

Republic of Yemen

National Biodiversity Strategy and Action Plan

``For a sustainable and decent standard of living of Yeme people while respecting the limits of nature and the integri of creation.``

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**Ministry of Water and Environment
Environment Protection Authority (EPA)**

**UNDP/GEF/IUCN
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Republic of Yemen

National Biodiversity Strategy and Action Plan

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Executive Summary

For millennia, the people of Yemen have been known for their sophisticated systems of agricultural terracing, rational use of arid rangelands, and sustainable fishing practices along the country's extensive coastline. Highly developed ancient cultures existed as far back as the 7th century BC. Prehistoric Yemen was prosperous using its natural resources wisely and sustainably while Europe was still primitive. Refined engineering projects such as the Ma'adin Dam and associated irrigation systems helped to create a surplus in agricultural production. Although they have suffered abuse and degradation, today, Yemen's natural resources still represent the basis of the national economy. The low average rainfall for most of the country coupled with the changing socioeconomic patterns, population explosion and urbanization have severely strained Yemen's already limited renewable water resources.

The biological diversity of Yemen occurs in a spectrum of habitats ranging from coastal mangroves and coral reefs to the highlands and deserts of the interior. These habitats harbor a great number of unique species of wildlife and domesticated animals and plants. But not much of our country's great natural biological wealth has become severely threatened over the last few decades by the changing patterns of human use and abuse which have degraded many very systems and resources on which the nation depends. Without serious and deliberate remedial actions and interventions, many of native species of wildlife of local and global importance will be pushed towards extinction and their unique habitats laid fallow.

The medium and long-term economic development of Yemen is very much dependent upon the appropriate management and sustainability of the limited resources in the country. The vision of the Biodiversity Strategy and Action Plan for Yemen (NBSAPY) is to achieve a better quality of life for all Yemeni people through the conservation and sustainable use of biological resources and stabilizing resource consumption in harmony with the limits of the carrying capacity of nature and the integrity of creation. This vision shall be achieved by mobilizing the resourcefulness of the Yemeni people and applying international technical and financial support. Yemen aims at nothing less than the restoration and rehabilitation of the diversity of species, genetic resources and ecosystems. As custodians of their national and global heritage, Yemenis are coming to realize that their livelihood and security are in peril until present and future generations are assured about the safety and integrity of their own biodiversity and natural resource base.

On the basis of a detailed situation analysis of biodiversity in Yemen, specific goals and objectives were identified to govern the thrust of the action plan outlined in this document. These goals spell out the pathways to preserve and use in a sustainable way the irreplaceable biodiversity and natural resources of Yemen. Such pathways are guiding principles, which represent the broad consensus of all the partners, who developed the strategy. The principles include, first and foremost, striving to maintain the integrity of Yemen's land and marine resources and their biotic wealth. They include respect for the intrinsic value of all life forms while their use needs to be sustainable and equitable. They also include the pursuit of collaborative management agreements and institutions. All affected communities and groups shall participate in policy actions that affect their right entitlements for the biotic resource.

The indigenous natural resource management systems of the Yemeni people will be supported, protected, utilized and seen as a rich natural heritage. The basic principles will incorporate responsible public management based on accountability, transparent participation in decision making and a full analysis of impacts.

The strategy is illustrated according to its strategic goals; which are broken down into sub-goals, each targeted to a strategic area and complemented with a number of priority objectives requiring immediate, medium or long-term attention. Some highlights of the agenda for each goal are presented below:

Table 1: Strategic goals, sub-goals and related strategic areas of intervention

Goal 1. Conservation of Natural Resource	
Strategic area of intervention	Sub-goal
1. Protected Areas	Conservation of Yemen's eco-systems through developing and maintaining a comprehensive and adequate network of protected areas supported by effective coordinating management mechanisms, adequately funded management plans and improved information system.
2. Endemic and Endangered Species	Conservation and rehabilitation of key endangered species through law enforcement, information gathering and implementation of community based in-situ conservation programs of key endangered flora and fauna.
3. Ex-situ Conservation	Ex-situ conservation of rare and endangered native taxonomic groups plants species by improving knowledge and understanding of species and ecosystems, and through the establishment and strengthening gene banks, seed banks, green belts, botanical gardens and protected gardens.
4. Alien Invasive Species	Establishment of an effective control and monitoring system backed with information system and legislative framework for the trade, use and control of alien invasive species.
Strategic Goal 2. Sustainable Use of Natural Resources	
5. Terrestrial Wildlife Resources	Strengthening the sustainable utilization of terrestrial wildlife resources through developing legislations and policies prohibiting hunting and capturing wildlife and expanding programs on rangelands, for restoration and abatement of desertification.
6. Coastal/Marine Life and Fisheries	Conservation and sustainable use of marine and fishery resources through the development and strict implementation of policy, legislative and management tools that ensure harvest level of biological resources are maintained within the biological limits. Examples are development of coastal zone management plans, establishment of marine protected areas, control hazard, illegal and unsustainable fishing, etc.
7. Agro-biodiversity	Conservation of biological resources through the adoption of ecologically sustainable agricultural and pastoral management practices including control of fertilizer and pesticides, terrace management, traditional land use and water management systems, introduction of modern irrigation systems, etc.
Strategic Goal 3. Integration of Biodiversity in Sectoral Development Plans	
8. Infrastructures and Industry	Reducing infrastructures and industry adverse impacts on habitats and ecosystems through eco-tech introduction, EIA enforcement and effective regulating policy.
9. Biotechnology and Biosafety	Mitigating the potential risks associated with the use and release of living modified organisms (LMOs) and the introduction of biotechnology on human and biological diversity through development and implementation of biosafety frameworks, developing biosafety guidelines and creating an entity to manage and control biotechnology and biosafety issues.

Cont. table1: Strategic goals, sub-goals and related strategic areas of intervention

Cont. Table1: Strategic Goal 3: Integration of Biodiversity in Sectoral Development Pl:	
Strategic area of intervention	Sub-goal
10. Tourism and Eco-tourism	Achieving the conservation of biological resources through adoption of ecologically sustainable management practice: tourism and recreation.
11. Urban, Rural Development and Land- Planning	Minimize uncontrolled urbanization through developing implementing land use management plans and enforcing land regulations.
12. Waste Management	Reducing adverse waste impact on ecosystems through the adoption of ecological policy and the introduction of new techniques such as recycling and treatment and green technology.
13. Water Management	Protecting the country limited water resources from over-exploitation and quality deterioration through optimal allocations of water resources and the use of improved quality control techniques.
14. Climate Change and Energy	Mitigate the impacts of energy GHG emissions and the subsequent climate change on biodiversity and desertification through energy mitigation strategy and a National Adaptation Program of Action (NAPA).
Strategic Goal 4. Implementation of Enabling Mechanisms	
15. Public Awareness and Participation	Rising environmental awareness of Yemeni society through integrating environmental themes into university and school curricula, promoting green media, and supporting youth clubs: eco-industry.
16. Indigenous Knowledge and Traditions	Reviving traditional biological knowledge, innovations and techniques in conserving biological resources.
17. Capacity Building	Strengthening productive capacities and potential of individuals, agencies, and communities in the planning, implementation, monitoring and evaluating of biodiversity conservation program
18. Equitable Sharing of Biodiversity Benefits	Enabling communities and individuals to conserve and sustainably use biological resources by facilitating their participation in planning and management of natural resources and providing with secure access to biological resources and sufficient financial and technical funding for community-based environmental programs
19. Policy, Legislation and Institutional Structure	Developing an integrated legislative and institutional framework composed of: 1) Updated environmental laws complete regulations, implementation and enforcement mechanisms mandated and empowered national institutions and mechanisms coordinating and effecting policies, legislations and strategies national policy advocating incorporation of biodiversity issues in national fiscal policy.
20. Monitoring and Reporting	Establishing a nationwide inter-agency mechanism for monitoring the implementation and results of the NBSAP and other biodiversity related programs.
21. International and Regional Cooperation	Maintaining and strengthening Yemen's relations and cooperation with international and regional partners in the field of biodiversity

In order to develop the action plan that translate the strategy vision, goals and prior objectives into implementable actions, a long list of options composed of forty broad actions were first identified and then they were short listed into seven priority initiatives (project concepts) based on the following priority criteria: (1) Geographic Impact, (2) Consistent with Convention Objectives, (3) Urgency, (4) Sequence (5) Country-driven, (6) Attainable and Resourceable, and (7) Multisectoral Implications to the objectives of this strategy. The priority project concepts form the Action Plan of this Strategy. They are considered of immediate importance and require urgent action and attention to meet pressing biodiversity conservation needs.

Table 2. Action Plan

1. Establishment and Development of a Comprehensive National Integrated Protected Areas System in Yemen (NIPASY)
2. Development and Implementation of an Integrated Coastal Zone Management Plan (ICZMP)
3. Development and Implementation of Policies, Legislation and Regulations on Biodiversity Issues in Yemen
4. Essential Measures for the Conservation of Agro-biodiversity in Yemen
5. Reviving Traditional and Indigenous Knowledge in Natural Resource Management Systems
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INTRODUCTION

The Convention on biological diversity

Biological diversity includes the genetic variability of all species of plants, animals and micro-organisms and the ecosystems that form their habitats. Ecological stability is guaranteed mainly through biological diversity; in essence, it is the insurance policy for life on earth. In recognition of the importance of biodiversity, during the 1992 UNEP conference (The Rio Earth Summit) a Convention on Biological Diversity (CBD) was opened for signature. One year later, a hundred and sixty eight countries had signed the CBD making it one of the most widespread conventions in existence. Signatory nations commit themselves to the three goals of the CBD, namely (i) the conservation of biodiversity, (ii) the sustainable use of biodiversity resources, and (iii) the equitable sharing of benefits resulting from the use of genetic resources. Moreover, signatory nations agree to elaborate a National Strategy and Action Plan to operationalize the goals of the CBD in accordance with its Articles 6 and 7, as well as to implement all its other articles.

A national endeavor for biodiversity conservation and sustainable development

Yemen has signed in 1992 and ratified in 1995 the International Convention on Biological Diversity which was launched at the Earth Summit conference in 1992. In so doing, Yemen has acknowledged the value of biological resources as an integral part of its natural heritage with the potential for yielding long term benefits for the Yemen people and as essential foundation for sustainable development. The Government of Yemen takes its responsibility for the conservation and sustainable use of its natural resources seriously. It recognizes that the well being of its present and future communities depends on the conservation of biodiversity and abundance of its biological resources.

Government focus on environmental and conservation issues is relatively new in Yemen, with the Environment Protection Council only having been established in 1990 and transformed into a full blown agency in 2001. In recent years however the country has ratified other international biodiversity-related conventions such as the UN Convention for Combating Desertification, the Climate Change Convention and the International Trade in Endangered Species of Fauna and Flora (CITES) convention. It also developed and implemented numerous policies and action plans related to biodiversity conservation and sustainable development including the National Water Strategy and Watershed Policy, a National Environmental Action Plan and a National Action Plan for Combating Desertification.

The NBSAPY thus constitutes a complement to the Environment and Sustainable Development Investment Program 2003-2008 recently prepared by EPA as well as to other sectoral development plans adopted or being prepared by the government.

The National Biodiversity Strategy development process has been funded by the Global Environment Facility, administered by United Nations Development Programme (Sana'a) and coordinated through the EPA with the technical assistance of the International Union for Conservation of Nature (IUCN). IUCN has provided continuing support in facilitating the planning process through technical back-stopping, advice on the development of work plans, organizational structures, terms of reference for national and international technical working groups and assisting the editor of the strategy in editing and finalizing the NBSAPY.

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In order to assess and collect the available information on biodiversity in Yemen, EPA contracted a number of well-qualified national experts from different institutes with competence in different areas of biodiversity conservation, including flora, fauna, marine, freshwater, social, economic and legal issues as well as agro-biodiversity (plant production, animal production and honey production). The reports of the technical working groups were used as the scientific basis upon which the NBSAPY was elaborated.

The work of the technical groups formed a foundation for the base data and reports, which are available at EPA. Although the priorities of the NBSAPY may be refocused during implementation, it is essential to have clear initial targets for activities and actions that will move the country towards the overall goals of the strategy. Towards this end, an agenda of action has been developed for each of the NBSAPY objectives. These agendas list prior targets and recommended actions as short-term (1-3 years), medium-term (4-8 years) or long-term (>8 years). Each agenda is intended to represent a list and schedule of activities that can realistically be achieved.

During the course of the NBSAPY formulation, a number of consultative activities with stakeholders were carried out in 6 provinces as representatives of the whole country. These included briefings, talks, discussion and information sharing with relevant stakeholders including government officials, NGOs representatives and academic members & officials and universities and research centers. This process has contributed significantly in improving awareness and common understanding on biodiversity issues and helped in building consensus among stakeholders regarding the strategy contents.

With the active contribution of a board of directors comprised of representatives from different line institutions, the EPA is committed to an active implementation of the NBSAPY which includes regular reporting to the public, concerned national agencies and international organizations.

Proposed mechanisms for implementing the National NBSAPY include the creation of a permanent board of directors and National Coordination unit within EPA which will be responsible for:

- Preparing an annual national report on policies, activities and plans aimed at implementing the strategy;
- Coordinating the implementation of national and international elements of the strategy;
- Recommending measures to encourage non-government participation in the implementation of the strategy;
- Regular reporting on the status of biodiversity; and,
- Updating the strategy after an initial implementation phase of 5-7 years.

Working groups could be formed on an ad hoc basis to prepare and implement the different elements of the action plan.

A portrait of biodiversity for Yemen

The Republic of Yemen ranks as the most populous country in the Arabian Peninsula with a population growth rate of 3.5%. The country's population, if unabated, will increase

37 844 000 by 2026¹. Rapid population growth and imbalances in spatial distribution will continue if there is no recognition of the relationships between population, resource environment, and development in policy decision-making at all levels of governance.

Under current accelerating growth of economy, environmental quality is fast deteriorating, dramatized by the increased occurrence of environmental problems. Specifically, the gains economic growth are being diminished, or even negated, by numerous factors including deforestation; pervasive and coral reef destruction; massive pesticide poisonings; degradation and erosion of agricultural lands; pollutant intrusion into aquifers; irresponsible tourist activities; marsh and mangrove destruction; loss of forest and green cover associated with massive urbanization; industrial pollution; continued reliance on non-renewable energy sources; destructive fishing methods; and indiscriminate oil exploration and exploitation.

Meanwhile, conservation of biological diversity has become a focal point for environmental conservation efforts with the declaration of a number of protected areas. There is also growing awareness among the environmental community of the importance of biological diversity and the role of indigenous ways of life in maintaining the integrity of ecosystems. While operationalization has been slow; sustainable agriculture, agro-forestry, and environmentally sound fishery initiatives have spread to the majority of provinces in the Republic of Yemen.

According to WWF Global 2000 analysis, Yemen hosts at least 4 globally important ecoregions: (1) Red Sea, (2) Gulf of Aden/ Arabian Sea, (3) Arabian woodlands and (4) Socotra. These ecoregions are amongst the key areas for global biodiversity and need to be protected from human activities.

