.

4.9.3 Industrial offshore fisheries

Features
Industrial offshore fisheries within the 200 n.m. EEZ is seasonal (4-6 month of the year) reflecting the migration of the large tuna schools within the Western Indian Ocean. Two tuna fisheries operate: longliners for deepwater species, such as yellow fin and big-eye tuna, which are caught 200-300 feet down and frozen for the Japanese market (7,000 -8,000 tons in 1996), and purseiners for skipjack and shallow water species (21,000 tons in 1996). The latter fish, which are canned, are of substantially less value than deepwater species. Tuna fishing fleets are owned and operated by various European and non-European companies.

Foreign vessels are currently licensed by the Africa and Middle East Trading Co. (AFMET), a Somali company which is registered in the U.K. Tuna catch is off-loaded in Seychelles and Mauritius. Catches from licensed vessels are reported to the Indo-Pacific Tuna Programme (IPTP), based in Sri Lanka, which monitors stocks on behalf of the FAO and member states. Skipjack tuna stocks fluctuate widely and the population is thought to be limited more by environmental conditions than by fishing. Management of tuna stocks is a world-wide issue. The IPTP is eventually to become the Indo-Pacific Tuna Commission, based in the Seychelles.

Strengths
The Somalia offshore pelagic fishery resources are extremely productive. However, the current lack of a central authority makes industrial fishery a risky activity (threat of kidnapping, etc.) thus creating a disincentive for industrial fishing companies.

Weakness
According to the UN Law of the Seas, exploitation of fishery resources within the Somali EEZ by foreign fishing fleets is illegal. The stocks of yellow fin and big eye tuna are under heavy fishing pressure and the western Indian Ocean stock may now be declining. Somalia is prevented from playing a major role in the management of tuna stocks because it lacks a national government.

Threats
The lack of data gathering on tuna catch within Somali waters prevents effective monitoring of the Western Indian Ocean tuna catch and an effective understanding the tuna dynamics. This could have an impact on the already reportedly declining tuna populations.

The industrial off-shore fisheries also have substantial by-catch of sharks and swordfish. This by-catch is unreported and therefore its effect on these populations is unknown.

Opportunities
International interest in the Somali fishery sector regarding sustainable use (i.e. application of the FAO Code of Conduct for precautionary approach to fishery development) and equity in distribution of benefits can provide the catalyst for undertaking a stock assessment of the Somali near-shore fisheries and development of sustainable management systems.

The Indo-Pacific Tuna Commission could work with AMFET and its agents in order to have observers placed on the industrial fishing vessels for purposes of monitoring catch and by-catch. This would assist in increasing understanding of the tuna fisheries in the Western Indian Ocean and the formulation and application of sustainable management systems..

Somalia could be represented by another agency, such as the EC or UN, on the IPTP to enable it's input with regard to the ocean-wide management of tuna stocks.

5. NATURAL RESOURCE MANAGEMENT ISSUES AND PRIORITIES

5.1 Background

Although the status of Somalia's natural resources and dependant production systems is not uniformly dreary and pessimistic, resource degradation and it's impact on the ability of the human population to maintain an adequate subsistence, is still a very prominent feature. Rangeland and forest ecosystems are experiencing widespread and significant losses of biodiversity and productivity. Marine ecosystems may be experiencing local deterioration. Terrestrial systems, but especially agriculture, are encountering problems with soil erosion and losses in soil fertility. Agricultural land in some areas is exposed to the threat of salinization.

Some of the more vivid examples of resource degradation presented in Section four of this report are: rangeland degradation, including soil erosion (especially on steep mountainous slopes in Somaliland); over exploitation of *Juniperus* and mangrove forests and of *Acacia bussei*, the principal tree species used for charcoal production; loss of riverine forests to agriculture; widespread reduction in numbers of wildlife and the probable over exploitation of spiny lobster populations along the north-eastern coast. Resource degradation is contributing to a decrease in sustainability of the dependant production systems : livestock production, fisheries, agriculture, wildlife, honey and tree gum production etc. and to the further impoverishment of pastoralists, farmers and fishermen who already live at the subsistence level.

However, resource degradation reflects (or is a symptom of) other, more far reaching influences. These are not, initially at least, as evident to the development planner as, say, erosion gullies in farmland, the loss of elephant populations to poaching or a sudden increase in fenced enclosures within valuable rangeland areas. Nonetheless, they are ultimately more important because they are the causes of resource degradation and, therefore, ultimately, of the unsustainability of Somalia's production systems. A highly simplified view of the relationship between rangeland degradation and it's causal factors is shown in Fig. 18.

5.2 Conservation and natural resource management issues

Section Four (Production Systems) identifies a number of major factors that drive natural resource degradation and influence the sustainability of production systems. They are presented here as "conservation and natural resource management issues" (Table 5).