The Red Sea is home to distinctive coral ecosystems comprising regional center of endemism for fish and invertebrates. It hosts a unique flora and fauna, a number of marine turtles, and several endemic birds and other unique species. Seventeen per cent of fish are endemic; more than 90 per cent of dottybacks (Family *Pseudochromidae*) and triplefins (Family *Tripterygiidae*) are endemic.

The Arabian Sea hosts highly productive habitats that reflect biophysical regimes and high endemism among algal communities. It has coral reefs with over 75 per cent cover in selected areas and sea grass beds that provide important breeding and nursery habitats especially for mollusks. It hosts several endemic species of marine fauna, a wide variety of invertebrates and algae as well as characteristic fish species.

Socotra hosts a distinctive insular biota with many endemism species. It has a more diverse and exuberant flora and fauna than any other region in Arabia. The island of Socotra is also an important site of local endemism for reptiles, plants, and birds. The islands have more than 250 endemic species of plants, 85 of which are nearly extinct. Socotra houses many unusual plants, including its aloes and the endemic dragon tree (*Dracaena cinnabari*) known for "dragon's blood", a brilliant red resin extracted from this plant. The island is also home to several endemic plant genera, some animals and endemic bird species, including the Island cisticola (*Cisticola haesitatus*) and the Socotra bunting (*Emberiza socotrana*).

Yemen highlands woodlands and shrub-lands sustain high levels of biodiversity and provide an important stopover site for migrating birds. The highlands support the majority of endemic or near-endemic species of plants and animals. It hosts the endemic Arabian tahr (*Hemitragus*

¹ Projected at population growth rate of 3.5%

jayakari), Arabian gazelle (*Gazella gazella*), Nubian ibex (*Capra ibex nubiana*), striped hyena (*Hyaena hyaena*), wild cat (*Felis sylvestris*), and leopard (*Panthera pardus*). Although Arabian oryx (*Oryx leucoryx*) is extinct in the wild, there are efforts to reintroduce it to the region. Representative bird species include yellow-vented bulbul (*Pycnonotus xanthopygus*), graceful warbler (*Prinia gracilis*), brown woodland warbler (*Phylloscopus umbrovirens*), Yemen linnnet (*Carduelis yemenensis*), gambage dusky flycatcher (*Muscicapa gambaga*), Arabian partridge (*Alectoris melanocephalia*) and black kite (*Milvus migrans*).

The role and importance of biodiversity for Yemen

As elsewhere in the world, the ecosystems of Yemen provide habitats for plants, animals and micro-organisms which can be used or which perform useful functions. Specifically, they regulate thermal and water regimes, influence the climate, and play an important role in maintaining atmospheric air quality and in ensuring a healthy ecological environment for humans. Elements of biodiversity also act to protect the soil from erosion. According to the World Resources Institute, ecosystems are "the productive engines of the planet", providing us with everything from the water we drink to the food we eat and the fibre we use for clothing, paper, or wood for construction². Yemeni people have hunted, fished and gathered the plants and animals of Yemen for centuries and their uses of natural resources continue today. Table 3 gives examples from the array of goods and services provided by four broad ecosystem categories found in Yemen.

Natural areas provide support systems for commercially valuable natural resources such as spawning areas in mangroves and wetlands. Other habitats act as genetic reservoirs for commercial crops. As many of the species in Yemen and elsewhere are not even known yet, we can assume that with an increase in knowledge new biological resources to increase human welfare will be discovered. There is a clear relationship between the conservation of biological diversity and the discovery of new biological resources.

There are numerous ways to value biological diversity. While it is not difficult to assign value to biological resources that are available on markets, such as vegetables, wool, medicines, fish, etc., there are many functions that cannot be so easily measured in monetary terms, for example ecosystem services or social benefits. For many people who rely on the products of ecosystems for their daily subsistence, it would be difficult to put a monetary value on all the products they use or benefits they enjoy.

In agriculture, biodiversity has ensured sources of food, fodder and grazing for livestock, genetic variation for selection, etc. Browsed and grazed plants include a large number of trees, shrubs, grasses and weeds that are important to cattle, sheep and goats.

In medicine, some plants are extremely important sources of natural and commercial remedies. Medicinal and aromatic: Even though the medicinal flora of Yemen is not well documented it is important to note that medicinal and aromatic plants play an important role in the lives of most Yemenis who use them as traditional remedies to cure diseases. They are also used as cosmetics, condiments, coloring and flavoring agents. A list of 224 medicinal and aromatic plants was compiled by national experts³ in 1995. Among the most common are *cassia senna* whose leaves are used as a laxative; *ziziphus spina-christi* as an antiseptic

² People and ecosystems: The fraying web of life (<http://www.wri.org/wr2000/ecosystems.html>)

³ Al-Dubaie and Al-Khulaidi, 1995: the list contains plant's scientific names, families, common names, distribution, active substances, and medicinal use.

lowsonia inermis as an antiseptic and cosmetic; *mentha longifolia* for abdominal disorder

Ecosystem	Goods provided	Services provided
Agro ecosystems	Food crops Additional food items (e.g. terrace fields, fishery) Frankincense, fibre Crop genetic resources crops	Maintain limited watershed functions (infiltration, flow control, partial soil protection) Provide habitat for birds, pollinators, organisms important to agriculture Build soil organic matter Bind atmospheric carbon Provide employment

withania somnifera and *solanum incanum* as a dental analgesic; and *anisotes trisulcus* kidney stones.

Table 3: Services and goods provided by ecosystems⁴

Agro ecosystems	Food crops Additional food items (e.g. terrace fields, fishery) Frankincense, fibre Crop genetic resources crops	Maintain limited watershed functions (infiltration, flow control, partial soil protection) Provide habitat for birds, pollinators, organisms important to agriculture Build soil organic matter Bind atmospheric carbon Provide employment
Mountain and Rangeland Ecosystems	Timber Fuelwood Drinking and irrigation Water Fodder Non-timber products Food (honey, mushrooms, fruit, and other edible plants; game) Genetic resources	Remove air pollutants, produce oxygen Cycle nutrients Protect water resources (infiltration, purification, flow control, soil stabilization) Maintain biodiversity Bind atmospheric carbon Moderate weather extremes and impacts Generate soil Provide employment Contribute aesthetic beauty and provide recreation
Freshwater Ecosystems	Drinking and irrigation Water Fish and other aquatic organisms Hydroelectricity Housing materials Medicines Genetic resources	Lessen or prevent the impact of floods Dilute and carry away wastes Cycle nutrients Maintain biodiversity Provide transportation corridor Provide employment Contribute aesthetic beauty and provide recreation

⁴ Source: adapted from WRI 2000. Global Ecosystem Assessment

Coastal and Marine Ecosystems	Fish and shellfish Sea weeds (for food and industrial use) Salt Genetic resources	Moderate storm impacts (mangroves barrier islands) Provide wildlife (marine and terrestrial) habitat Maintain biodiversity Dilute and treat wastes Provide harbors and transportation routes Provide employment Contribute aesthetic beauty and provide recreation
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Rangelands, forests and other woodland areas comprise about 40% of the land area. More than 8 million sheep, goats and cows graze the land. The remaining land (57 % of the country) is mostly desert.

Forest resources are widely used in industry and construction. Species most commonly utilized for fuelwood include *Acacia spp.*, *Ficus spp.*, *Tamarix spp.*, *Acalypha fructosa*, *Caesalpinchia purpurea*, *Rumex nervosus* and others. Timber for construction includes *Acacia spp.*, *Ficus spp.*, *Cordia africana*, *Terminalia brownii*, *Trichilia emetica* and *Ziziphus spina-christi*.

Fisheries are considered a promising sector for sustainable development. The Republic of Yemen owns one of the best fisheries areas in the region. The fish stock is estimated at 8 thousand tons allowing for catchments of 350-450 thousand tons annually compared to the current catch, which did not exceed 158 thousand tons in 2001. This level does not exceed 40% of potential fish catchments per year. The contribution of this activity to the GDP is limited and does not exceed 0.89 % annually (based on fixed prices and 1.4 % based on current prices in 2001⁵). Fish has already become Yemen's third most important export commodity; one third of total fish production, with a value of \$70 million was exported in 2001⁶. Fish is also nutritionally significant, contributing to local food security by providing an important source of animal protein.

It is expected that this sector will hold an important position in the economy of the country in the future, either for meeting the food demands and narrowing the food security gap or for exportation to support the country's foreign currency earnings.

Though cultivated land in Yemen represents only 2.2% of the land area (1 668 858 hectares), agriculture still plays a leading role in Yemen's economy, accounting for about 22.98% of the GDP in 2001 and employing 53% of the total labor force⁷. Three quarters of the rural population depend on the sector for the provision of their food requirements. However, the sector is clearly and primarily subject to a set of natural and human factors, which collectively lead to the occurrence and spread of land degradation and hence the retardation of its future role.

Main field crops are cereals including sorghum, wheat, maize, millet and barley. Vegetable crops include potato, tomato, beans, cucurbits, onions, carrots, crucifers, okra, eggplant and pepper. Fruit crops include grapes, dates, citrus, guava, mango, peach, apples, banana, papaya

⁵ Statistical Year Book 2001, Jun, 2002, Central Statistical Organization

⁶ Ibid

⁷ Ibid

apricot, almond and pomegranate Cash crops include qat, coffee, cotton, sesame and tobacco. While forage and feed crops include alfalfa, sorghum and grasses.

Land area allocated for cultivation of cereals has dwindled from 787 000 hectares in 1995 to 710 550 hectares in 2001. Agricultural productivity has sharply declined during the same period and figures show that productivity of the hectare has dropped from 1.68 to 1.62 ton for wheat, from 0.96 to 0.93 ton for sorghum and millet, from 1.3 to 1.22 ton for legumes.⁸

Major threats to biodiversity in Yemen

As a result of extensive agricultural development over the last 40 years, many natural landscapes in Yemen have been severely degraded. In 2001, around 72% of cultivable land was under cultivation, and a further 0.8 million ha was covered by pasture and grazing land. The use and conversion of land for agriculture has resulted in degradation, and even loss, of certain natural habitats, as well as causing large-scale pollution.

In recent years, agricultural practice in the Republic of Yemen has been characterized by significant increase in the use of mechanization, fertilizers and pesticides; bad soil fertility management; poor plant nutrition; and overgrazing. These inappropriate practices impact directly on the quality of land resources limiting the options for other land use needs. The continued application of chemicals is likely to result in some change of the soil structure. The results from the increased use of fertilizers as the soil loses its nutrients. One of the long-term consequences of this practice is desertification. As the soil becomes less fertile, and costs rise in using the area, it may often be abandoned.

Inadequate agricultural practices, such as the application of an often mechanized and repeated single or double crop system in the rain-fed areas, has led to soil loss through wind and water erosion, a decrease in fertility and a subsequently decline in crop yields. More marginal lands being put under cultivation, even during years with rainfall deficits, fail to produce crops and are abandoned barren, ready to contribute to desertification, while new marginal lands are to be cultivated. The result of such practices in the coastal plains and in Ma'arib is that wind erosion takes place on formerly more or less stabilized dunes, which, are put under a continuous process of drifting thus increasing desertification by encroachment on productive lands and infrastructures. Elsewhere in Yemen, this leads to water erosion, which affects lands downstream and ultimately results in widespread degradation and desertification.

In short, the country's vegetation cover is being drastically reduced by rapid degradation of the environment, a direct result of desertification and droughts, and as a result of the following root causes:

- a) Inadequate cultivation and poor agricultural practices;
- b) Wood cutting for firewood, timber and charcoal;
- c) Over grazing;
- d) Soil salination;
- e) Water and wind erosion and sand dune encroachment; and
- f) Encroachment due to housing and infrastructure development around cities and villages.

Threats to terrestrial fauna in Yemen are common to many countries in the region and include:

- a) Destruction, degradation and loss of natural habitats;

⁸ Ibid

⁹ Ibid

- b) Over-hunting and proliferation of firearms; and
- c) Road construction opening up avenues into the hinterland.

Similarly, the quantity and quality of freshwater are threatened by numerous factors including overuse of water sources, degradation of wetland ecosystems, excessive use of pesticides, misuse of fertilizers, untreated wastewater and increased industrial waste.

The coastline of Yemen is over 2500 km long and includes three different coastal regions namely the Red Sea, Gulf of Aden and Arabian Sea. The Red Sea region represents about a third of this coastline, with the remainder bordering the Gulf of Aden region. The Red Sea and Gulf of Aden region of Yemen represent a complex and unique tropical marine ecosystem with extraordinary biological diversity and a remarkably high degree of endemism. It is an important shipping lane linking the world's major oceans. For example, about 100 million tons of oil transits the Red Sea annually. The Eastern Gulf of Aden and Arabian Sea region is a highly productive fishery region due to the Tropical Upwelling phenomenon, supporting a food web that ultimately sustains fish communities. Both the Red Sea and the Gulf of Aden are designated "special areas" under the international MARPOL convention.

Over 120 islands lie in the seawater of Yemen with distinct climatic and natural characteristics. More than 115 of these islands lie in the Red Sea region. Among those located in this region: Kamaran Island is the largest, and Mayoon Island, located in the Bab Mandab Strait, has strategic importance. Most corals and coral habitats exist around the Yemeni islands, but with different diversity of communities and number. Socotra Island, the largest Yemeni island (nearly 3 625 km²), is located in the Arabian Sea region of Yemen and has more exuberant and diverse flora and fauna than any other region in the Arabian Peninsula.

Coastal and marine resources are threatened by over fishing, spear-fishing, aquarium fishing and dynamite fishing. These factors also represent major disturbances to the coral reefs of Yemen. Oil exploration and transport have resulted in several oil spills. Sewage discharge, agro-chemicals flushed by floods, and sedimentation from urban development pose further threats to the Red Sea's coral reefs. Industrial and urban development, as well as extensive coastal development, land filling, and coastal engineering are dramatically altering certain coastal areas. Recreation and tourism also contribute to eutrophication and reef degradation. Coastal and marine biodiversity, including the Socotra Island, is threatened by the cutting of mangroves for wood and the use of mangroves for feeding animals, fuel-wood supply and new development projects.

Other threats to the coastal and marine environment of Yemen include the uncontrolled use of coastal zones, destruction of marine and coastal habitats and ecosystems, spatial conflicts among various users, unplanned coastal reclamation, the destruction of benthic habitats, bottom trawling and the destruction of endangered species due to non-selective gear.

THE NATIONAL BIODIVERSITY STRATEGY

A National Vision

“To achieve a better quality of life for all Yemeni people through the conservation and sustainable use of biological resources and stabilizing resource consumption in harmony with the limits of the carrying capacity of nature and the integrity of creation.”

Guiding Principles

The NBSAP adopts a framework that places the Yemeni people and nature at the center of the government concern in the development process. Thus the components of the NBSAP have been developed based on the following sustainable development principles:

1. Equity

- Ensuring social cohesion and harmony through equitable distribution of resources and providing the various sectors of society with equal access to development opportunities and benefits today and in the future. No individual or social groups should be denied the opportunity to benefit from natural resources. The equal rights and opportunities of men and women must be assured.

2. Solidarity and shared responsibility

- Recognizing that sustainable development is a shared, collective and indivisible responsibility, which calls for institutional structures that are based on the spirit of solidarity, convergence, and partnership between and among various stakeholders.
- Recognizing that since communities residing within or most proximate to a given ecosystem will be the ones to most directly feel the positive and negative impacts of human activities on that ecosystem, they should be enabled access to and control over common natural resources, such as water and biodiversity.
- Protection of natural resources is viewed as a shared and indivisible responsibility of all individuals, families, communities, and other institutions in society.
- Biological diversity conservation and enhancement are pursued through direct involvement of local communities and indigenous peoples and the extension of support to institutional initiatives including the harmonization of national and local biodiversity-related policies, legislation and programs.

3. Ecological Soundness

- Recognizing nature as our common heritage and thus respecting the limited carrying capacity and integrity of nature in the development process to ensure the right of present and future generations to this heritage.
- The integrity and carrying capacity of biological resources should not be degraded, but rather conserved, protected and enhanced in the process of development.
- Yemen possess rich biotic resources many of which are now threatened and some already extinct. The future development of the country must reflect the

intrinsic value of its landscapes, terraces, ecosystems, habitats, populations, species and genes.

4. Know-how and eco-technology

- The biological limits to natural resource productivity are scientifically researched and established and have become the bases and indicators for strategic policy decisions on societal use of the country's natural resources
- Regular review, proposals for appropriate amendment of the strategy, and strict enforcement of environmental laws are undertaken by both communities and appropriate government institutions.

5. Islamic Values

Islam commands us to respect other plants, animals and creatures living with us and consider them living communities, exactly like mankind. God says in the Glorious Quran "There is not an animal (that lives) on the earth, nor a being that flies on wings, but (forms part of) communities like you."

"God created earth and all creatures living on it in due proportion and measure." God says, "Verily all things have we created in proportion and measure", and God says "And the earth we have spread out" and "planted therein all kinds of things in balance." So Protection, conservation and development of the environment and natural resources is a mandatory religious duty to which every Muslim should be committed. Any deliberate or intentional damage to the natural environment and resources is a kind of mischief or corruption that is forbidden by Islam. God says, "Do no mischief on the earth after it hath been set in order" and "...but loveth not mischief."

Islam calls all individuals at all levels to protect, conserve and use environment and natural resources sustainably as per the following religious duties:

- No extravagance, excessive use or over-utilization. God says, "Eat and drinks: waste not by excess, for God loveth not the waster"
- No illegitimate or unlawful attempt at destroying the natural resources.
- No damage, abuse, pollution or distortion of the natural environment in any way.
- Construction and development of the earth, its resources, elements and phenomena through the improvement and betterment of natural resources, the protection and conservation of all existing forms of life, the cultivating of land and the reclamation and cleansing of the soil, air and water.
- Ownership of all environmental elements is the common and shared right of all members of the Islamic community. Each is entitled to use and benefit from them without infringement, violation or delay of other.

Main strategic goals

Goal 1. Conservation of Natural Resources

1. Protected Areas

Yemen is blessed with rich, diverse and distinctive ecosystems comprising fresh water wetlands, coral reefs, oceanic islands, mountainous woodlands and forests, rangelands, well as terraced and irrigated valleys. For centuries, these ecosystems have been used, managed and protected by Yemeni people through traditional use and management systems. These traditional systems include rangeland protected area (Mahjur), Islamic Waqf, and local rural jurisdiction. Under traditional Mahjur systems, the production of rangelands of rai seasons are conserved and kept by local communities for their use in drought periods. Islamic Waqf systems, landowner transfers the property of privately-owned lands to a community for their common use and for the faith of God. Through this system Jebel B Forest was donated in 1816 BC by its landowner to the local community, after which it has been kept under continued public protection. Under the tribal jurisdiction of local sheik administrators and local development councils, there are cases of local forest felling interdiction and entry bans into certain local areas in order to protect the environment and fines are levied in the case of infringements.

Presently traditional protection systems are retarded and this contributes to the accelerated destruction of eco-systems. This situation is exacerbated by the absence of a professional agency to provide leadership, the lack of management infrastructure, trained staff and funding dedicated to planning and caring for the national network of protected areas. In the absence of proper management mechanisms and under the lack of human and financial resources the declared protected areas will remain no more than a list on paper and ecosystems destruction will further increase.

Recognizing the difficulties hindering the effective management of protected areas and given the ecological, agricultural, historical, cultural and economical importance of Yemen's mountainous and coastal ecosystems to Yemeni welfare and to the world biodiversity, the government has committed to undertake a combination of vigorous measures to address the problems hindering the effective management of protected areas. This strategy is one of the most important measures taken in this context and through which the proper management of Yemen's ecosystems, including the promotion of terraced agricultural production, integrated watershed management and the introduction of environmentally appropriate technologies will be facilitated.

Key Issues

- Lack of effective administration and conservation management regimes for protected areas;
- Limited geographic coverage of Protected areas (PA) associated with lack of PA management plans
- Insufficient staff and resources.
- Incomplete legal framework for protected areas.
- Lack of precise information on the number of fauna and flora species present in Yemen, or on rare, threatened endemic species and their habitats;
- Lack of adequate legislation to protect flora and fauna;
- Lack of Institutional Capacities for protected area

- Criteria for defining critical habitats or biotypes are missing.

Sub-goal: Conservation of Yemen's eco-systems through developing and maintaining comprehensive and adequate network of protected areas, supported by effective co-ordinating management mechanism, adequately funded management plans and improved information system.

Priority Objectives

Short-Term (1-3 years)

- Develop and strengthen co-ordinating management mechanisms to improve integrated management of the protected areas system.
- Maintain and develop an integrated and adequate network of protected areas, representing key eco-systems of Yemen.
- Prepare management plans for selected priority protected areas.
- Establish an integrated database for biodiversity resources and protected areas
- Establish a single department to manage protected areas

Medium-term (4-8 years)

- Expand the Protected area network to include Ramsar sites, World Heritage sites, and World Biosphere Reserves.
- Expand management planning and implementation in selected protected areas.
- Promote research targeted on protected areas improved conservation management practices.
- Provide equipment, transport, communications and other material to strengthen conservation of protected areas.

Long-Term (>8 years)

- Expand the program in protected areas management to include one trans-border reserve with Saudi Arabia or Oman.
- Review management needs for key priority conservation areas and facilitate implementation.

Performance Indicators

- Single department for protected area management in place.
- By 2010, at least 7 new protected areas created.
- Results of research on protected areas published and made publicly accessible.

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2. Endemic and Endangered Species

The flora of Yemen is very rich and heterogeneous. Species diversity is a result of considerable climatic changes in former periods, which enabled different species to survive in the different ecological habitats. Over 3 000 plant species are possibly found in the mainland and about 10% of them are endemic. One checklist¹⁰ comprised 467 plant species belonging to 244 genera from 71 families. Socotra Island is unique in its flora and like many oceanic islands, has a high level of endemism. The latest study reported that Socotra contains

¹⁰ Compiled by S. Gabali & A. Gifri (1990).

approximately 850 plant species, 254 (about 30%) of which are endemic. Out of the eight plant genera endemic to the Arabian Peninsula, ten genera are restricted to the Socotra archipelago.

The majority of endemic taxa in Yemen are associated with mountainous areas which provide a rich variety of ecological niches and offer a degree of environmental stability during periods of climatic changes. Endemism is generally very high among the succulent plants. The largest numbers of endemic species are found within the Asclepiadaceae taking into account the Stapeliad genera (*Carraluma*, *Duvalia*, *Huernia*, and *Rhytidocaulon*). Euphorbiaceae and Aloeaceae also have high percentage of endemism as they include the succulent *Euphorbia* and *Aloe* species respectively. Precise data on the status and number of rare and endangered plants are not available. Some eight species (seven of these from Socotra) are included in the IUCN Red Data Book as being endangered or rare, and an additional 19 species are considered to be endangered or rare at the national level in Yemen.

Yemen has a rich and diverse terrestrial fauna because of the wide range of habitats in the country and due to its position at the juncture of three major bio-geographic regions, the palearctic, Afro-tropical and oriental regions.

Yemen has 71 recorded land mammal species representing eight orders including bats. About one third of the mammals are relatively large species which are rare in other parts of Arabia such as the Idmi or Arabian Mountain Gazelle (*Gazella gazella*), Ibex (*Capra ibex nubiana*), Baboon (*Papio hamadryas*), Arabian Red Fox (*Vulpes vulpes arabicus*), Sand Fox (*Vulpes ruppelli*), Blanford's Fox (*Vulpes cana*), Striped Hyena (*Hyaena hyaena*), Arabian Wolf (*Canis lupus arabs*), Jackal (*Canis aureus*), Arabian Leopard (*Panthera pardus nimr*), and possibly the Cheetah (*Acinonyx jubatus*).

It is notable that seven mammal species are now considered endangered including three of the four species of gazelle, and another three species the Cheetah, Arabian Oryx and the four gazelle, the Queen of Sheba's Gazelle are now extinct in the wild. Furthermore, most sizeable mammals have long since been hunted into extinction in this country where firearms abound and a large proportion of the natural forests have been cut down. With some dedication and luck, ecotourists may still spot rare land animals such as the Arabian leopard, hyena, Hamadryas baboon, honey badger, hedgehog, ibex, and fox.

Yemen has ratified the Convention on International Trade in Endangered Species of Fauna and Flora (CITES), and has recently enacted by-laws to implement the treaty.

Yemen also has a very rich bird life with more than 363 species thus far recorded representing 18 orders, 61 families and 177 genera. It is a home to a large number of species that are endemic to southwest Arabia. For a country to be so richly endowed with endemic birds is of great significance to its international significance. With the exception of the Arabian Golden Sparrow all endemic species occur on the mainland. The loss of the terracing systems could adversely affect several of the endemics as a result of soil erosion and loss of trees. Terrestrial arthropods are represented by 5 classes, 38 orders, 313 families, 1 833 genera, and 3 3 species.

From an eco-tourism point of view, endemic birds have the highest relevance. The endemic and near endemic species of the mainland found in the southern portion of the Arabian Peninsula are: philby's and Arabian partridges, Arabian woodpecker, Yemen thrush, Arabian wheatear, Yemen warbler, Arabian golden sparrow, Arabian waxbill Yemen accent

Arabian olive-rumped and Yemen serins, Yemen linnet, and golden-winged grosbeak. The endemic species to Socotra Island include the Socotra warbler, Socotra cisticola, Socotra sunbird, Socotra starling, Socotra sparrow, and Socotra bunting

The authoritative report by M. Evans et al (1994) on *Important Bird Areas of the Middle E* contains a detailed inventory of 57 sites, which are of vital importance for the conservation birds in Yemen. These 57 sites, covering a total area of 7 300 sq km or about 1.4 % of the area of the country contain all the endemic or near-endemic bird species, as well as other rare significant or limited-range species. These sites, distributed around the country (including Socotra Island), also represent prime eco-tourism destinations in Yemen since, apart from containing important and interesting avifauna, many of them consist of relatively undisturbed natural areas and are of great botanical interest. Some of them also contain other interesting types of animals. However, none of these sites are legally protected for nature conservation purposes (although some may be covered by traditional resource-use reserves or Mahjur) and many of them are in serious risk of degradation or destruction.

Key Issues

- Weak monitoring capabilities for endangered and rare species.
- Lack of enforcement of wildlife protection measures.
- Inadequate systematic population monitoring of species, specially endangered ones.
- Lack of information on the status and habitat requirements of species at risk.
- Habitat destruction caused by activities associated with development.

Sub-goal: Conservation and rehabilitation of key endangered species through 1 enforcement, information gathering and implementation of community-based in-situ conservation programs of key endangered flora and fauna.

Priority Objectives

Short-Term (1-3 years)

- Inventory existing information on endemic plant and animal species.
- Prepare and effect by-laws and regulations on protection of endangered and threatened wildlife species.
- Prepare and establish an IUCN red list of rare and endangered species of Yemen.

Medium-term (4-8 years)

- Design and implement a local community-based program related to *in situ* conservation of selected endemic, endangered fauna and flora.

Long-Term (>8 years)

- Prepare and implement recovery and rehabilitation plan for threatened species

Performance Indicators

- By 2006, inventory of endemic species published.
- By 2007, relevant by-laws and regulations on wildlife protection prepared and enacted.
- Pilot community-based in-situ conservation programs for endemic, endangered fauna and flora implemented.
- Recovery and rehabilitation plans prepared and implemented.

3. Ex situ Conservation

Ex-situ biodiversity conservation measures are only complementary to those for in-situ conservation. Ex-situ biodiversity conservation depends on a number of kinds of facilities such as seed banks, gene banks, zoos, botanic gardens, etc. The NEAP pointed out the need for inventorying species and prioritizing those, which need ex-situ conservation. The Environment Protection Law (EPL) does not address the issue of ex-situ conservation. This aspect of biodiversity conservation urgently needs legislation, especially as it relates to rare endemic and endangered species.

Despite the large biodiversity and the rich genetic resources of Yemen, there is slow development in the establishment of seed banks, gene banks, herbarium, and zoological and botanical centers. Specifically, there are only two nucleus units of genetic resources centers Sana'a University and Agriculture Research and Extension Authority (AREA) in Dhahran. Their primary role is to collect and preserve selected organisms alive outside their natural habitat for the purpose of captive breeding, propagation and potential re-introduction, but their effective role is hampered by limited resources and facilities.

There is a need to prepare a national policy on ex-situ conservation addressing wild and domesticated or cultivated biological resources (plants, animals and microorganisms). Among other issues the policy should address collection, research, importation and exportation of biological materials, and property rights over the collected specimens. The policy should also address issues related to the management of ex-situ conservation facilities particularly to building human and physical capacity for establishing and maintaining ex-situ collections. The environmental impacts of reintroducing or re-establishing species conserved ex-situ should also be addressed. This policy should be harmonized with the EPL and executive by-law, and with the draft by-law on access to genetic resources.

Key Issues

- Lack of genetic resources centers that can collect genetic materials and conserve them to be available for research and genetic improvement.
- Lack of botanical garden for collecting and preserving rare and endangered flora.
- Absence of a Natural History Museum for biological diversity in Yemen

Sub-goal: Ex-situ conservation of rare and endangered native taxonomic groups of plants species by improving knowledge and understanding of species and ecosystems and through the establishment and strengthening of gene banks, seed banks, green belts, botanical gardens and public gardens.

Priority Objectives

Short-Term (1-3 years)

- Develop and establish a basic reporting system for monitoring biodiversity deterioration.
- Prepare and adopt a national policy on ex-situ conservation.

Medium-term (4-8 years)

- Stimulate *ex situ* conservation through the establishment of gene banks, seed banks, green belts and public gardens.
- Develop guidelines for collection, maintenance and reintroduction of plants and animal species in ex-situ programmes.

Long-Term (>8 years)

- Expand the establishment of botanical gardens, National Herbarium and Seed Banks to collect, house and preserve rare and endangered native taxonomic groups of plants species of Yemen.