Figure 18. A simplified view of rangeland degradation and its causal factors

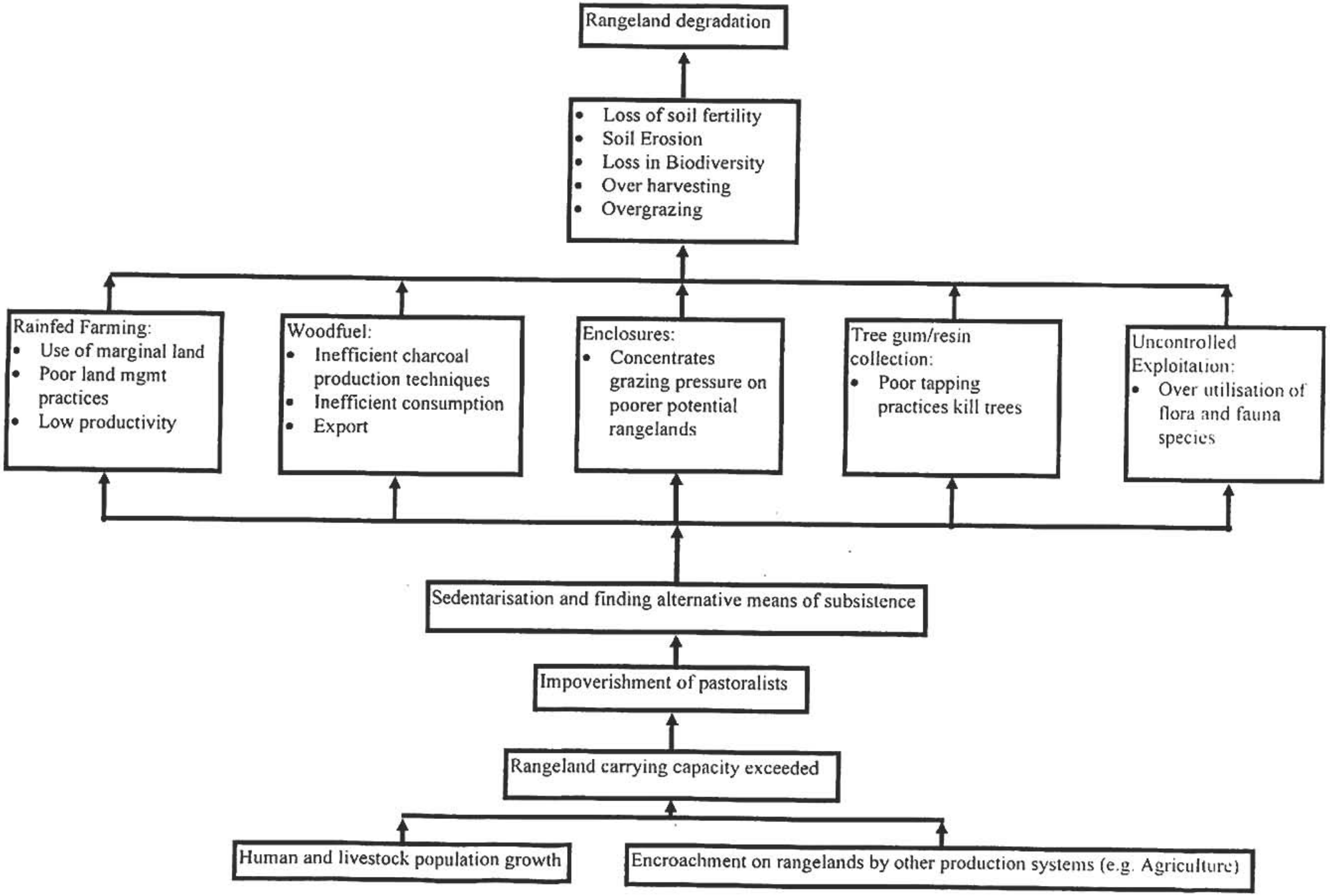


Table 5. Principal conservation and natural resource management issues arising from a review of Section four on production systems.

• Unplanned expansion and use of water supplies in rangeland areas.
• Poor (on-site) farming practices.
• Unsustainable exploitation of land resources for rainfed farming in agriculturally marginal areas.
• Loss of riverine forests and woodlands.
• Loss of better rangeland areas to cropping,(especially rainfed cropping) and closures.
• Poor pastoralists forced into ecologically unsustainable and economically marginal pursuits.
• Poor and/or improveable irrigation infrastructure.
• Poor and/or improveable processing and marketing of natural resource products.
• Unmanaged exploitation of targeted resources.
• Uncoordinated use of river water by different production systems within the major river valleys.
• Unregulated flow of river water affects downstream production systems.
• Insufficient knowledge for effective planning.
• Unmanaged exploitation of targeted marine resources.
• Non-representation of Somalia's interests on international marine/fisheries regulatory bodies.
• Dependence of urban and rural Somalis on a single energy source: wood (charcoal and fuelwood).
• Lack of awareness on the part of the farmer / pastoralist regarding the value of wildlife (both terrestrial and marine) resources.

The relevance to rehabilitation and development planners of each of these issues is explained below:

Unplanned expansion and use of water supplies: This has to do with the impact of water development on natural resources - especially rangelands. It applies to all types of water development. Too often, unplanned expansion and use of water supplies results in overgrazing, inappropriate agricultural cropping, rangeland degradation (including soil erosion) and a lowering of forage and livestock productivity. A good example is in West Galbeed Region in "Somaliland" where there is proliferation of *berkads* which store rainwater, and which are often filled by tanker trucks. These enable pastoralists and farmers to permanently occupy and utilise rangeland that otherwise would have been rested from use during at least part of the year because of lack of water. The result has been overuse, which has caused rangeland degradation.

Poor (on-site) farming practices: This applies to all agricultural cropping systems. Poor farming practices lower agricultural productivity and encourage soil erosion and salinization. For instance, improper and inefficient useage of irrigation water in Middle Shabeelle Region, through use of river water when it is salty, inadequate flushing/draining of irrigation water, poor maintenance or destruction of infrastructure etc., lowers crop yields and supports salinization of the soils. Shortened fallow periods in rainfed cropping give insufficient time for soil fertility to recover, poor seed quality produces low yielding crops, poor soil preparation methods may induce soil erosion etc.

Unsustainable exploitation of land resources for rainfed farming in agriculturally marginal areas: Poor soils and low and highly unreliable rainfall (frequent droughts) constrain agricultural productivity in areas of marginal agricultural value, lead to rangeland degradation (including soil erosion) and, eventually, become ecologically unsustainable.

Loss of riverine forests and woodlands: This applies to riverine forest along the Shabeelle and Jubba rivers but especially the latter. Loss of riverine forests reduces biodiversity, in particular endangering endemic species, removes numerous uses to which the forest may be put (honey production and various wood products for instance), and, as well, removes the ability of the forest to stabilize riverbank erosion and moderate the effect of high river waters on nearby farms. Loss of woodlands in drier areas because of charcoal production, rainfed farming, and overgrazing undermines biodiversity through loss of habitat, and contributes to land degradation.

Loss of rangelands to cropping and enclosures: Riverine dry season grazing areas are being lost to irrigated and rainfed agriculture. Rainfed cropping and fenced enclosures are removing land in other important dry season grazing areas from use by livestock. Even where livestock are allowed to enter fallowed fields, the biodiversity and productivity of the latter are significantly reduced and the fields are easily overgrazed and degraded (causing soil erosion), further reducing livestock carrying capacity.

Impoverished pastoralists forced into ecologically dubious and economically marginal pursuits: Impoverished pastoralists must find other ways to survive, often more than one. Examples are rainfed farming (on marginal lands), cutting trees for charcoal production, poaching and enclosing land to grow forage crops etc., all of which remain marginal means of subsistence while contributing to further degradation of the rangeland environment.

Poor and/or improveable irrigation infrastructure: The recent war and subsequent lack of political unity has contributed to a breakdown in the infrastructure necessary to support irrigated agriculture. This is especially evident in Middle Shabeelle Region where broken, destroyed and otherwise non-functioning ditches, dikes, pumps, pipes, barrages etc. reduce the amount, quality of water used for irrigation and inhibit it's proper useage (as in timing of use, for instance).

Poor and/or improveable marketing of natural resource products: All production systems would benefit from either and/or improved processing and marketing of their products. This would make them more economic and, probably, sustainable. Some examples: Livestock hides are poorly processed and, therefore command low prices; significant numbers of Somali livestock shipped to Saudi Arabia are rejected because of poor condition and health; honey production in Somalia does not include propolis and bees wax, which could be marketed; the marketing of livestock and tree gums could be made more efficient by better organisation of traders, knowledge of present market conditions etc.

Unmanaged exploitation of targeted resources: This applies to all production systems and resources. More effective management practices, such as, for instance in agriculture, the use of soil and water conservation methods, dung for fertiliser and crop residues for fodder, improve productivity and sustainability of the production system and reduce it's effect on environmental degradation.

Uncoordinated use of river water by different production systems within the major river valleys: Eventually, if not now, the amount of water provided by the Shabeelle and Jubba rivers will probably not satisfy the total demand for water by all of the water users along these rivers. At that point, some system for equitable distribution will be necessary. At present, any coordination that exists is only at the local level.