Performance Indicators

- By 2005, a reporting system for monitoring biodiversity in place.
- By 2008, a national policy on ex-situ conservation prepared and enacted.
- Number of gene banks, seed banks, green belts and public gardens established.
- Guidelines on collection, maintenance and reintroduction of plants and animal species developed and used.

4. Alien Invasive Species

Invasive plants or animals are no exceptions, as non-native species, are among the high threat to the native species especially the threatened and/or endangered species. They create permanent impacts on ecosystems and ultimately contribute to the loss of biodiversity. For example, invasive plants compete with native species for resources because it has no natural predators or pests, thereby becoming dominant. They out-compete native plants that are food supplies for animals in the ecosystem and alter the invaded ecosystem and species composition to such an extent that they threaten native flora and fauna.

Non-indigenous plant species are spreading rapidly in Yemen and have invaded a wide range of habitats. Moreover, the number of exotic species is not precisely known and not yet well studied. As the number of these invasive species increases, more native plants will come in direct competition with and be threatened by the non-native species and become endangered and possibly extinct.

Yemen is characterized by large diversity of native species, varieties and soil types adapted to different agro-ecological zones. Uncontrolled introduction of invasive plants, insects, microorganisms and animals has caused the degradation, decline and extinction of some native and/or endemic species. Crops such as wheat, lentil and millet are examples of local varieties whose yield and quality are deteriorating as a result of introducing homogeneous high yielding varieties. Similarly, the introduction of alien genera of honeybee has resulted in reduction of the Yemeni honeybee race *Apis mellifera jemenitica* as a result of spreading the varroa mite pest. Such undesirable introduction has had major environmental and economic impacts. Recent examples include citrus nurseries, which introduced diseases, and the armyworm.

Some other alien invasive species have also caused wide spread distortion of eco-systems. This has particularly been the case when introduced under weak environmental management.

and control system that paid insufficient attention to their potential impacts. One good example is the species of the mesquites plants known as *Prosopis juliflora*, which was intentionally introduced into Hadarmout four decades ago. It was introduced as a planting scheme along roads, farms and public garden and has subsequently invaded many agricultural lands, irrigation canals, drainage lines and downstream beaches of wadies. However, when introduced to Say'un and Tarim areas under appropriate environmental control system unwanted weedy component, *P. Juliflora* have been found of great importance to the community there, providing them with substantial quantities of wood, firewood, charcoal and animal fodder.

In short, undesirable introduction has had adverse environmental and economic impacts over the past decade and thus control of alien harmful species is necessary to conserve biodiversity and to halt further destruction of ecosystems.

There is a clear need to prepare a national policy which addresses the problems of all invasive species. The policy should establish the basis for an integrated risk-based approach to controlling and managing intentional and unintentional introductions of these organisms. Important pathways for introduction should be identified and appropriate legal and institutional measures should be applied on a pathway-by-pathway basis. The policy should also address measures for control and eradication of these organisms, including liability, at introduction.

Key Issues

- Lack of adequate information of the type, numbers, status and structure of alien species.
- Lack of institutional capacities in evaluating and preserving alien species.
- Lack of monitoring system for alien invasive species.
- Lack of adequate legislative tools to control introductions of alien invasive species.
- Absence of preventive and remediation measures.

Sub-goal: Establishment of an effective control and monitoring system backed up with information system and legislative framework for the trade, use, and control of alien invasive species.

Priority Objectives

Short-Term (1-3 years)

- Prepare a list of alien invasive species and identify the most dangerous ones.
- Monitor and control the expansion of key alien invasive species.
- Strengthen quarantine measures to control intentional and unintentional introduction of alien invasive species

Medium-term (4-8 years)

- Develop and implement control programs for key alien invasive species.

Long-Term (>8 years)

- Develop relevant legislation to control the importation and trade of alien invasive species.
- Develop and strengthen database of alien species
- Establish a specialized unit to be concerned with alien invasive species.

Performance Indicators

- By 2007, a list of alien invasive species published and disseminated.
- Number of control programs for key alien invasive species completed.
- By 2010, adequate legislation regulating import and trade of alien invasive species in place.
- By 2012, a list of most dangerous alien invasive species eradicated and controlled.

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Goal 2. Sustainable Use of Natural Resources

5. Terrestrial Wildlife Resources

Yemen hosts a variety of habitats which range from coastal mangroves, shrub lands and dunes along the coastal plains to the eastern deserts and an array of montane habitats that reach elevations of up to 3760 m at Jabel Al-Nabi Shauib, the highest point on the Arab Peninsula. Rapid degradation of the environment, a direct result of desertification and droughts, among the oldest global environmental phenomena, are drastically reducing the country's vegetation cover and posing severe threats to wildlife, including many endemic species. Over the last several decades, the area of natural habitat has decreased or been degraded, through over-exploitation of range resources, land conversion, poor agricultural practices and the pressures of an ever expanding population with a current growth rate of some 3.5% per annum, one of the highest rates in the region. Wildlife populations are thought to have declined considerably, and agricultural production has undergone dramatic changes due to the expansion of qat plantations at the expense of other crops. The centuries-old harmonious relationship of people and environment that has characterized Yemen's culture and history is rapidly disappearing. These alarming trends demand urgent conservation attention, if even representative portions of Yemen's natural biotic wealth are to remain for future generations.

Key Issues

- Degradation and conversion of natural habitat.
- Desertification, including wind erosion and sand dune encroachment
- Agricultural expansion and poor agricultural practices.
- Wood cutting for firewood, timber and charcoal production.
- Overgrazing of rangelands including loss of sustainable practices of sound rangeland management by local people.
- Over-hunting and indiscriminate killing of wildlife species, especially ungulates and carnivores.
- Overuse and depletion of limited fresh water.
- Degradation of wetland ecosystems.
- Improper application and use of persistent pesticides and chemical fertilizers.

- Contamination of ecosystems with sewage, industrial waste and other pollutants.
- Smuggling and uncontrolled exporting of indigenous livestock and native genetic species.
- Low public awareness and appreciation for biodiversity conservation.
- Inadequate legislative tools and conservation measures for the protection of indigenous plant and animal species/varieties.

Sub-goal: Strengthening the sustainable utilization of terrestrial wildlife resources through developing legislations and policies prohibiting hunting and capturing wildlife and expanding programs on rangelands, forest restoration and abatement of desertification.

Priority Objectives

Short-Term (1-3 years)

- Evaluate maps and data availability, information accuracy and gaps for endangered ecosystems, habitats, vegetation and threatened or rare endemic species.
- Develop and update data-base and GIS information systems on biodiversity, including species, habitats, vegetation and other thematic information.
- Conduct surveys and research on rangeland utilization and management patterns to assess effectiveness of rangeland management and utilization.
- Halt hunting and capturing wildlife until utilization of wildlife is surveyed, assessed and regulated.

Medium-term (4-8 years)

- Formulate rangeland policies and programs for improving rangeland management.
- Expand action program for forest restoration and desertification reduction.

Long-Term (>8 years)

- Support traditional and environmentally sound land use practices.
- Expand rangeland management program, to include more areas in the country.

Performance Indicators

- Gaps in maps and information pertaining to endangered ecosystems, habitats, vegetation and rare species identified.
- Data-base and GIS information systems on biodiversity established and functioning.
- Assessments report on rangeland management and utilization published and accessible.
- Survey and assessment report of wildlife utilization published.
- By-laws on wildlife utilization prepared and enforced.
- A rangeland policy in place and a number of rangeland management programs completed.
- Number of forest restoration and desertification control programs implemented

- Traditional and environmentally sound land use practices in place

6. Coastal/Marine Life and Fisheries

Yemen's coastal and marine environment is both diverse and attractive from its rocky and sandy coasts to the saline mud flats, mangrove swamps, coral reefs and seagrass beds. Fringing and bottom reefs are known to contain at least 90 species of corals which has thus far been recorded. There is likewise a great diversity of fish (416 species), 82 species of sea and shore birds, 625 species of mollusks, algae (485 species), phytoplankton (2 species), as well as four species of marine turtles, including the most important nesting beach for green turtles in the entire Arabian Region at Ras Sharma. Compared to other parts of the Red Sea, the shallow nutrient rich waters above the wide continental shelf of Yemen are rich fishing grounds. Fish supply a great amount of protein in the diet of Yemenis, and now with the improved road communications systems, people in the populated mountainous areas can also enjoy a more diverse diet with seafood. An array of threats from pollution to coastal reclamation and bottom trawling currently threatens Yemen's coastal and marine environment. It is important to limit these threats and initiate and implement sound integrated coastal zone management for the sustainable use of Yemen's marine and coastal environment including the identification and management of protected areas.

The over 2 500 km coast of the mainland is suffering from pollution and saltwater intrusion. The most surface water is fully exploited upstream. The sea along the mainland coast and on numerous islands in the Red Sea are heavily trafficked, and prone to oil spills from ships and oil terminals. Marine critical habitats such as mangrove, seagrass and important coastal sites for bird feeding and breeding are increasingly threatened by coastal development. If planned correctly, development in Socotra Island will have considerable environmental impact on marine resources, including coral, fish and turtle species. Tourism attractions of the country include possibilities for diving and snorkeling in the coral reefs of the Red Sea, the Gulf of Aden and Socotra Archipelago.

Moreover, coral reefs and seagrass important to fish and other marine life are destroyed by trawling and other unsuitable harvesting methods causing loss of productivity and threat to endemic and rare species. The formerly rich fish resources on the country's continental shelf are now reduced through overtake. Due to overexploitation of resources, a number of animal and plant species, some of which are globally threatened, rare and endemic to Yemen, are endangered or already extinct.

Key Issues

- Marine and coastal habitat degradation caused by unplanned coastal reclamation.
- Over-exploitation, pollution and mismanagement of fishing in the Red Sea, Arabian Sea, Gulf of Aden and Yemeni Islands.
- Degradation of coastal and marine habitats caused by ship dumping, industrial, agricultural and sewage waste.
- Sharp decline in important marine resources especially lobsters, cuttlefish, shrimps and sharks caused by over-fishing, poaching of foreign vessels, uncontrolled gear and fishing effort, and lack of quality controls.
- Destruction of coral reefs and underwater habitats caused by bottom trawling, ornamental fishing

- Non- functional fishing law

Sub-goal: Conservation and sustainable use of marine and fishery resources through the development and strict implementation of policy, legislation and management tools that ensure harvest levels of biological resources are maintained within the biological limits. Examples of priority actions include the development of coastal zone management plans, establishment of marine protected areas, hazard control, prevention of illegal and unsustainable fisheries, etc.

Priority Objectives

Short-Term (1-3 years)

- Design and conduct inventory, surveys, habitat mapping, and sensitivity analysis of the entire coastline, including distribution of rare and endangered species.
- Assess impact and extent of mangrove cutting and grazing and find alternative sources of wood and camel fodder.
- Establish improved data base management systems of fishery resources based on stock assessment for cuttlefish, rock lobsters, shrimps, sharks, sea cucumber and other species.
- Prepare and implement pilot Integrated Coastal Zone Management Plans (ICZMP) for Balhaf-Bir Ali area, Al-Hodidah and Jethmun-Sharma and red sea eco-system
- Declare protection areas on Sikha Island, Jethmun-Sharma, AlloHayah and Kamaran

Medium-term (4-8 years)

- Complete coastal zone mapping for the mainland and islands.
- Establish a national body, with appropriate representation of communities, local administrations and NGOs, for ICZMP.
- Enhance ICZM planning through establishing regional branches of central authorities.
- Develop fisheries management plans based on fish stock assessments.
- Continue stock assessment for other commercial pelagic and demersal fishes.
- Conduct studies on coastal and marine environment to develop and implement local communities' strategies on sustainable management and use of their fishery resources and recovery of depleted areas.
- Assist fishing communities in protecting traditionally used areas from outsiders, implementing alternative programs during fisheries recovery periods, and marketing their marine products.

Long-Term (>8 years)

- Conserve key threatened coastal and marine species, habitats and ecosystems.
- Re-plant/re-forest mangroves wherever feasible.

Performance Indicators

- By 2007, inventory reports and maps on coastline habitats and endangered species published.

- By 2007, assessments report on mangrove clearance and alternative options for camel fodder published.
- By 2007, data base management systems for fishery resources in place and Functional.
- Four pilot Integrated Coastal Zone Management Plans implemented.
- By 2009, two marine areas legally declared as protected areas.
- By 2009, a national agency for costal zone management legally declared and functioning.
- Fish stock assessment report prepared.
- Adequate fishery management plans officially approved.
- By 2008, local communities' strategies on sustainable management of fishery developed.
- Pilot area of forest mangroves re-planted.

7. Agro-biodiversity

Historically, Yemen was a good example of economical and sustainable use of the available natural resources, where conservation of soil, crops and rangelands were part of the traditional systems, and agricultural terraces were mainly built for conserving water and preventing soil erosion. Given the low growth rate in agricultural GDP, which averaged only 6.7 % during the period 1997-2001, combined with population growth rate of the highest in the region (3.5% according to 2001 Census), it is likely that natural resources deterioration associated with critical food shortage will continue to be of pressing issues hindering sustainable development until this situation is reversed. Production systems have already approached their maximum potential with the full use of limited resources such as water and natural vegetation. The development policy in the past 30 years has been focused on short-term objectives, which provided immediate economic benefits, while the impact of this development process on the environment was ignored. As a result, destruction and degradation of natural resources has reached a critical level. If Yemen is to achieve sustainable development in the future, agricultural biodiversity conservation projects must be included in the development and socio-economic plans of the government.

Key Issues

- Deterioration of native genetic resources as a result of introduction of alien species.
- Improper application and use of pesticides.
- Insufficient and unreliable information and networking on agricultural biodiversity.
- Desertification, terraces and rangeland degradation associated with rapid urbanization.
- Increased water depletion for qat production and agriculture irrigation associated with lack of water conservation systems.
- Declining agricultural production caused by drought and degradation of agro-systems.
- Abandonment of productive traditional agricultural practices.
- Improper use of agro-chemicals (pesticides, fertilizers, fruit ripening agents, etc.).
- Over-grazing and over-cutting of trees and shrubs for fuel consumption.

- Limited capacity and funding for biodiversity and agricultural research.

Sub-goal: Conservation of biological resources through the adoption of ecologically sustainable agricultural and pastoral management practices, including control of fertilizer and pesticides, terrace management, traditional land use and water management systems, introduction of modern irrigation systems, etc.

Priority Objectives

Short-Term (1-3 years)

- Conduct research on improvement of drought resistant varieties, terrace management, traditional land use and water management systems, and introduction of efficient irrigation systems.
- Encourage research on the use of alternative feed resources and agro-processing by-products as a ruminant feed to reduce pressure on rangelands.

Medium-term (4-8 years)

- Promote in situ conservation of indigenous crops by farmers.
- Promote integrated pest management techniques.
- Develop incentives for natural fertilizer use in replacement of imported agrochemicals.
- Provide incentives and implement pilot projects in propagation of local and crop varieties and replacing qat plantations with cash crops, coffee and grapes.