Unregulated flow of river water affects downstream production systems: Unregulated river flow (floods, low periods) affect the nature of downstream production systems, such as freshwater fisheries, flood retreat cropping and riverine forest. For instance, a permanent reduction in downstream flow by dams interferes with the regeneration of certain forest tree species that require periodic inputs of relatively high water; reduced frequency of floods (caused by upstream dams) will seriously impact flood recession farming. On the other hand, periodic floods which are not checked and/or modified by physical structures, can play havoc with planted fields.

Insufficient knowledge for effective planning: Again, this applies to all resources and production systems for which development planning would be required. This usually need not be an insurmountable constraint. Considerable amounts of information, directly applicable to development planning, are obtainable through interaction with local communities of pastoralists, farmers and fishermen. Some examples of information that might be obtained in this way are; plant species of potential use in agroforestry measures, plant indicators of various attributes like soil salinity or rangeland degradation, land use practices best fitted to a certain area, valuable uses of certain plants etc.

Unmanaged exploitation of targeted marine resources: This issue primarily relates to the fact that certain areas of the coast (including beaches and reefs) are: (a) of particularly high ecological complexity (biodiversity); (b) important habitats for endangered species, such as sea turtles and the dugong; (c) of high potential productivity and (d) also relatively unspoiled. These areas present the potential for assisting local communities in managing (and benefiting from) shore and marine ecosystems / resources without having first to build up depleted populations and restore the original habitats.

Non-representation of Somalia's interests on international terrestrial and marine/fisheries regulatory bodies: Somalia's non-presence on this bodies means that it has little input in their deliberations on matters that may affect it's own resources, such as the management of Indian Ocean tuna populations which periodically move within Somalia's sphere of influence : the Exclusive Economic Zone.

Dependence of urban and rural Somalis on a single energy source: wood (charcoal and fuelwood): Over-exploitation of wood, but especially of the tree *Acacia bussei*, for both local and export markets, has resulted in degraded rangelands and wildlife habitat (loss of tree cover/increased soil erosion) and threatens Somalia with a deficit in available energy that is likely to occur when the final resources of trees are eventually finished.

Lack of awareness on the part of the farmer / pastoralist regarding the value of wildlife (both terrestrial and marine) resources: Although generally of widespread application with regard to important elements of a number of issues, this has particular relevance to local attitudes toward the value of wildlife, both terrestrial and marine.

5.2.1 Prioritising conservation and natural resource management issues.

There are too many issues in Table 5 for all of them to be addressed immediately. Some issues call for more urgent attention than others. Other issues, while extremely important, presently face important political and security constraints and can only be dealt with once these constraints have lessened. Thus, it is important to set priorities.

Determining priorities requires some form of criteria. Several types of criteria are used here to rank the various issues (Table 6). The criteria reflect different attributes of an issue that influence the need for, and potential success of, development and conservation efforts relevant to the issue. These are: (a) ecological sensitivity and potential of the resource and/or production system involved; (b) needs of the affected human population and how they perceive the immediacy of future benefits; (c) technical and social feasibility of the development / conservation effort.

The principal types of criteria are further subdivided, providing a relatively large number of different criteria with which to prioritise issues . This is an attempt to make the prioritisation process as objective as possible. However, ultimately and necessarily, the final ratings are subjective. They reflect individual and institutional biases. Furthermore, they are based on judgements and conclusions which are in turn based on often incomplete information. Nonetheless, they reflect what information is available from historical and contemporary documentation and the personal experiences of staff and consultants of the IUCN Somalia Natural Resources Management Programme.

Criteria reflecting ecological sensitivity and potential of the resource and/or production system and the needs of the human population have been given greater weight in the prioritisation process than those reflecting the perceptions of the human population and technical and social feasibility (Table 6). Thus, the achievement of "sustainability" and "potential" and the "meeting of needs" are assumed to be more important in development and conservation of Somalia's natural resources than the relative ease or difficulty or time involved in the development input. In fact, the former criteria are given double weight. Not all criteria could be applied to every issue. This was taken into account in the calculation of the final priority rating, examples of which are shown in Appendix 7.

Table 6. Criteria for use in prioritising conservation and natural resource management issues.

ECOLOGICAL SENSITIVITY	*Ratings: (High/many etc. = 1 and low/few = 5. These criteria are considered to be the most important for prioritising issues. Therefore, the final ratings are halved)*
Degree to which resource/production system is threatened (in terms of nearness of time) • Degree of existing degradation • Degree of sensitivity of resource to degradation • Ecological potential of resource • Relative level of biodiversity • Level of biological productivity • Degree of endemism characterising the resource (or threatened species) • Ecological regulatory / control functions of resource • Probable degree of response to development/conservation measures • Area affected / influenced by the resource	
NEEDS OF THE HUMAN POPULATION	*Ratings: (High/many etc. = 1 and low/few = 5. These criteria are considered to be the most important for prioritising issues. Therefore, the final ratings are halved)*
• Size / density of affected population • Degree of dependency on the resource (production system?)	
PERCEIVED IMMEDIACY OF BENEFITS (SHORT AND LONG TERM) BY THOSE WHO ARE AFFECTED	*(Same ratings as above but the final ratings are doubled)*
• Degree of recognition that problem exists by those affected • Perception of benefits	
TECHNICAL FEASIBILITY	*Ratings: (Low/few/little = 1 and high/many = 5. These criteria are considered to be less important for prioritising issues. Therefore, the final ratings are doubled. Criteria relate to the relative difficulty to be expected in addressing an issue)*
• Relative ecological complexity of the problem (for instance, causes) • Degree of technical sophistication required to address the problem (equipment, experts, costs, no. of related activities etc.)	

SOCIAL FEASIBILITY	*Ratings: (Low/few/little = 1 and high/many = 5. These criteria are considered to be less important for prioritising issues. Therefore, the final ratings are doubled. Criteria relate to the relative difficulty to be expected in addressing an issue)*

- Number of different social groups involved/affected (clans, families etc.)
- Number of different economic groups involved / affected (rich, middle, poor)
- Number of different user groups involved / affected (pastoralists, farmers, charcoal producers etc.)
- Degree of other vested interests (politicians, warlords etc.)
- Sensitivity to gender of the outcome
- Demonstrated commitment by affected group(s)

The outcome of the prioritising exercise, examples of which are shown in Appendix 7, is shown in Table 7 which presents the various conservation and natural resource management issues in order of importance. Those issues at the top of the list and with the highest ranking index are of the highest priority. Those at the bottom of the list have the lowest priority. Note that a few of the issues have been noted as long term issues which will either take considerable time to develop (awareness of the importance of wildlife) or must wait for existing political constraints to lessen before being addressed.

Table 7. Major conservation and natural resource management issues ranked by priority. Priority issues are at the top of the list and have a high ranking index. Low priority issues are at the bottom of the list.