Long-Term (>8 years)

- Implement pilot projects on land use management, terrace management, desertification, and in situ conservation of rangeland.
- Adopt programs to reduce ground water consumption through wastewater recycling, efficient irrigation, etc.
- Enhance seed banks.

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Performance Indicators

- By 2007, results of research in five agro-biodiversity areas published.
- Number of farms applying integrated pest management techniques.
- Quantity of natural fertilizer use increased and level of agrochemical fertilizer import reduced.
- Areas of cash crops, coffee and grapes increased and qat plantation reduced.
- Number of pilot projects on terrace rehabilitations, desertification, and in-situ conservation of rangeland implemented.
- Number of wastewater recycling and efficient irrigation programs completed.

Goal 3. Integration of Biodiversity in Sector Development Plans

8. Infrastructures and Industry

Industrialization plays a fundamental role in achieving a high rate of economic growth, creating job opportunities and in providing for the basic needs of the population. According to the results of a recently conducted industrial survey, the size of the industrial sector in Yemen accounts for only 4% of GDP and employs only 2% of the Yemeni labor force.

Over the past 20 years, it has been found that industry, transport and construction works have had increasing direct and indirect impacts on biodiversity resulting from the use of antiquated and polluting technologies, the lack of enforcement of EIA procedures and the absence of quality and waste management standards. The gross industrial product of the nation has resulted in the overuse of natural resources and serious ecological problems. In particular, pollution from the mineral industry, heavy industry, household waste, air emissions and noise has had a significant impact on biodiversity.

Key Issues

- Weak implementation of EIA procedures for development projects.
- Poor investment from the private sector in community-based biodiversity projects.
- Lack of policy addressing air pollution, wastewater, and solid waste production from industrial sources.
- Weak enforcement of standards regulating industrial activities.
- Use of environmentally unfriendly technologies.

Sub-goal: Reducing infrastructures and industry adverse impacts on habitats and ecosystems through eco-tech introduction, EIA enforcement and effective regulating policy.

Priority Objectives

Short-Term (1-3 years)

- Enforce EIA procedures implementation for infrastructure and industrial projects.
- Regulate the use of dangerous chemicals.
- Develop policies and regulations concerning use of appropriate and safe technologies.

Medium-term (4-8 years)

- Promote certification processes leading to the adoption by industry of more responsible and efficient production.
- Review, amend and adjust laws, by-laws, and regulations to prevent industrial pollution.

Long-Term (>8 years)

- Promote eco-tech in replacement of unfriendly industrial technologies polluting coastal and marine habitats and ecosystems.

Performance Indicators

- EIA procedures in place.
- Laws, by-laws, and regulations on preventing industrial pollution reviewed, updated and enforced.
- Laws on dangerous chemicals prepared and enacted.
- Industrial certification for eco-industry and eco- production in place.
- Policies and regulations on safe technologies prepared and enforced.

9. Biotechnology and Biosafety

Given that biotechnology and biosafety are relatively new issues in Yemen, there is poor understanding and knowledge on the nature and extent of the risks on biodiversity associated with the transfer of biotechnology and the use of living modified organisms (LMO). Furthermore, there is no specific entity responsible for handling the safe use and transfer of biotechnology and LMOs. These deficiencies, combined with unavailability of policy and legislation framework for regulating biotechnology and biosafety issues, are likely to cause a high level of risk on the country's fragile ecosystems and its endemic species. Therefore, in order to foster this situation and halt any further biodiversity destruction, there is a need to develop a national biosafety framework.

Key Issues

- Poor knowledge and understating of the nature and potential impacts of living modified organisms (LMO) on biodiversity.
- Lack of protection measures and legislations to regulate the use and release of living modified organisms.
- Lack of institutional framework for the management and monitoring of biotechnology and biosafety issues.
- Weak national capacity in the field of modern biotechnology.
- Absence of policy addressing biotechnology and biosafety issues.

Sub-goal: Mitigating the potential risks associated with the use and release of living modified organisms (LMOs) and the introduction of biotechnology on human and biological diversity through developing and implementation of biosafety frameworks, developing biosafety guidelines and creating an entity to manage and control biotechnology and biosafety issues.

Priority Objectives

Short-Term (1-3 years)

- Carry out stock-taking and assessment of existing biotechnologies and their safe application and use.

- Identify and analyze options for biotechnology applications and implementation of biosafety frameworks.
- Prepare and enact national biotechnology policy and biosafety frameworks.

Medium-term (4-8 years)

- Create an entity responsible for the management and control of biotechnology and biosafety issues.
- Implement priority activities and information exchange requirements.
- Develop National Biosafety Database.
- Assess feasibility and impacts of applying genetically engineered seeds to introduce drought-resistant, herbicide-tolerant, insect-resistant and saline-resistant species of crops, fruits and vegetables.
- Regulate, manage or control the risks associated with the use and release of living modified organisms (LMOs) resulting from biotechnology which are likely to have adverse environmental impacts affecting the conservation and sustainable use of biological diversity.

Long-Term (>8 years)

- Strengthen institutional capabilities in the field of Biosafety.
- Enhance management skills in biosafety issues through training.

Performance Indicators

- Stock-taking of safe use of biotechnologies published.
- A national biotechnology policy and biosafety frameworks prepared and enforced.
- Laws on LMOs and Biotechnology prepared and enacted.
- An entity for the management of biotechnology and biosafety created and functional.
- A National Biosafety Database established and made publicly accessible.
- Assess report on applying genetically engineered seeds published.
- Number of genetically engineered species safely introduced and controlled.
- Number of staff trained in Biosafety.

10. Tourism and Eco-tourism

Yemen is characterized by many features that make it a destination for tourists from all over the world. UNESCO has declared three ancient Yemeni cities (Sana'a, Zabid and Shibam) World Cultural Heritage Sites. Yemen's unique biodiversity, particularly on Socotra, attracts eco-tourism¹¹. The NEAP emphasized the importance of ecotourism, especially in the Socotra Archipelago and along the thousands of kilometers of coastal areas, which extend along the Red Sea, Gulf of Aden, and the Arab Sea. Nevertheless, legislation regulating tourism

¹¹ For the purpose of this paper, eco-tourism is defined as tourism that: “ has a low-impact on the environment and local cultural values and which is used to help sustain local economies and the conservation of the natural and built heritage”.

general, and ecotourism in particular, can still be considered insufficient, and is a source jurisdictional overlaps and conflicts.

Yemen's Environmental Protection Law (EPL) addresses eco-tourism in broad general terms and there is a need for it to be amended to adequately account for eco-tourism concerns. The EPL provisions on EIA requirement for licensing development projects or establishments should also apply to tourism projects. The General Authority for the Protection of Historical Cities also must approve any tourism projects in historical cities or in the close vicinity of historical monuments or sites. A first step in any initiative to rationalize the tourism sector must focus on jurisdiction harmonization.

Aware of the exceptional importance of eco-tourism and its enormous potential for Yemen, the General Tourism Authority established, in cooperation with EPA, a department of eco-tourism. In 2002, the department was shifted to Ministry of Culture and Tourism and Aid support to this department is provided from various international institutions. The department has prepared a draft law on ecotourism. There is a proposal to consolidate all the existing and proposed legislations into one general law governing the sector.

In addition to legislation there is a need for a comprehensive national tourism policy, which should set goals for the sector, establish coordination mechanisms among all institutions involved in the sector, establish standards to be followed when developing tourism projects, define the concept of eco-tourism in the Yemeni context, determine areas most suitable for eco-tourism, etc.

Key Issues

- Lack of knowledge on eco-tourism attractions.
- Insufficient level of professionalism and training in the tourism sector, including eco-tourism.
- Poor environmental awareness and ecological education amongst populations.
- A generalized deficiency in eco-tourism facilities.
- Inadequate legislative framework and weak enforcement of eco-tourism legislation.
- Weak local communities and private sector participation in tourism management and investment in this sector.

Sub-goal: Achieving the conservation of biological resources through the adoption of ecologically sustainable management practices for tourism and recreation.

Priority Objectives

Short-Term (1-3 years)

- Conduct surveys of areas suitable for eco-tourism, taking into account habitat vulnerability.
- Consider criteria for eco-tourism development in protected areas and buffer zones.
- Minimize the impact of tourism activities on biodiversity and natural habitats.
- Assess impacts of recreational activities in coastal areas.
- Prepare proposals of pilot tourism projects based on significant natural and/or cultural attractions.
- Develop manpower development plan for the sector.

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Medium-term (4-8 years)

- Promote cooperation and participation of the private sector, NGOs and local communities in tourism investment and management.
- Review, update and publish a directory for eco-tourism sites.

Long-Term (>8 years)

- Promote eco-tourism in established and managed national parks.

Performance Indicators

- Survey reports on eco-tourism published.
- Criteria for eco-tourism development published and enforced.
- Four assessment reports on eco-tourism impacts on coastal sites published.
- Number of pilot tourism projects in areas of significant natural and/or cultural attractions implemented.
- Human resource development plan for tourism sector implemented.
- Number of investment project in tourism completed by private sector, NGOs and local communities.
- A directory for eco-tourism sites published.

11. Urban, Rural Development and Land-use Planning

Land use planning is the process through which the allocation of discrete areas for different land use activities is determined. In land use planning, land use areas are locked out for specific uses within the context of higher order planning criteria and directives and requirements of integrated national, regional, or urban planning.

The continuing absence of a comprehensive rural development program has contributed to unabated migration to urban areas. The absence of far-reaching comprehensive land use and human settlement plans has resulted in the growth of informal settlements. Rapid urbanization has resulted in the conversion of agricultural land to residential, commercial and industrial uses, has displaced informal settler communities and undermined food security. Thus, cities have deteriorated as human habitats, become beset with intractable and often interrelated problems including inadequate mass transportation and road systems; pollution, inadequate and inappropriate waste disposal; flooding; water shortage; deterioration of sanitation, health and other basic services.

Transactions for the acquisition of land for urban and industrial development have grown rapidly in all parts of the country, principally beside main roads and along coastal shores. Owing to this, and to steady and rapid rural to urban migration, Yemen faces immediate as well as long-term environmental problems. Along the shorelines, this is leading to very intense, erratic and unforeseeable coastal dune erosion and sand movement. Due to lack of urban planning, most agricultural land in cities and along main roads is illegally exploited for residential and other urban usage, resulting in the loss of highly productive agricultural land and causing land and water degradation. The explosion in building activities has resulted in the opening of many quarries that have affected local communities, damaged the landscape and caused the loss of arable land.

Key Issues

- Loss of natural habitats as a result of deforestation, desertification and land conversion.
- Destruction of sensitive natural habitats caused by unplanned land reclamation.
- Rapidly growing population with intensive use and pressure on natural resources particularly in the densely populated centers of the country.

Sub-goal: Minimize uncontrolled urbanization through developing and implementing land use management plans and enforcing land use regulations.

Priority Objectives

Short-Term (1-3 years)

- Promote traditional and environmentally friendly land use practices (e.g. traditional rain-fed agriculture, agro-forestry).
- Enforce rangeland management and control illegal logging.

Medium-term (4-8 years)

- Develop and implement land regulation, pricing and registration.
- Continue forest restoration and desertification control programs.
- Halt uncontrolled urbanization and enhance land-zoning and land use management plans.
- Improve mapping of soil degradation and desertification

Long-Term (>8 years)

- Improve maps for land registration and ownership, soil and plant cover.
- Expand desertification control programs focusing on conservation of plant cover, reduction of soil erosion and watershed management.

Performance Indicators

- Number of land-zones and land use management plans implemented.
- At least three models of friendly land use practices (e.g. traditional rain-fed agriculture, agro-forestry) replicated.
- Reduction rate in the volume of illegal logging.
- Land regulation, pricing and registration systems in place.
- Number of forest restoration and desertification control project carried out.
- Soil degradation and desertification maps developed for extended geographic areas

12. Waste Management

Waste management is one of the major environmental problems. The volume of solid, liquid and gaseous waste generation including hazardous waste increases rapidly in the absence of sound and competent waste management. This may lead to serious environmental problems affecting soil, ground water, air, human health, animals and plants, especially since some of these wastes are hazardous.

The principal sources of environmental pollution in Yemen can be summarized as follows:

- Solid waste and sewage from cities and populated centers, which are discharged into the sea, deposited in open spaces or buried under the soil or agricultural land;
- Waste and effluents from laboratories and factories;
- Chemical waste and effluents arising from the use of pesticides and/or other chemicals;
- Waste oil and hazardous waste discharged on the ground;
- Waste discharged by ships into Yemeni territorial waters as well as oil spills from passing tankers, warships, submarines;
- Shipwrecks and collisions at sea.

The Government, with limited capacities, is undertaking a set of measures to dispose of waste in a traditional fashion in landfills, which receive waste for incineration or dumping with separation or recycling. In the absence of financial, technical treatment and recycling capabilities, wastewater is directly discharged into the environment without treatment. Also, in the absence of effective regulations, the food industry and hospitals are operating without adequate consideration of environmental impact and large quantities of untreated solid and liquid waste are directly dumped into the environment.

Similarly, air-pollution from industry, energy and transport sectors is inadequately controlled, causing many threats to human health and to the environment. To mitigate air pollution from the transport sector, the Government has encouraged the substitution of gasoline and diesel fuel with gas and is now preparing a national action plan to mitigate air pollution from various sources (see section 14 on climate change). The industrial community is encouraged by the Government to prevent pollution through improved design, introduction of eco-technology, developing new processes, recycling hazardous/useful materials from waste, and producing non-polluting goods.

Key Issues

- Weak enforcement of solid waste management guidelines.
- Inappropriate practices/ lack of norms regarding waste management.
- Weak awareness and knowledge of solid waste impact.

Sub-goal: Reducing adverse impacts of waste on ecosystems through the adoption of an ecological policy and the introduction of new techniques such as recycling, treatment and green technology.

Priority objectives

Short-Term (1-3 years)

- Assess water quality, liquid and solid waste dumping nearby coastal cities and ports.
- Study the feasibility of liquid waste recycling.
- Enable relevant agencies and stakeholders including NGOs and local communities to implement environmentally sound techniques.
- Develop program to decrease waste production in households.
- Prepare plans for improving sewage systems.

Medium-term (4-8 years)

- Develop and implement Pilot projects for composting, recycling, and reuse of solid waste
- Enforce regulations preventing dumping of industrial liquid and solid waste into coastal areas and the sea.
- Enforce EIA for all relevant projects (e.g. landfills, waste projects, and treatment plants).

Long-Term (>8 years)

- Support the implementation of the Solid Waste Management (SWM) guidelines (e.g. monitoring landfills).
- Implement Pilot projects to demonstrate sustainable waste management.
- Develop and implement hazardous waste management systems

Performance Indicators

- Four assessment reports on water quality and waste dumping for coastal areas published.
- Feasibility study on liquid waste recycling published.
- Reduction rate of household waste production.
- Number of new connections to sewage systems.
- Number of completed Pilot projects pertaining to composting, recycling, and reuse of solid waste.
- Enforced regulations preventing dumping of industrial liquid and solid waste into coastal areas and the sea.
- EIA fully applied to landfills, waste projects, and treatment plants.
- Solid Waste Management (SWM) guidelines applied.
- Hazardous waste management system functioning.