ISSUE	PRIORITIES	
	SHORT TERM	LONG TERM
Dependence of rural and urban Somalis on a single energy source: wood (charcoal and fuelwood).	6.68	
Destruction/loss of riverine forest and woodlands	6.28	
Unsustainable exploitation of land resources for rainfed agriculture in agriculturally marginal areas	6.00	
Poor on-site farming management practices	5.76	
Unmanaged exploitation of targeted marine resources	5.48	
Unmanaged exploitation of targeted resources (all production systems)	5.38	
Loss of rangeland to other uses (rainfed farming and enclosure)	5.38	
Unplanned expansion and use of water supplies in rangeland areas	5.33	
Inadequate knowledge for effective planning	5.28	
Impoverished pastoralists forced into ecologically unsustainable and economically marginal practices	5.18	
Poor/improveable processing and marketing of natural resources	5.16	
Poor/improveable irrigation infrastructure	5.12	X
Uncoordinated use of river water	5.10	X
Unregulated river flow affects downstream production systems	4.95	X
Lack of representation of Somalia's interests in international regulatory bodies concerned with fisheries	4.72	
Lack of awareness regarding value of wildlife (both terrestrial and marine) resources	4.48	X

5.2.2 Priority geographical locations for addressing issues

Geographical areas within Somalia that are relevant to specific types of natural resource management have been approximated by FEWS/Somalia (1997) (Fig. 11). Generally, criteria such as ecological potential (including biodiversity) and sensitivity and human needs, which would be useful in prioritising geographical areas for future natural resource management interventions, have already been used to prioritise environmental themes.

The choice of a geographical area to implement a natural resource management intervention is also influenced by security. However, it is understood that the security situation will vary over time from place to place. At the time of writing the following regions in southern Somalia are considered to be closed to development activities because of poor security: Gedo, Middle Jubba, Lower Jubba, Bay and Bakqol. In addition, Sanaag Region in Somaliland, is presently a non-fully operational area.

Therefore, priority areas for addressing issues are based primarily on the degree to which an area is affected by a priority issue or issues. Information of this nature came from a review of the recent literature and from the personal experiences of the consultant and IUCN EARO staff. Only the high potential area of western Somaliland, i.e., the Hargeisa-Borama area of Awdal and Waqooyi Galbeed regions, might be said to be, in itself, a real priority geographical area because more issues apply to this area than any where else in Somalia.

The priority geographical areas are given below for each issue. To locate these areas on a map refer to Fig.11 (*deegaans*) and Fig. 8 (administrative regions and districts) as well as the figures noted below which depict the location and extent of some of the production systems.

Dependence of rural and urban Somalis on a single energy source : wood (charcoal and fuelwood (Fig. 16)

- Bay Region in southern Somalia
- Awdal, Togheer, Galbeed, Sanaag, Sool Regions in "Somaliland" and northern Somalia

Loss of riverine forests and woodlands (Figs. 15&16)

- Jubba and Shabeelle River Valleys (especially along the middle Jubba).
- Golis mountain range in Sanaag, Sheikh and Bari Regions

Unsustainable exploitation of land resources for rainfed agriculture in marginal areas

Widespread but especially applicable to:

- Cowpea belt
- Northwest Agro-pastoral Zone.
- Possibly, also Wamo Deegan (Lower Jubba Region) in southern Somalia, and Buraha and Dharror deegans in "Somaliland" and Bari Region, chosen because limited (and, therefore, probably rainfed), farming is said to occur in these areas (Barkhadle, 1993).

Poor on-site farming management practices

- *Irrigated agriculture* (Fig. 15)
- *Rainfed farming*:(a) Western Somaliland (Northern Agro-pastoral food economy zone); (b) Southern Somalia (Rainfed Sorghum - camel Belt and Rainfed Maize - cattle Belt.

Unmanaged exploitation of targeted marine resources (see Marine Fisheries above)

- Northwest coast/coral reefs/islands near Zeila
- Far south coast (Bajuni Islands area)
- Northeast coast (lobster fisheries)

Unmanaged exploitation of targeted resources (all production systems):

- *Agriculture*: Jubba and Shebeelle Valleys, Bay and Waqooyi Galbeed regions (Figs. 13 & 15)
- *Rainfed agriculture on marginal lands* Widespread but especially applicable to: Cowpea belt and Northwest Agro-pastoral Zone. Possibly, also Lower Jubba Region (southern Somalia) and the Buraha and Daror deegans in Somaliland (parts of Bari, Sanaag, Togdheer and Waqooyi Galbeed regions)
- *Livestock production:* Widespread (Figs. 12 & 13)
- *Fuelwood production:* Widespread but especially in Bay, Sanaag, Bari, Nugal, Awdal and Sool regions (Fig. 16)
- *Tree gums*: Bari, Sanaag, Bakool & Gedo (active collection); Togdheer, Galgadud & Hiraan regions and the rest of southern Somalia (some potential)(Fig. 17).
- *Honey production*: Jubba and Shabeelle valleys, riverine and *Juniperus* forests (Fig. 16) and also possibly elsewhere above 200 mm annual rainfall (Fig. 1).
- *Wildlife:* Widespread
- *Traditional plant uses*: Widespread
- *Freshwater fisheries*: Jubba and Shabeelle rivers.
- *Marine resources*: Entire coastal area but especially northwest coast (Zeila-Djibouti border) (Biotope "A", Fig. 7) and far south coast (Bajuni Islands area:) (Biotope "E", Fig. 7) for conservation and management of relatively unspoiled resources; the continental shelf area between Ras Mabber and Ras Surud for management of productive upwelling fisheries (Biotopes "B" & "C", Fig. 7) and the north-eastern coast for management of spiny lobster fisheries.

Loss of rangeland to other uses (rainfed cropping and enclosure) (Fig. 12)

- Especially in riverine areas, western Somaliland and the cowpea belt of central Somalia

Unplanned expansion and use of water supplies in rangeland areas

- Widespread within Muduq, Galgadud, Sanaag (especially in hilly areas) and Sool regions.
- Especially applicable to the Cowpea belt and northwest agro-pastoral zone

Inadequate knowledge base for effective planning

- Widespread but priority in areas where development activities are being planned.

Impoverished pastoralists forced into ecologically unsustainable and economically marginal practices/pursuits

- Widespread but concentrate on cowpea belt, northwest agro-pastoral zone and on the margins of the River Valley and southern Somalia Rainfed Sorghum -camels and rainfed maize - cattle zones and (for charcoal production), Sanaag, Bari, Nugal, Awdal and Sool regions.

Poor / improveable processing and marketing of natural resource products

- Geographically speaking, primarily the major cities, ports and fishing centres.