13. Water Management

The degradation of watersheds, from mountain ranges to coastal and marine zones in Yemen leads to rapid declines in the quality and quantity of water resources that are available to people. Deforestation of upper watersheds, overgrazing, terrace degradation and changes land use are increasingly threatening downstream areas with floods, erosion and reduced d season river flows. The continued loss of water resources, forests, agro-forestry land t systems and desertification reduces biological diversity and ecosystem integrity.

Pollution of water resources has highly negative effects on health and water availability. number of diseases are reported as being caused by polluted water and the accumulation garbage from houses.

Environmental conservation is directed towards integrated water resource management. Yemen, like in many mountainous countries of the world, pressure on upland resources (such as overgrazing and forest destruction) has increased and watershed degradation has become a major concern. In fact, watershed degradation effects and impacts have represented a serious threat not only to the environment conditions but also to the survival of people living in uplands as well as in downstream areas.

The conservation, use and sustainable management of water resources to meet the demands of growing populations have become a major concern for the country. The important role of the environment in integrated water resources management falls still behind the attention given to technical solutions and water supply aspects in Yemen's programmes and priorities.

Environmental conservation and environmentally friendly natural resource management need to be further promoted. Until today interventions such as forest restoration and terracing, which does not have a direct and short-term impact on family income is seldom considered a priority for local communities. Environmental awareness and natural resource management skills need to be improved. EPA can play a crucial role in this regard.

Key Issues

- Lack of information on the vulnerability of watersheds to climate change.
- Inadequate systems for water management, inadequate restrictions on well drilling and inefficient use of irrigation facilities.
- Fragmented and non-participatory management and planning of watersheds.
- Unclear mandates of agencies involved in watershed management.
- Weak technical capacities in watershed management.

Sub-goal: Protecting the country's limited water resources from over-exploitation and quality deterioration through optimal allocations of water resources and the use of improved quality control techniques.

Priority Objectives

Short-Term (1-3 years)

- Promote action programs for the protection and increase in quantity and quality of available water.
- Strengthen the National Water Resource Administration (NWRA) to enforce water abstraction licensing, control and monitoring system.
- Introduce wastewater discharge and strict water abstraction licensing and control systems.

Medium-term (4-8 years)

- Develop and implement watershed management plans for limited pilot areas.
- Implement integrated water management for watersheds.

- Assist rural communities in adopting collaborative management of water resources including rainfed farming, water harvesting, catchments strategies and watershed protection.
- Increase data accessibility by agencies and individuals.

Long-Term (>8 years)

- Optimize water use through reduction of water exploitation, reduction of illegal drilling, efficient irrigation, desalinisation and rational water use in key areas.
- Apply and enforce water quality standards (standards for drinking water, irrigation water, wastewater disposal and bottled water).
- Develop efficient methods for water withdrawals, harvesting and use in pilot areas.

Performance Indicators

- At least four regional management plans developed and implemented.
- Water quantity and quality improved.
- Number of drilled wells reduced.
- At least four watershed management plans implemented.
- Water quality standards enforced.

14. Climate Change and Energy

Agricultural land in different areas of Yemen is subjected to land deterioration due to numerous factors, of which the most important are the rapid runoff of water in the wadis (wadies), sand storms, the increasing use of fertilizers and the excessive pumping of underground water, in addition to the long successive period of drought. Desertification of agricultural land ranges from 3 to 5% per annum, where the area of deteriorated land due to soil erosion is estimated to be 12 million hectares and another 3.8 million hectares due to salinity¹². Additionally, desertification is further exacerbated by sand dune encroachment. The dependence of rural communities on land for their livelihoods means the adverse effects of the deterioration of land resources and desertification affect rural populations more than urban populations.

With increasing evidence of climatic variability, environmental issues in Yemen could become even more significant. Periods of extreme rainfall or drought could have serious adverse effects on the country's sustainability in terms of food and threats to industry, notably tourism. Over the past decade, Yemen has faced frequent flash floods, resulting in wide spread loss of agricultural land and great volumes of topsoil in the vicinities of wadis and in Socotra island. The drought has occurred for many years causing severe impacts on locally cultivated crops. Climate records produced by meteorological authority over the past decade indicate that Yemen has been experiencing less rainfall than in the earlier decade. Anticipated impacts of global climate change such as sea-level rise and the increasing incidence and intensity of flood rains will also exacerbate coastal erosion and degradation and lead to the increasing build-up of destructive sediments and nutrients.

¹² Source of information: Poverty Reduction Strategy Paper (PRSP), 2003-2005

The gradual increase of temperature leaves numerous impacts on agricultural production and brings about plant and livestock diseases that raise the risk to agriculture, especially since Yemeni farmers do not have the appropriate ways for protecting their crops from such change. A predicted hotter and dryer climate could also result in gradual shift of climate zones. This could lead to the displacement of the dry tropical climate, prevalent in the coastal areas, tens of kilometers into the interior. This would have an effect on the climatic features of the western and southern slopes. This displacement could bring about rainfall and push the climate towards the arid desert climate, or the humid tropical region could extend northwards which will increase the amount of torrential rain that falls on these slopes and other areas, and thus increase the probability of flooding towards the west, while increasing rainfall and thus improving the climate in the plateaus, highlands and western regions.

Climate change specialists predict that a more arid climate would be likely to result in further desertification, with increases in semi-desert and desert areas, along with significant decline in wetland areas. Such changes are likely to have important consequences for plants and animals with specific or restricted distributions, and such species may face increased risks of extinction.

Yet, information on the vulnerability of watersheds to climate change is still lacking and climate change is not currently a national development priority for the Republic of Yemen. Nevertheless there is growing government endeavor to integrate climate change issues in national development planning through the development of the National Adaptation Programme of Action (NAPA). NAPA is still in its early stages of formulation and is expected to enhance policy dialogue among stakeholders. It should also facilitate participation of NGOs, the private sector, community organizations and government agencies whose role is expected to minimize the costs and enhance the efficiency of climate change adaptation.

Fuel-wood constitutes a major source of energy, particularly for the rural household, in Yemen. People are highly dependent on fuelwood as there is a shortage of electricity and other products supply. Fuel-wood consumption is estimated to be 3.24 million metric tons of wood annually, consisting of 2.8 million tons of firewood, 260,000 tons for commercial charcoal and 173,000 tons for households' charcoal¹³. This level of wood harvest poses serious threats to nearly 19 species of common trees and shrubs, which in turn results in drastic deterioration of rangelands and wood resources. This leads to accelerated soil erosion, sand encroachment, and subsequently desertification associated with a notable decline in agricultural productive lands in addition to the loss of nurseries of many mammals, reptiles and birds inhabiting harvested areas. Beside environmental problems, the removal and burning of trees leads to the loss of carbon sinks and to increased emissions of greenhouse gases.

In 1995 GHG emission due to fuel-wood burning was estimated to be 355 Gg of CO₂, which came through burning of 324 Kt of dry wood mainly consumed by households sector and a smaller contribution by commercial. Given that Yemen enjoys a very diverse natural environment and diverse climate, this level of emission can be reduced and the country's stock of wood can be conserved substantially by shifting towards cleaner energy sources fully available in Yemen. These include solar and wind energy, agricultural and municipal solid waste and LPG. Recently, the gradual replacement of fuelwood by LPG, which has become the major fuel for cooking, has led to significant reductions in fuel-wood consumption. In order to counterbalance current trends of woodland depletion for energy purposes, the

¹³ FAO yearbook on forest products, 1995

strategy calls for preparing and developing mitigation measures to further decrease fuel-wood consumption and minimize its effects on biodiversity and climate change.

Key Issues

- Intensive use of fuelwood leading to rangeland degradation.
- Weak enforcement of existing standards for air-pollution control.
- Development and access to alternative energy sources.
- Lack of national mitigation and adaptation plans for climate change.
- Limited public awareness on climate change and biodiversity issues.
- Lack of human resources to address the issues.
- Weak recognition of the climate change issue relative to other development priorities.
- Poor understanding of the science of climate change domestically.
- Absence of an institutional structure aimed at integrating climate change issues into national plans.

Sub-goal: Mitigate the impacts of GHG emissions and subsequent climate change on biodiversity and desertification through energy mitigation strategy and a National Adaptation Program of Action (NAPA).

Priority Objectives

Short-Term (1-3 years)

- Assess current energy use to identify key areas for mitigating GHG emission and potential use of renewable and alternative energy.
- Reduce the use and GHG emissions from fuelwood through switching to cleaner energy sources and technologies (e.g. LPG lamps, solar water heating and LPG stoves in replacement of fuel-wood stoves).
- Establish energy balance and scenario.
- Implement “no regrets” mitigation policy and technologies in energy sector.
- Identify causes of desertification associated with climate change and revive indigenous knowledge of land use management systems to help combat desertification.
- Integrate biodiversity principles into climate change through developing and implementing a National Adaptation Program of Action (NAPA).
- Conduct feasibility studies on alternative sources of energy (solar, biotechnology, wind) while taking into account their potential impacts on biodiversity.

Medium-term (4-8 years)

- Develop and implement a National Mitigation Plan (NMP) for reducing greenhouse gases emissions from energy sector.
- Develop an investment strategy for Clean Development Mechanism (CDM) and implement pilot projects of best practice.
- Promote agriculture drought management.
- Improve irrigation efficiency.

Long-Term (>8 years)

- Develop energy use and air-quality strategy.
- Develop and enact air quality control measures.
- Establish national coordination body for emergency and disaster management.
- Prepare emergency and disaster management plan.

Performance Indicators

- A report on options to mitigate GHG emissions from energy sector published.
- Reduction rate of fuelwood consumption.
- Utilization rate of cleaner energy sources/technologies.
- Energy balance scenario prepared.
- “No regrets” mitigation policy and technologies implemented in energy sector.
- Number of indigenous land use management systems to combat desertification applied.
- A National Adaptation Program of Action (NAPA) approved.
- A National Mitigation Plan (NMP) for reducing greenhouse gases emissions from energy sector developed and implemented.
- Feasibility studies on promising alternative sources of energy (hydro-power, biotechnology, wind) published.
- Agriculture drought management adopted.
- Irrigation efficiency increased.
- Energy use and air-quality strategy developed.
- Air quality control measures developed and enacted.
- A national coordination body for emergency and disaster management in place.
 - An emergency and disaster management plan developed.

Goal 4. Implementation of Enabling Mechanisms

15. Public Awareness and Participation

It is generally agreed that the current level of ecological awareness, especially among decision-makers and relevant agencies, is still very poor. So long as it remains conservation measures will be less than adequate and policies for sustainability are unlikely be adequately supported by policy makers. Similarly, the impacts of human actions on ecosystems and the level of biological monitoring remain poorly limited.

Efforts by government agencies and NGOs are under resourced and the following actions needed to overcome this situation:

- 1) Developing a national strategy that addresses issues of environmental awareness and education at the national and local levels,
- 2) Ensuring the effective transfer and integration of new environmental knowledge into the educational and training system,
- 3) Strengthening and raising environmental awareness through a nationwide public campaign,
- 4) Improving the free flow of information to the public; and

5) Establishing mechanisms for monitoring the state of the environment and progress towards sustainability

Involvement of urban and rural communities in the design and implementation of environmental measures that directly affect their lives is poor or non-existent. As communities become more environmentally aware they are more likely to mobilize to keep their neighborhoods clean, or to request industries to become more environmentally responsible. It is of critical importance to raise awareness of environmental issues, make available technology and instruments to address these issues, and mobilize institutions and individuals to take action. This can be achieved through public awareness campaigns, development and promotion of environmental education, professional education and information exchange.

Public information and awareness campaigns of Yemen's dependence on a diminishing biodiversity and rapidly deteriorating environment should be undertaken. These campaigns should be launched where both private and public actors have the potential to act appropriately (e.g. waste collection, irrigation, sanitation arrangements). The campaigns should involve the media and include the distribution of posters, children's books, and pamphlets in various public places calling attention to basic environmental problems and how to address them. In addition to these more general campaigns, media campaigns can be directed toward specific public and private stakeholders (e.g. industry, agriculture, women and children).

In addition to public information campaigns, environmental education programs should be introduced to adequately train staff at all levels in the education system (e.g. primary school, high school, technical schools, and universities). Target groups include teachers, journalists from the printed media, radio and television, as well as environmental specialists. To test the potential for improved resource management through better community involvement in Yemen, a pilot program is proposed involving farming, fishing, and urban communities.

Key Issues

- Weak public awareness on biodiversity issues
- Limited participation of local communities and NGOs in biodiversity related initiatives.
- Lack of national policy on Environmental education (EE)
- Biodiversity conservation and environmental protection themes are not integrated into school and university curricula.
- Notable shortage of trained manpower, specially of environmental educators and facilitators
- Notable absence of youth green clubs, green press, and eco-industry.

Sub-goal: Rising environmental awareness of Yemeni society through integrating environmental themes into university and school curricula, promoting green media, and supporting youth clubs and eco-industry.

Priority Objectives

Short-Term (1-3 years)

- Assess capacity needs for incorporating environmental themes into schools and universities.
- Promote public awareness of various aspects biodiversity issues through TV and radio mass campaigns, press campaigns, community workshops, fact sheets and brochures production, electronic information and other communication materials.
- Promote the development and expansion of youth organizations, green clubs, green media and NGOs to act as advocacy groups for the protection of nature and the environment
- Develop a nation-wide environmental awareness campaign, addressing priorities of biodiversity and environmental issues

Medium-term (4-8 years)

- Integrate green themes into the education curricula of schools and universities.
- Expand public education and awareness program to cover various aspects of biodiversity issues such as protected areas, habitats and wildlife conservation, biosafety, alien invasive, energy saving, etc.
- Improve professional skills of teachers and university lecturers in producing and teaching environmental topics.
- Encourage community-based participatory research and management at local levels to revive traditional indigenous knowledge and practices for biodiversity conservation and sustainable use of natural resources.
- Strengthen the capacity of non-governmental conservation and development organizations as advocacy groups to promote biodiversity conservation.

Long-Term (>8 years)

- Promote and facilitate community awareness and involvement in biodiversity conservation programs, particularly women and the underprivileged.
- Expand public awareness and education programs to target government officials and promote the conservation and sustainable use of biodiversity.
- Integrate more biodiversity environmental themes into university and school curriculum.

Performance Indicators

- By 2005, needs for incorporating environmental themes identified
- A nation-wide environmental awareness campaign minimally addressing 18 environmental themes implemented.
- Adequate TV and radio mass campaigns, press campaigns, community workshops completed.
- Adequate awareness materials publicly distributed.
- Number of youth organizations, green clubs, green media and NGOs agencies in place.
- By 2007, at least six themes introduced into formal curricula of schools and universities.
- Number of teachers and university lectures trained.

- Number of women participating in biodiversity conservation programs
- Percentage of population aware of the importance of conservation and sustainable use of biodiversity.
- By 2012, all environmental themes incorporated into curriculum of universities and schools.