Poor / improveable irrigation infrastructure (Fig. 15)

- Shabeelle River Valley (Jowhar-Balad area)
- Also, oasis farming sites in the North

Uncoordinated use of river water

- Shabeelle and Jubba River Valleys (entire valleys)

Unregulated river flow affects downstream production systems

- Shabeelle and Jubba River valleys (especially the lower reaches)

Lack of representation of Somalia's interests in international regulatory bodies concerned with fisheries

- Heads of Somalia's different factions, EC Somalia Rehabilitation Programme, United Nations

Lack of awareness regarding the value of wildlife (both terrestrial and marine)

- Target areas of endemic and threatened species. Widespread but especially on the coastal plains of central Somalia, Ddaroor and Nugal valleys and, over the longer term, in southern Somalia.

6. CONCLUSIONS AND RECOMMENDATIONS

Several conservation and natural resource management issues deserve priority attention.

6.1 Dependence of Somalia on a single energy source: wood (fuelwood and charcoal)

This was rated a priority issue because of the ecological sensitivity of the basic resource and it's relatively high ecological potential, the large area covered by the resource and the large number of Somalis who are dependant on it and are, therefore strongly affected by loss of wood resources through over-cutting.

One way to moderate the problem of reduced and increasingly expensive supplies of charcoal is to improve the efficiency of charcoal production. This can be done through providing awareness of the problem and possibilities and in assisting in the introduction of more efficient techniques, several of which exist. The integration of fuelwood trees into agroforestry measures may alleviate the problem to some extent in local situations. More efficient use of charcoal and fuelwood is another possibility, such as the manufacturing of improved stoves *and* in ensuring that users know how to use them properly. Alternative sources of energy will reduce the need for use of charcoal, especially once they are competitive in price. Kerosene is one such alternative. Efforts should be made at the community level to manage rangelands areas for sustainable harvesting of wood / charcoal. Forests, because they are so small in area and ecologically important, require special attention.

This issue has widespread geographical application. However, improvement of the efficiency of charcoal production is best carried out within the major areas of production (Fig. 16). Awareness of the proper use of improved stoves should be fostered, the use of alternative sources of energy, such as kerosene should be further investigated.

6.2 Destruction of riverine forest and woodlands

Riverine forest (Fig. 16) is ecologically highly sensitive and has a high ecological potential. Biodiversity is high and it harbours within it's narrow boundaries a number of endemic and endangered species. Riverine forest provides a multitude of uses, including honey production, and, in addition, protects riverbanks from erosion and modifies the impact of flooding waters on nearby farms (Madgewick , 1989).

Perhaps the best way to ensure the conservation of riverine forest and the sustainability of it's the products and services is to assist the neighbouring groups of farmers in developing community-based management programmes (for their section of forest) from which they will benefit in terms of (a) sustainability of products and services supplied by the forest and (b) fees charged to users; just as in the case of marine resources (see above). In addition, it may be possible to replant degraded forests and to integrate some useful forest tree and shrub species into agroforestry measures on nearby farms. Improved methods of honey production. processing and marketing will also increase the value of the forest.

This is relevant to the entire length of both the Jubba and Shabeelle rivers but. primarily on the small area along the Jubba River where the few remaining stands of relatively undisturbed riverine forest occur (Fig. 16).

6.3 Unsustainable exploitation of land resources for rainfed farming on agriculturally marginal areas.

This is a priority issue because the ecological sensitivity of the basic resource, rangeland soils. the tenuous level of subsistence provided by this production system in marginal areas. the relative impoverishment of many rainfed farmers, and the decreasing productivity of rainfed farms and increasing impact on rangeland degradation caused by poor rainfed farming practices. It is driven primarily by the pressure of an increasing population of Somalis who can no longer make a living as pastoralists, as well as, more recently, the influx of people driven from the cities by civil war. Many rainfed farmers in agriculturally marginal areas are impoverished. forced to farm as well as carry out other activities, such as charcoal production, in order to survive. Often, rainfed farming itself is not enough to ensure survival (Laird & Potterton, 1997).

The major objective here is to improve sustainability of rainfed farming. This will, hopefully, reduce the encroachment of farms into those rangeland areas where they have no long term future but a great potential for causing rangeland degradation. This can be approached by such interventions as the improvement of soil fertility (use of animal dung for fertiliser. minimal cultivation); water availability (micro-catchments), improvement and diversification of crops, and agroforestry measures which encompass both cropped and fallowed fields. Improvement of the productivity and usefulness of fallowed fields (as with agroforestry measures) brings with it the question of tenure and access by pastoralists.

This is a widespread issue within Somalia, occurring all along the fringes of, and in small patches here and there within rangelands used by nomadic pastoralists (Fig. 13).

6.4 Poor on-site farming management practices

This issue was regarded as being of high priority because the basic resource agricultural land) is ecologically sensitive; agriculture in Somalia is potentially highly productive; affects a large population of Somalis - either directly as farmers or indirectly as users and is recognisably of value to most Somalis. There are also relatively few technical and social issues that might seriously constrain agricultural development activities.

Regardless of the type or location of farming, poor farming practices lower agricultural productivity and often encourage environmental degradation, such as soil erosion and salinization, which reduce productivity even further. Even when sustainable, certain farming practices may often be improved to bring about higher productivity while continuing sustainability. However, the relatively recent generalised breakdown of infrastructure, changes in *de facto* land tenure and movement back to rural areas of large numbers of city residents have undoubtedly significantly lowered the standard of agricultural practices in Somalia.

Upgrading of existing farming management practices may involve a number of interventions such as those dealing with the proper use of irrigation water (amount and freshness of water, timing of it's use, the degree of drainage) - relevant to the main river valleys; or diversification of crops, development of higher quality seed sources, control of soil erosion, introduction of agroforestry to integrate other products, such as wood products, honey and fodder, into the farming system, and use of manure for fertiliser.

One example of the need for better practices is in Middle Shabeelle Region where many farmers need to learn how to deal properly with irrigation water. This includes the negative effects on agricultural sustainability of use of salty river water during the rivers' low and early flood periods, the need for at least basic maintenance of bunds and irrigation and drainage ditches and the use of appropriate technology, such as siphons, to replace motorised pumps. Where plantation cropping has been given over to small holder cropping, crop diversification and agroforestry interventions might be profitable.

6.5 Unmanaged exploitation of targeted marine resources

The importance of this issue reflects the high biodiversity, ecological productivity and sensitivity to degradation of marine resources and the relatively high technical and social feasibility of implementing conservation and development activities. The in-shore marine environment (inter-tidal zone and close inshore continental shelf) of certain parts of the coastline combine particularly high ecological diversity and productivity with a (presently) relatively low level of exploitation (with the possible exception of the spiny lobster fishery on the north-eastern coast). This provides an opportunity to assist local fishing centres to develop, and benefit from, sustainable community-based management programmes for these areas.

For instance, the Aibat and Saard Din islands on the far western coast of Somaliland, near Djibouti, (Biotope "A", Fig. 7) have the potential for the development of an artisanal/ subsistence, multi-species coral reef fishery incorporating resource protection measures, monitoring of catch and underwater community structure, controlling use by outsiders and developing a capacity for SCUBA diving and eco-tourism. Resource control measures might include protected areas to ensure continuation of adequate breeding stocks, minimum size catch limits, protected species and gear restrictions backed by marine patrols. The local community responsible for planning and carrying out the management programme would derive their benefit from (a) sustainability of the resource and (b) revenues collected from resource users (McClanahan, 1997).

A similar opportunity exists on the far southern coast of Somalia from the Bajuni islands to Ras Chiamboni (see mangrove area, Biotope "E", Fig. 7) where there is a particularly diverse mixture of beach, coral reef, sea grass, island and mangrove habitats used by endangered species, such as sea turtles and dugong, as well as a relatively low level of use. In this area there is an opportunity to benefit, through cross-border cooperation, from the considerable experience of Kenyan marine resource conservation agencies and the close proximity of managed marine ecosystems just across the Kenya border (Salm, pers. comm.).

The same approach may be appropriate to support artisanal fishing for spiny lobster along the north coast from Bargal in Bari Region to Garaad in Muduq Region although the situation here is different. In this case a booming fishing industry is already underway. This involves a significant infrastructure of gear, boats and small refrigerated trucks; is facilitated by a functioning seaport and airport and is driven by high lobster prices (Lovatelli, 1996). It is important, for the sustainability of this fishery, and the support that it provides the local fishing communities, that the lobster population is not overexploited. These fishing centres should, therefore, be supported in the development of a community-based programme to ensure a sustainable supply of lobster stocks.

6.6 Unmanaged exploitation of target resources (all production systems)

This applies to all production systems. Improved methods are discussed separately below for farming in general and rainfed farming. Methods of improving the fuelwood production system were described above. Improved management of fallowed fields and the introduction of agroforestry measures into farming practices would increase biodiversity and improve sustainability of some rangeland and agricultural areas.

6.7 Loss of rangeland to other uses (farming and enclosure)

Riverine floodplains, which are a very important dry season source of water and forage for livestock, have now largely been taken up for irrigated and rainfed agriculture (Fig. 15).

Elsewhere, as the population of pastoralists, and the livestock on which they depend, increases, the ability of the rangeland to support them is increasingly exceeded. Subsequently, many pastoralists are forced into other means of survival, such as rainfed farming on marginal soils (the better soils having long been taken by somebody else) and enclosure of land for production of fodder crops. Farming practices are generally poor resulting in rangeland degradation, including soil erosion, especially on fallowed fields. Land is often also enclosed by traders for fodder production and sale (Fig. 12). Stockton & Chema, 1995; Laird & Potterton, 1997). The rangelands used for rainfed cropping and enclosure/fodder production are often marginal for agriculture but relatively high potential for rangeland (Stockton, 1996). Thus, the best rangeland, which is limited to begin with, is alienated for other uses, as well as often being degraded, forcing pastoralists to confine themselves to use of less productive, more ecologically sensitive rangelands. Many pastoralists fail and subsequently, become rainfed farmers, build more enclosures, and alienate and degrade yet more rangeland.

There is no one solution. Part of the approach towards an eventual solution could be to investigate the feasibility of providing groups of pastoralists with some form of legal land tenure as has been done in Kenya with Group Ranches. Enclosures for producing fodder for sale, as is being done in Somaliland at present, might then be incorporated into Group Ranch activities from which the Ranch as a whole receives cash profits. Enclosed rangeland often improves in productivity. Therefore, if large enough and properly managed, enclosures could be used both as sources of fodder for sale (grasses) and of dry season use by livestock, but especially by camels (Stockton, 1996).

Another part of the approach would be to improve the sustainability of existing farms in order to reduce the need for farmers to encroach further into rangeland areas. This approach is that described in: Ecological unsustainability of rainfed farming on agriculturally marginal areas.

Riverine farming communities might be encouraged to establish access points for use by pastoralists to water their livestock during the dry season. They would, of course, be more interested in doing so if they could adequately protect their fields from livestock with fencing and sell pastoralists fodder/stover and / or grazing.

6.8 Unplanned expansion and use of water supplies in rangeland areas.

Overgrazing, which is widespread throughout the rangelands of Somalia, is dependant upon the existence of water. This is especially true of stable, high volume, supplies of year round water. Usually, such supplies are provided by boreholes with motorised pumps but, increasingly, at least in the north, berkeds, filled with surface water runoff from rainfall, are also becoming focal points for rangeland degradation. Such water sources also support settlement, rainfed farming and other rangeland uses, such as charcoal production which may further cause rangeland degradation. Too often, these activities are also not sustainable because of the combination of low potential productivity of the land, (unreliable climate, poor soils).

Therefore, it is very important that development programmes carefully consider the ecological and, ultimately, socio-economic consequences of water development in rangeland areas. The ability of the surrounding rangeland to support the grazing, cutting and farming use facilitated by water development needs to be investigated before new water sources are provided or existing sources upgraded. If the land can not, ultimately, support the human population that uses the water then it is best to find other ways of assisting them. The rehabilitation of existing small volume wells and / or seasonally filled wars and berkeds may often be a more practical approach. And, even then, it would be well to first investigate the status of rangeland degradation in the area surrounding the water site. Degraded rangeland indicates that the existing use of the land is already unsustainable.

Widespread application throughout Somalia's rangeland areas (Figs. 12 & 13) but especially within Galgadud and Muduq regions in central Somalia and Sanaag (especially in hilly areas) and Sool regions in Somaliland.

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Appendix 1 : Terms of Reference

Consultancy to establish thematic and geographic priorities for undertaking natural resources management programmes in Somalia

INTRODUCTION

As part of the EC Rehabilitation Programme for Somalia. IUCN is undertaking a natural resources management Programme to assist the EU develop adequate and flexible strategies and methodologies for the conservation and sustainable use of the natural resources in Somalia. The first phase objectives of the Programme are:

- to establish a basis for the conservation of Somalia's natural resource assets from further deterioration
- to promote and consolidate the links between natural resource management and conservation, and the improvement in the welfare of the local communities of Somalia
- to provide guidance and advice to the EC Rehabilitation Programme for Somalia on natural resources and environmental matters.

The initial first phase, characterised as a strategic planning period, aims to address all the necessary programmatic and operational preparatory work to establish a sound basis for the implementation of field-based natural resource management activities *per se* or activities in support of, or benefiting from, other sectors of the EC Rehabilitation Programme for Somalia.

One of the stated outputs of the Programme is priorities for geographical and thematic environmental operations set for concrete actions on the ground. At this point in time the Programme has accumulated substantial information on Somalia and natural resources management issues as well as contacts with relevant institutions and professionals.

The need for a short-term consultancy has been identified to undertake the assimilation of this information, to develop criteria for prioritisation, and to coordinate/facilitate the input of relevant institutions and individuals.

OBJECTIVES

The objectives of the consultancy are:

- Identify and describe Somalia's terrestrial and marine ecosystems and biodiversity characteristics, including distribution, extent, status, uses, threats and opportunities using recognised and universally accepted classification systems.
- Establish criteria for prioritisation of conservation and natural resources management issues.
- Establish conservation and natural resources management priorities for action by theme and geographical locations.