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16. Indigenous Knowledge and Traditions

The imperatives of sustainable development necessitate a reorientation in the fundamental values of society. Hence, the formulation and implementation of a comprehensive information, education and communication advocacy plan is an indispensable part of the efforts to mainstream the principles of NBSAPY in the various efforts of all stakeholders in the overall development process.

The legal protection and enhancement of traditional and indigenous knowledge and skills and the improvement of people's attitude and participation for the conservation and sustainable use of biodiversity and related natural resources are very important steps towards the rehabilitation of the natural resource base and man-made agricultural, pastoral, and fishery systems. In recent decades, economic growth and development in Yemen has proceeded without giving sufficient support, cognizance or respect for the environment and the natural capital. In addition, the high population growth rate, and rapid expansion in urbanization with immigration to cities from rural areas has increased pressure on the country's limited natural resources. It has enhanced environmental degradation and is threatening some of the country's most famous agricultural landscapes, the terraces of the western mountain slopes, well as the traditional rangelands and movements of nomads and their domestic flocks. Rekindling the knowledge and skills of the ancestors will be a process of re-learning, testing and adapting sometimes forgotten systems to the present day situation. The public will need to be convinced of the advantages, economy and rationality of looking to the past to help guide the country's future development.

Key issues

- Retardation of environmentally friendly traditional and indigenous techniques, practices and management systems.
- Low level of public awareness in traditional and indigenous natural resource management systems, biodiversity conservation and sustainable development.
- Inadequate records on the state and extent of abandonment of traditional environmental norms and practices.
- Lack of participation of local communities

Sub-goal: Reviving traditional biological knowledge, innovations and techniques in conserving biological resources.

Priority Objectives

Short-Term (1-3 years)

- Compile and verify information on traditional knowledge and skills pertaining to biodiversity.
- Document and disseminate traditional knowledges addressing sustainable use of natural resources.

- Identify sites where traditional systems are successfully functioning to be studied for potential replication.
- Prepare case studies in consultation with knowledgeable rural people at selected sites to revive and improve abandoned systems, techniques, practices, skills and methods.
- Promote replication of environmentally friendly systems, practices, skills and methods to other areas through appropriate awareness campaigns and by facilitating cross visits to demonstration sites.
- Based on research results, revive indigenous practices, including terraces management, water harvesting, etc.

Medium-Term (4-8 years)

- Provide incentives for integrating traditional resource management systems into modern management practices, and their adaptation among agricultural, pastoral and fishing communities country-wide.
- Expand extension services to assist rural and coastal communities in adapting eco-technologies, both new innovations and traditional systems, in resource management.

Long-Term (>8 years)

- Expand integration of appropriate traditional and indigenous management systems in rural and coastal areas of Yemen.
- Provide incentive, materials, guidance and monitoring to farmers to enable them to repair terraces.
- Develop a funding program to stimulate traditional experience and sustainable use of biodiversity at a local level.

Performance Indicators

- Information on traditional knowledge and skills pertaining to biodiversity gathered and published.
- By 2006, number of thematic reports on traditional biodiversity practices, skills, techniques and management are published.
- Number of models on traditional biodiversity management developed and replicated.
- Traditional systems of biodiversity conservation are parts of provided extension services.
- Funding program to stimulate traditional experience in place.

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17. Capacity Building

Yemen experiences a shortage of specialists in several biodiversity related disciplines such taxonomy, marine biology, entomology, land-use planning and resource management. The country is also in need of experienced public relations and community development specialists. This situation is aggravated by lack or shortage of funds and resources to conduct proper training on a regular and systematic basis.

There are no formalized training courses devoted to biodiversity conservation available within the country, and thus far there have been too few opportunities for international studies

because of limited options and language deficiencies. It is therefore imperative that development assistance projects and programs recognize this situation and place capacity building and institutional development among the priorities for assistance. The nation's self-reliance and abilities to carry out the demanding tasks ahead in biodiversity conservation depend upon it.

Therefore, there is an urgent need to increase funding support to establish a systematic programme for scientific and technical training of human resources within the formal and informal education systems. Only with this investment will the country be able to meet the required qualifications and training needs in biodiversity conservation and natural resource management.

Key issues

- Lack of professional and systematic training in the field of biodiversity conservation.
- Shortage of biodiversity specialists and general lack of adequately trained human resources in research, planning, policy development, monitoring and documentation.
- Poor training opportunities for local communities.
- Lack of training and financial support for electronic networking and access and use of the Internet.

Sub-goal: Strengthening productive capacities and potential of individuals, government agencies, and communities, in the planning, implementation, monitoring and evaluating of biodiversity conservation programs.

Priority Objectives

Short-Term (1-3 years)

- Conduct training needs assessment for environmental agencies and NGOs regarding their capacity in effective biodiversity management.
- Based on the assessment findings, develop and implement national, regional and local training plans addressing relevant biodiversity issues.
- Develop specialized training programs in desertification control planning, land use management, monitoring and impact assessments, Geographic Information Systems (GIS) and remote sensing techniques.
- Strengthen the capacities of relevant institutions, including NGOs and local communities in the implementation and management of biodiversity and protected areas projects.
- Provide training for various stakeholders on coordinated policy planning, project development, implementation, and monitoring of environmental resources.

Medium-term (4-8 years)

- Review and assess training plans and amend appropriately.
- Establish regularly updated information system on biodiversity.
- Build national staff capacity in preparing and enforcing EIA regulations for development projects.

- Develop and strengthen national capacity in monitoring biological resources utilization
- Develop the capacity in combating oil pollution.
- Continue capacity building of various stakeholders, including local communities in fishery management, coastal and marine protection.
- Develop staff capacities in preparing, reviewing and updating action plans.

Long-Term (>8 years)

- Strengthen biodiversity management capabilities line environmental agencies.

Performance Indicators

- Biodiversity training needs for environmental agencies and NGOs identified.
- National, regional and local training plans developed and implemented.
- Number of national staff trained in desertification control planning, sand dune management, monitoring and impact assessments, GIS and remote sensing.
- Number of staff trained in EIA, policy planning, project development, implementation and monitoring.
- Information system on biodiversity functional.
- Number of staff trained in management plan development, combating oil pollution, and monitoring of biological resources utilization.
- Number of stakeholders, including local communities, trained in fishery management, coastal and marine protection.
- Number of stakeholders trained in solid waste management.

18. Equitable Sharing of Biodiversity Benefits

Yemen is characterized as a least developed country, ranking 148 out of 183 countries in the 2003 Human Development Index. Yemen's population is around 19 million (18.7 million in 2001) and is growing at an alarming rate of 3.5 % per annum. A high population growth rate together with a low GDP growth has created a structural economic gap. To improve living standards of its people, Yemen must achieve positive real growth rates in its economy, which exceed its population growth rate. Each of the Yemen's 21 governorates differs significantly in terms of development, institutional capacities and population densities. The Government has begun to consider decentralization of some services to local jurisdiction.

This situation notwithstanding, Yemen still contains numerous localities with interesting and fairly rich natural wildlife communities; Socotra Island is a case in point holding more than 250 endemic plants. The commercialization of genetic resources is becoming more popular as a means of promoting the conservation and sustainable use of the biodiversity of different countries around the world through two powerful mechanisms. First, the recognition of genetic resources as an economic asset that can generate income results in the local communities, leading government policy makers to view the protection of biodiversity in a different light. Realizing that the development of genetic assets creates jobs and generates income for local peoples, government officials have a greater interest in the protection and sustainable use of biological resources. At the national level, the recognition of biodiversity contributing positively and directly to Yemen's economic well-being, is giving conservation a new priority among policy makers. And second, the development of the country's genetic

reserves offers the opportunity to generate the revenues necessary to finance further conservation and protection efforts, particularly protected areas management. A careful assessment of Yemen's resources with respect to their potential for generating income on a more equitable basis is an option that should be pursued.

There is no existing legislation regulating the sharing of benefits derived from the use of genetic resources. Fortunately, neither are there provisions in either existing legislation or Islamic Shari'a, which would prevent or restrict the sharing of such benefits. Any legislation regulating access to genetic resources and sharing of benefits from the use of those resources will likely rely on some form of contract for the transactions involved. Therefore, it is important to look at the legislation governing contracts in Yemen. Contracts of any kind between state bodies (ministries, authorities, etc.) or corporations and others are subject to the general provisions of the Civil Code, the Law on Public Purchasing (which needs to be reviewed) and other legislation. Contracts entered into by any government entity for the purpose of access to genetic resources or benefit sharing would also be subject to the provisions governing biological resources such as State ownership of those resources, among others.

Key Issues

- Lack of land property registration.
- Outdated land survey and registry records.
- Lack of allocation system to share, access and use rangelands and hunting grounds equitably.
- Inadequate delegation of responsibilities from the center to the governorate/district level.
- Uncontrolled hunting of wildlife along with unregulated utilization of fuelwood, rangelands and agricultural lands.
- Reduced economic values of marine and coastal biodiversity as a result of increasing pollution and habitat destruction.
- Lack of allocation system for equitable sharing of fishery resources.
- Conflicts among fishery users over the control and use of marine resources.

Sub-goal: Enabling communities and individuals to conserve and sustainably use biological resources by facilitating their participation in the planning and management of natural resources and providing them with secure access to biological resources and sufficient financial and technical funding for community-based environmental programs.

Priority Objectives

Short-Term (1-3 years)

- Strengthen local capacity to access and benefit from crop and genetic diversity through provisions of seeds, seedlings, fingerlings, etc., and through extension services, participatory dialogues, and promoting the establishment of cooperatives within communities.
- Promote and facilitate the development of community forests integrating useful trees (nuts, fruits, animal fodder, etc.) into existing habitat, and tree plantations for construction, fuel and domestic use.
- Encourage marketing of cash crop products in protected areas to create job opportunities for people living there.

- Provide incentives and support for fishing cooperatives and communities in adopting equitable quotas of fishery resources.

Medium-Term (4-8 years)

- Establish “polluter pays“ legislation to recover rehabilitation costs of damaged resources by polluting industries.
- Conduct studies on indigenous medicinal plant and assess the feasibility of replicating traditional methods nationally and globally.
- Integrate in resource-based development policies and programs the notion of equitable participation of local communities to resource management and benefits from the use of these resources.

Long-Term (>8 years)

- Establish guidelines for trading Yemen’s native genetic resources and for pharmaceutical and biotechnological uses.

Performance Indicators

- Number of rural peoples accessing/benefiting extension services.
- Marketing schemes for protected area products functioning and percentage of local people benefiting from the scheme.
- Equitable quotas of fishery harvest adopted by number of fishing cooperatives.
- Rehabilitation cost of damaged resources born by polluting industries.
- Number of studies on indigenous medicinal plant published and disseminated.
- The principle of Equitable Sharing of Biodiversity Benefits incorporated in national development policies.
- Guidelines on trade of pharmaceutical genetic resources published

19. Policy, Legislation and Institutional Structure

The existing national legislation in the Republic of Yemen has evolved in an ad hoc fragmented manner, leading to increased potential for overlapping jurisdictions associated with weak law enforcement. As a result, there are many overlapping sectoral laws and by-laws, there is no specific legislation for biodiversity resources, and there are only limited provisions in the Environmental Protection Law (EPL) No. (26) for 1995 dealing with biological resources. Although the existing provisions in EPL are inadequate to comply with Yemen's obligations under the Convention on Biological Diversity (CBD), they provide a basis for a national legislative framework for biodiversity conservation. In addition, a number of outdated laws, by-laws, and regulations are responsible for unclear mandates, role and responsibilities of designated environmental entities, creating confusion, lack of trust, and a long lasting dispute among them.

The reasons for legislation not being enforced are multiple, including insufficient staff, financial and technical capacity of responsible departments, and unclear enforcement procedures for existing legislation.

The current Environmental policy is generally lagging behind development issues and has seldom been coordinated with the economic development decisions that commonly shape the environment. This is leading to a situation where biodiversity issues are being addressed in the National Environmental Action Plan (1996-2000) in general terms which are not adequately meeting CBD requirements. This policy also obscures potential compatibilities among competing interests, and increases the difficulty of resolving conflicts.

The current Environmental policy must therefore be replaced by effective policies and legal frameworks that ensure that it takes into consideration the interests of current and future generations, as well as the productivity and diversity of the natural resources. This endeavor would require institutions capable of an integrated, forward-looking, cross-sectoral approach in decisions making related to environmental conservation. More importantly, there are immediate needs to incorporate the objective of sustainable use of natural resources in the agenda of agencies dealing with national economic policy and planning and international policies. Some of the recommendations in the National Environmental Action Plan (NEAP) incorporated into the second National Five-Year Development Plan (2001-2005) contain specific policy statements to this end. These first steps toward integrating environmental and biodiversity concerns at the national policy level indicate that awareness of these issues within the central government is increasing. This trend is very positive and should be advanced through additional actions at the policy and legislative levels as soon as possible.

With the exception of EPA's planning, policy development and coordinating role, the responsibility for biodiversity and protected areas management is "entangled" between several government agencies and parties. Overlapping areas of responsibility and disputes arising from territorial imperatives have been a hindrance to progress, and a detriment to resource conservation. Clarification of the different roles and responsibilities of the relevant agencies has become an urgent matter, and a confirmation of EPA's coordinating role and authority is equally important.

In addition to the above policy and legislative deficiencies, there are a number of root causes which influence the performance of national agencies responsible for environmental management. These include: inflated organizational and functional structure of the public administration; insufficiency of qualified specialized manpower; inappropriate practices/lack of norms and standards; retardation of traditional practices and norms in environmental protection; lack of partnerships with NGOs and the private sector in protecting the natural resources and environment, as well as limited information flow and weak external coordination.

Therefore, there is strong need for a mechanism to harmonize the existing policy and legislations through extensive review and assessment. In this context, the Government is now launching a nationwide reform program aiming to rationalize government institutions and policies, to be more responsive to the public and international needs, and to become more efficient and effective in developing and executing government policies and programs. In the environment sector, the objective of the initiative is to restructure the environmental agencies to effectively meet their ultimate objectives nationally and internationally. This will be reached through:

- Restructuring and rationalizing environmental agencies with redefined mandates and responsibilities;
- Strengthening collaborative working relationships among environmental agencies supported with solid legislative and regulation framework for environmental protection;

- Updating and implementing the Environment policy and its action plans;
- Creating a reliable resource mobilization mechanism to finance environmental protection and facilitate greater involvement of private sectors, NGOs and local councils in environmental protection activities.

Key Issues

- Absence or inadequacy of existing legislation and standards regulating biodiversity use and management, including agricultural practices.
- Inadequate law enforcement.
- Overlapping and unclear mandates of environmental agencies.
- Inexistence of establishment decrees for a number of agencies.
- Insufficient financial auditing system.
- Inexistence of a staff evaluation system within the public administration.
- Unregulated inter-agencies coordination for biodiversity and protected areas.
- Incomplete hierarchical structure of environmental agencies.
- Inadequate policies to comply with Yemen's obligations committed under international conventions.
- Insufficient manpower of regional and local environmental bodies in planning and monitoring managing natural resources.
- Insufficient community role in planning, monitoring and managing natural resources
- Antiquated environmental plans

Sub-goal: Developing an integrated legislative and institutional framework composed of: Updated environmental laws complete with regulations, implementation and enforcement mechanisms; 2) mandated and empowered national institutions and mechanisms coordinating and effecting policies, legislations and strategies; 3) national policy advocacy incorporation of biodiversity issues in the national fiscal policy.