TASKS

In order to attain the above-mentioned stated objectives, the consultant will undertake the following specific tasks:

- Review and analyse relevant literature housed within IUCN and other institutions in Nairobi, the U.K. and elsewhere, pertaining to past and current conservation and natural resources management issues and programmes in Somalia.
- Based on Review of bio-geographic, ecosystem, biodiversity, agro-ecological, climatic, administration and crop-based classification systems, among others, develop appropriate classification system for describing and assessing Somalia's natural resources characteristics, including biodiversity conservation issues (i.e. threatened/vulnerable species), uses and threats, and degradation problems.
- In collaboration with a GIS specialist, identify and apply appropriate mapping tools to present and/or elaborate ecological and biodiversity characteristics, criteria, and establish priorities.
- Based on review and analysis of literature, and in consultation with relevant institutional partners, elaborate criteria for establishing conservation and natural resources management priorities for action and their geographical location. Criteria should take into consideration accepted ecological methods for setting conservation priorities as well as social and economic dynamics.
- Organise and facilitate at least three workshops in Somalia (e.g. Hargeisa, Bosasso and Jowhar) in order to seek discussion and endorsement of proposed classification and criteria, and to collectively apply the agreed criteria in order to identify priorities. The workshops will bring together representatives of local "administrations", international and local institutions, and professionals.
- Present findings of the participatory process for establishing criteria and identified thematic and geographical priorities during a workshop in Nairobi bringing together representatives of international and Somali institutions.
- Work in close consultation and collaboration with the IUCN Somali Programme Coordinator, IUCN staff and EC Somalia Unit staff.

OUTPUTS

The main output of the consultancy will be a report that includes the following sections, among others:

- Executive summary and introduction
- Methods and approach of activity
- Concise description of classification system and main characteristics of each unit including main conservation and natural resources management issues
- Criteria established for guiding prioritisation process
- Result of applying criteria, priority issues and geographical locations
- Conclusion
- Annexes: Maps, workshop proceedings, TORs, itinerary, etc.

TIME-SCHEDULE

The consultancy will be undertaken as par the following schedule:

- 14 - 22 April: 7 person-days accessing and reviewing U.K. based literature
- 23 April: travel to Nairobi
- 24 - 29 April: 5 person days in Nairobi - consultations. review of documentation. elaboration of criteria and Somali mission preparation
- 30 April - 11 May: 11 person-days in Berbera/Hargeisa/Bosasso
- 12 May: 1 person-day in Nairobi
- 13 - 15 May: 3 person-days in Jowhar
- 16 - 23 May: 7 person-days in Nairobi to complete draft report and present in Nairobi workshop
- 23 May - 31 May: 5 person-days in UK to finalise report.

REQUIREMENTS

The Consultancy will be undertaken by a natural resources management specialists having specific expertise in ecology. He/she will be assisted by a GIS specialist contracted by IUCN and at least two national consultants recruited in Somalia to assist in the assessment exercise and also facilitate in-country workshops. GIS applications will be arranged by IUCN either within its premises or with other institutions in Nairobi.

Appendix 2 Schedule of Activities

14 - 29 April: 1997	Literature review based in UK and Nairobi, drafting of background information, consultations with Nairobi-based institutions by Robert Douthwaite
30 April - 11 May	Field visit to N.W. Somalia by Robert Douthwaite. Note: visit to N.E. was not possible due to last minute changes in ECHO schedule. Contracting of Mr. Odowa and Mr. Awale to prepare briefing paper for N.W. Somalia ("Somaliland")
12 May - 28 May	Consultations and drafting of report. Presentation of paper on production systems and natural resource dynamics by Robert Douthwaite during IUCN/EC Workshop on "Develop a Strategic Framework for Natural Resource Management and Dependent Production Systems under the 2nd Rehabilitation Programme for Somalia".
Late May	Submission of draft report by Robert Douthwaite
June	Review and editing of draft report by Alex Forbes, Programme Coordinator, and IUCN Eastern Africa Regional Office (EARO) technical staff.
21 - 22 July	IUCN Workshop on Priorities for Natural Resources Management and Dependent Production Systems in Hargeisa.
August/ September	Review and editing of draft report. Inclusion of findings and recommendations from briefing document prepared by Odowa and Awale for N.W. Somalia, and recommendations from IUCN Workshop on Priorities for Natural Resources Management and Dependent Production Systems, 21 - 22 July 1997, Hargeisa. By Dennis Herlocker, 2nd Short-term consultant, and Alex Forbes, Programme Coordinator.
October	Review and editing of document.
6 - 7 Nov.	IUCN Workshop on IUCN Somali Natural Resources Management Programme, Silver Spring Hotel, Nairobi
November/ December	Finalisation of report
24 December	Submission of draft final report to EC Somalia Unit.
March 1998	Final IUCN/EC Somalia Unit discussion on report, and finalisation of report.

Appendix 3 Some of the commercially important marine fish, crustacean and turtle species in Somalia's coastal waters.

Large pelagic fish	
Yellowfin tuna	*Euthynnus affinis*
Longtail tuna	*Thunnus tonggo*
Bigeye tuna	*Thunnus obesum*
Albacore tuna	*Thunnus albacare*
Skipjack	*Katsuuonus pelamis*
Spanish mackeral	*Scomberomoris commersoni*
Jacks	*Caranx* spp.
	Seriola spp.
Bonito	*Sarda orientalis*
Barracuda	*Sphyraena barracuda*
Hammerhead sharks	*Sphyrnidae*
Grey sharks	Carcharhinidae
Mako sharks	Lamnids
Small pelagic fish	
Indian sardines	*Sardinella longiceps*
Rainbow sardine	*Dussumieria acuta*
Anchovys	*Stolephorus* spp.
	Engraulus spp.
Scads	*Selar* spp.
	Decapterus russelli
	Decapterus macrosoma
Horse mackeral	*Trachirus indica*
Mackeral	*Scomber japonica*
Demersal fish	
Scavengers	Lethrinidae
Groupers	Serranidae
Snappers	Lutjanidae
Grunts	Pomadasyidae
Seabreams	Sparidae
Threadfin breams	Nemipteridae
Lizard fish	Synodontidae
Goat fish	Mullidae
Crustaceans	
Spiny lobster	*Panulirus* spp.
	Puerulus sewelli
	Puerulus carinatus
Sea turtles	
Greenbill turtle	*Chelonia mydns*
Hawksbill turtle	*Eretmochelys imbricata*

Appendix 4 Endemic mammals in the Horn of Africa: Somalia and the Ethiopian Ogaden.

Order	Species
Insectivora	Somali elephant shrew *Elephantulus revoili*
	Somali shrew *Crocidura somalica*
Carnivora	Desert fox *Vulpes rupelli somaliae*
Perissodactyla	Somali wild ass *Equus asinus somalicus*
Artiodactyla	Beira *Dorcatragus megalotis*
	Dibatag *Ammodorcus clarkei*
	Speke's gazelle *Gazella spekei*
	Pelzeln;s gazelle *Gazella pelzelni (ssp. of G. dorcas?)*
	Soemmering;s gazelle *Gazella soemmeringii*
	Piacentini' dik dik *Madoqua picentinii*
	Dik dik *Madoqua swayneii citernii*
	Phillip's dik dik *Madoqua phillipsi*
	Klipspringer *Oreotragus oreotragus*
	Hirola *Beatragus hunteri*
Rodentia	Fat-tailed gerbil *Microdillus peeli*
	Weak gerbil *Ammodillus imbellis*
	Spiny mouse *Acomys louisae*
	Speke;s gundi *Pectinator spekei*
	Gerbillus dunni
	Gerbillus rosalinda
	Dipodillus brockmani
	Dipodillus somalicus
	Leggada bella
	Arvicanthus somalicus reptans
	Acomys wilsoni ablutus
	Myomys fumatus tana
	Graphiurus brockmani brockmani
	Graphius parvus

Appendix 5 Threatened bird species in Somalla (Collar, et al., 1994)

Species	Habitat	Sites
Critically endangered		
Northern bald ibis *Geronticus eremita*	cliffs, wadis	Recent unconfirmed breeding report from Aroley, Taleh District
Bulo Berti bush shrike *Laniarius liberatus*	Riverine bushland	Bulo Berti hospital only
Endangered		
Ash's lark *Mirafra ashi*	Coastal grassland	1 area north of Warsheik
Archer's lark *Heteromirafra archeri*	Grassland	2 areas: Borama and Tug Wajale
Somali thrush *Turdus ludoviciae*	Juniper forest	Several sites in the north
Warsangli linnet *Carduelis johannis*	Juniper forest, woodland & scrub	Several sites; locally common; north
Vulnerable		
Somali pigeon *Columba okiviae*	Rocky hills, bushland	Widespread
Lesser kestrel *Falco naumanni*	Various - migrant	Widespread
White-eyed gull *Larus leucopthalmus*	Wetlands, marine	Very common resident, n.w. coast
Near-threatened		
Southern banded snake eagle *Circaetus fasciolatus*	Riverine forest	Jubba River only
Pallid harrier *Circus macrourus*	Various-migrant and wintering	Widespread
Little brown bustard *Eupodotis humils*	Bushland	Widespread

White-winged collared Dove *Strptopelia reichenowi*	Riverine woodland and bushland	Jubba and Shabeelle rivers
Fischer's turaco *Turaco fischeri*	Riverine forest	Jubba River only
Obbia lark *Spizocorys obbiensis*	Coastal grassland	Widespread
Malindi pipit *Anthus melindae*	Coastal grassland	Widespread
Somre chat *Cercomela dubia*	Mountain cliffs	One site in the north
Basra reed warbler *Acrocephalus griseldis*	Wetlands	Jubba and Shabeelle valleys
Short-billed crombec *Sylvietta philippae*	Bushland	Widespread in west
Salvadori's weaver *Ploceus dicrocephalus*	River banks	Widespread, Jubba and Shabeelle rivers

Appendix 6 Some tree and shrub species in Somalia which can be used to produce charcoal and/or honey (* = useful, ** = very useful) (Mahony, 1990).

	Tree species	Charcoal	Honey
Native species			
	Acacia albida	**	*
	Acacia bussei	**	*
	Acacia nilotica	*	*
	Acacia senegal	**	*
	Acacia tortilis	**	*
	Balanites aegyptiaca	**	
	Conocarpus lancifolius	**	
	Salvadora persica		*
	Tamarindus indica	**	*
	Tamarix aphylla	*	
	Terminalia prunoides	**	
	Terminalia spinosa	**	
	Zizyphus mauritiana	*	
Introduced species			
	Albizia lebbeck	*	*
	Azadirachta indica	*	*
	Cassia siamea	*	*
	Casuarina equisetifolia	**	
	Eucalyptus camaldulensis	*	**
	Khaya senegalensis		*
	Leucaena leucocephala	*	
	Parkinsonia aculeata	*	*
	Prosopis chilensis		*
	Prosopis cineraria	*	*
	Prosopis juliflora	**	
	Schinus molle	*	*
Introduced fruit tree species			
	Anacardium occidentale	*	*
	Mangifera indica	*	*
	Psidium guajara	*	

Appendix 7 Examples of use of the method for prioritising conservation and natural resource management issues

(A) Criteria used in determining priorities (note the numbers at the left of the page; each criterion will be represented by it's number in part (B) on the next page).

Ratings: (High/many etc. = 5 and low/few = 1. These criteria are considered to be the most important for prioritising issues. Therefore, the final ratings are doubled)

Ecological sensitivity

(1) Degree to which resource/production system is threatened (in terms of nearness of time)

(2) Degree of existing degradation

(3) Degree of sensitivity of resource to degradation

Ecological potential of resource

(4) Relative level of biodiversity

(5) Level of biological productivity

(6) Degree of endemism characterising the resource (or threatened species)

(7) Ecological regulatory / control functions of resource

(8) Probable degree of response to development/conservation measures

(9) Area affected / influenced by the resource

Needs of the human population

(10) Size / density of affected population

(11) Degree of poverty

(12) Degree of dependency on the resource (production system?)

Perceived immediacy of benefits (short and long term) (by those who are affected)

(Same ratings as above but the final ratings are not weighted)

(13) Degree to which the methods to apply to the problem are known

(14) Degree of recognition that problem exists by those affected

(15) Perception of benefits

Ratings: (Low/few/little = 5 and high/many = 1. These criteria are considered to be less important for prioritising issues. Therefore, the final ratings are not weighted. Criteria relate to the relative difficulty to be expected in addressing an issue)

Technical feasibility

(16) Relative ecological complexity of the problem (for instance, causes)

(17) Degree of technical sophistication required to address the problem (equipment, experts, costs, no. of related activities etc.)

Social feasibility

(18) Number of different social groups involved/affected (clans, families etc.)

(19) Number of different economic groups involved / affected (rich, middle, poor)

(20) Number of different user groups involved / affected (pastoralists, farmers, etc.

(21) Degree of other vested interests (politicians, warlords etc.)

(B) Three examples of use of the method for determining priority issues.

Criterion no.	Selected conservation and natural resource management issues		
	Dependence on a single energy source	Unmanaged exploitation of targeted marine areas	Lack of awareness
1	5	3	5
2	5	2	5
3	5	4	5
4	4	5	5
5	3	1	n/a
6	3	3	5
7	4	3	2
8	4	5	4
9	5	3	5
10	5	2	3
11	omit	4	n/a
12	5	5	1
Subtotal	48	40	40
(Double value)	*96*	*80*	*80*
13	4	4	4
14	4	4	1
15	3	4	1
16	4	4	3
17	4	3	3
18	3	4	5
19	3	4	3
20	3	4	1
21	3	4	2
Subtotal	31	35	23
Total	127	115	103
No. of criteria	19	21	19
Rating index	**6.68**	**5.48**	**4.48**