Priority Objectives

Short-Term (1-3 years)

- Review the adequacy of government agencies' mandates and management responsibilities for biodiversity and harmonize them according to EPL and other relevant regulations.
- Develop biodiversity management and co-ordination mechanisms recognizing the legitimacy of NGO, private sector and local community involvement in the planning and management of natural resources.
- Develop strategies for sustainability, and implement them directly and through regional and local planning.
- Adopt an integrated approach to environmental policy for the conservation and sustainable use of natural resources.
- Prepare waste reduction, reuse and recycling strategies, policies, and legislation.
- Strengthen and enforce legislations, regulations and guidelines on agro-chemicals import, plant quarantine, water use and harvesting, and protected areas.
- Promote approval of by-laws for relevant agencies: EPA and NWRA.

- Review, amend where necessary and enforce existing laws and by-laws for tourism sector.

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Medium-Term (4-8 years)

- Enforce laws, by-laws, and regulations prohibiting sea pollution from passing ships and land-based sources.
- Enforce laws, by-laws, and regulations national marine resources.
- Enforce fishery legislation to halt catching sharks and cuttlefish by nets, destruction of coral reefs by any method, turtle slaughtering or egg collecting, and prohibit collection of aquarium and reef fishes.
- Develop a renewable energy policy.
- Prepare and enforce by-laws on Protected Area and Forest
- Create a partnership mechanism with community groups and the private sector to enhance law enforcement.
- Promote biodiversity research and funding.

Long-Term (>8 years)

- Review, update and enforce regulations for land use.
- Develop and implement hazardous waste policy, including incentives and law enforcement.
- Review national policy, legal and institutional framework and amend where necessary to support decentralization.
- Strengthen decentralizing through devolution of sufficient power to regional, local governments and local communities in monitoring the effectiveness of modified systems of natural resource management.

Performance Indicators

- By 2006, overlap and duplication in regulation and mandates of environmental agencies identified
- By 2006, co-ordination mechanisms for Biodiversity management created and functional.
- Strategies and policies for renewable energy, hazardous waste and waste reduction officially endorsed.
- Enforce Legislations on agro-chemicals import, plant quarantine, water use and harvesting approved.
- EPA and NWRA laws and by-laws enacted.
- Laws and by-laws for tourism sector reviewed and amended.
- Laws for Protected Area, Forest and Land use enforced.

20. Monitoring and Reporting

To effectively assess the implementation of the NBSAP, a comprehensive monitoring, and reporting mechanism should be established to guide all stakeholders to meaningfully participate in the process of operationalizing the implementation of NBSAP. Such mechanism will also help institute broad-based accountabilities and responsibility for sustainable development among members of society. This mechanism may include the following elements: (a) a system to coordinate and evaluate the extent to which the NBSAP has been adopted and implemented by all stakeholders; (b) a system to coordinate, support

and enhance existing national and local multi-sectoral as well as sectoral monitoring, evaluation and information exchange on the implementation of initiatives related to the NBSAP; and (c) a system for reporting, feedbacking and utilizing the monitoring and evaluation results on the implementation of the NBSAP for international, national and local stakeholder communities.

No strategy and action plan is infallible, so continuous monitoring and reporting should be undertaken to detect problems as they arise and to facilitate remedial actions. Monitoring should be undertaken during implementation of the NBSAP programs and activities to measure the impact of each activity. This allows better targeting of future resources and possible redefinition of goals, objectives and actions in specific areas.

In addition to illustrating environmental status and trends, indicators will be designed to measure how well policies and projects are being implemented and how they need to be redirected to achieve intended goals. When combined with targets for future performance, environmental indicators can show both the progress achieved and how far still to go. Given the complex nature of biodiversity issues, monitoring needs to be participatory across stakeholders and inclusive to all community groups. It should include baseline survey, expert reporting, field monitoring and stakeholder involvement in the implementation of the CI objectives at the national and regional levels.

Agencies responsible for monitoring regulations are often severely constrained by manpower and have little or no training in legal procedures such as the chain of custody. These deficiencies not only weaken the institution but also weaken the administrative apparatus of the government and the force of the legislation when it is perceived that prosecution is unlikely to succeed. At the monitoring levels there is a need to establish or upgrade the capacity to assess the environmental impacts of proposed programs and projects. There is also a need to analyze the environmental implications of policy and public investments, and formulate policies that incorporate sustainability. Furthermore, the precautionary principle should direct decisions on development and environment, and standards and controls should be progressively strengthened in the light of knowledge and technological capability.

Key Issues

- Outdated data on species and their habitat as a result of research and monitoring inadequacy.
- Absence of national indicators related to biodiversity.
- Lack of coordinated mechanism for monitoring biodiversity deterioration.
- Lack of monitoring tools

Sub-goal: Establishing a nationwide inter-agency mechanism for monitoring the implementation and results of the NBSAP and other biodiversity related programs.

Priority Objectives

Short-Term (1-3 years)

- Prepare annual reports and submit to government coordination committee.
- Review and adapt plan of activities and relative priorities in response to changing situations.

- Review the adequacy of administrative controls, and of implementation and monitoring mechanisms, recognizing the legitimacy of local approaches.
- Develop environmental indicators for monitoring resources deterioration.
- Develop a nationwide coordination committee for implementing the NBSAP and for monitoring natural resources depletion.
- Subject development projects to environmental impact assessment.
- Prepare and submit national reports on the convention implementation to the conference of the parties (COP) of the convention as per agreed upon reporting requirements
- Conduct annual review of implementation, and revise NBSAP document regularly.

Medium-term (4-8 years)

- Conduct feasibility studies for initiating a national biodiversity monitoring program.
- Develop regional and local plans for the conservation and sustainable use of biological resources.

Long-Term (>8 years)

- Assess the various sectors' (protected areas, rangeland management, fisheries, agriculture, and tourism) achievements with a view towards generating improvements.

Performance Indicators

- Annual reports on NBSAP submitted to government coordination committee.
- Environmental indicators for monitoring resources deterioration published.
- A national coordination committee for NBSAP implementation in place.
- EIA applied to all development projects.
- Regular national reports submitted to the COP of the biodiversity convention.
- Implementation of NBSAP regularly reviewed and amended.
- Number of regional and local plans on biodiversity developed.

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21. Regional and International Cooperation

In response to resources deterioration, the Republic of Yemen has been pursuing its active involvement in global efforts through, among others, the development of NBSAP and effectively participating in the work of the United Nations and other international organizations. At the same time, the Republic of Yemen is continuing the implementation of its obligations under other international environmental agreements. Furthermore, the government is attempting to pursue its economic development efforts within the context of a sustainable development framework. Information and access to information are becoming more significant in influencing, popularizing and effecting sustainable development. Inadequate sharing and inaccessibility of information among key actors hamper their ability to initiate and enhance sustainable development activities through information technology, public advocacy, and participation in governance and decision-making processes.

Given the fact that the Republic of Yemen has limited capacity and weak or evolving institutional arrangements to respond to environmental challenges, the Government has sought support from regional and international communities to address biodiversity issues particularly those of global concern.

At both regional and international levels, the country has been engaged in international environmental processes and efforts that led to the ratification of the UN Framework Convention of Climate Change, the Convention to Combat Desertification and the Convention of Biological Diversity.

In addition to the Rio conventions, the Government of Yemen is also party to a number of other relevant international conventions and regional protocols (including the CITEAU Convention on Hazardous Wastes, Law of the Sea, Ozone Layer Depletion, RAMSAR, World Heritage, and the Bonn Conventions), which make some provision for meeting global environmental objectives. A primary example of the regional protocols that the Republic of Yemen is party to is the Agreement of the Cooperation for the Strategic Action Plan for the Red Sea and Gulf of Aden. Its main objectives include the strengthening of regional coordination and cooperation, reduction of navigation risks and pollution, sustainable use of living marine resources, development and implementation of a regional network of marine protected areas, support of integrated coastal zone management, and enhancement of public awareness and participation in overall environmental management.

To implement the commitments specified by these conventions, the government in cooperation with various international communities has succeeded in reflecting the provisions of these conventions in a number of policy documents, strategies and action plans including: Vision 2025, Poverty Reduction Strategy Paper (2003-2005), National Environment Action Plan (NEAP), National Climate Change Communications Report, National Action Plan for Combating Desertification (NAPCD), National Report to the World Summit on Sustainable Development, Wastewater Strategy, Water Law, Watershed Management Policy, Action Agenda, Water Policy, National Population Action Plan.

In translating these policy documents into actions, the government in cooperation with international communities has identified a number of projects of significant importance for preserving biological diversity, examples of these initiatives include:

- The biodiversity conservation zoning plan for Socotra archipelago
- Master plan for the Development of Socotra Archipelago
- Forest conservation in some areas
- Databank on genetic resources
- Creation of an Eco-tourism department
- Initial Land degradation maps
- Initial Desertification Maps
- Report on the potential of Eco-tourism in Yemen
- Watershed database and maps

Key issues

- Continued commitment in global and regional efforts for environmental protection and biodiversity conservation.
- Continued implementation of national obligations under international environmental agreements.

Sub-goal: Maintaining and strengthening Yemen's relations and cooperation with international and regional partners in the field of biodiversity.

Priority Objectives

Short-Term (1-3 years)

- Enable national expertise, through the provision of adequate training, to actively participate in the development of a regional biodiversity strategy and studies related to the Red Sea.
- Promote exchange of information on mutual biodiversity issues at both regional and international levels.

Medium-term (4-8 years)

- Develop regional co-ordinating mechanism for biodiversity issues of common interest.
- Continue regional projects in the Red Sea.

Long-Term (>8 years)

- Develop international partnerships and cooperation in biodiversity.
- Enhance country capacity in negotiating and follow up biodiversity issues at the regional and international levels.

Performance Indicators

- Number of national experts, involved in the development of a regional biodiversity strategy and studies related to the Red Sea.
- A regional co-ordinating mechanism for biodiversity issues in place.
- Number of new regional projects in the Red Sea approved and implemented.
- Number of international and regional agreements approved.
- Up-to-date information on international and regional biodiversity issues accessible.

THE ACTION PLAN

Yemen's natural resources are the basis of the national economy. The depletion and degradation of these resources represents not only a loss of the country's national capital but also undermines the sustainability of its economy. In the NBSAP process a number of environmental issues of national concern were identified and analyzed in order to determine their priority importance and inclusion in the action plan. This section describes the priorities for implementing the strategy, and presents the approach used for the selection of priorities.

Given the large number of issues covered by the strategy, considering the country's limited resources, it was necessary to prepare a set of criteria for prioritizing actions and projects contributing to the implementation of the Strategy. In the absence of qualitative indicators for criteria selection, they were identified on the basis of consensus building among stakeholders responsible for NBSAP implementation. The primary criteria reached through this process are: (1) Geographic Impact, (2) Consistency with Convention Objectives, (3) Urgency, (4) Sequence (5) Country-driven, (6) Attainable and Resourceable, and (7) Multisectoral Implications. These primary criteria are briefly discussed below:

Geographic Impact: Actions with potentially extended Geographic impact are more important than actions of localized impact.

Consistency with Convention Objectives: Action that directly affects biological diversity is deemed less relevant than action that indirectly affects it.

Urgency: The action is urgent when it addresses highly deteriorated ecosystems, and where a large number of people or resources are under immediate threats or risk. Disasters such as toxic chemical spills, earthquakes, and landslides, are examples of situations calling for urgent action.

Sequence: Actions/projects are organized in time-sequence when one action/project's output is input or prerequisite to a second one. According to this criterion, programs addressing data collection, policy and legislation gaps are placed before implementation programs and forest protection programs are before forest production programs and so on. In this context, Policies and Legislation Project (Project N3), Biosafety Regulations Project (Project No7), Traditional Knowledge Project (Project No5), and Education and Awareness Program (Project No 6) ought to be more important than other projects included in this document and are prerequisites for implementing future biodiversity Projects.

Country-driven: Projects that support the overall country interest and lie with the government's priorities are more viable than projects that are of pure global nature. Such projects are politically supported by the government and have many opportunities to be funded from national sources, including government, NGOs, private sector and local communities. Projects fitting this criterion are those contributing to increase economic growth, reinforce environmental management of natural resources, optimize exploitation of fisheries and agricultural resources, mobilize beneficiaries, involve the poor, and support the role of women and youth in environmental conservation.

Multisectoral Implications: A specific intervention is given special priority when it seeks to address issues of interrelated impacts on biodiversity, climate, freshwater and desertification. Terrace rehabilitation, protected areas establishment and eco-practices in agriculture

examples of such actions. These actions contribute not only to land conservation, but also to improve water infiltration, waste management, urban environment and prevent ground water pollution.

Attainable and Resourceable: Projects with clearly defined objectives and adequately funded activities backed-up with cross-sectoral, collaborative and inclusive management mechanism are certainly to be more successful in producing their planned outputs in an efficient and effective manner. However, in order to ensure that the results of these projects are sustainable, they should also be people-centered, knowledge-based, and consensus-oriented.

Overall projects contained in the action plan were selected according to the above criteria and on the basis of a consensus reached among stakeholders. The following biodiversity projects thus constitute the present national priorities for NBSAP of Yemen:

- Establishment and Development of a Comprehensive National Integrated Protected Areas System in Yemen (NIPASY)
- Development and Implementation of an Integrated Coastal Zone Management Plan (ICZMP)
- Development and Implementation of Policies, Legislation and Regulations on Biodiversity Issues in Yemen
- Essential Measures for the Conservation of Agro biodiversity in Yemen
- Reviving Traditional and Indigenous Knowledge in Natural Resource Management Systems
- National Biodiversity Education and Awareness Program
- Regulations and Guidelines for Biosafety

These projects are briefly presented in the following pages in the form of project concepts outlining project title, lead agency and key partners, goals, objectives, outputs, main activities, timeframe, and estimated cost.

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Project 1. Establishment and Development of a Comprehensive National Integrated Protected Areas System in Yemen (NIPASY)

Lead agency and key partners: Ministry of Water and Environment, Environmental Protection Authority, Ministry of Planning and Development, Ministry of Agriculture and Irrigation, Ministry of Fisheries and Navy (for marine PA), NGOs, IUCN, and local stakeholders and communities, General Authority for Tourism, MFW and surroundings, WFP, UNDP and other Donors/Funding Agencies (to be identified).

Goal: Identify, establish and develop a comprehensive National Integrated Protected Areas System for Yemen (NIPASY), which will include the terrestrial, wetland and marine environments to strengthen community livelihood.

Objectives:

- Identification and design of the NIPASY.
- Establishment and management of 7 selected priority protected areas (Socotra, Jabal Bura, Hauf, Sharma/ Jathmoon, Bir Ali, Autma and one Red Sea ecosystem)
- Enable 20 small scale community conservation initiatives.

Main Outputs:

- Integrated and comprehensive database and relational GIS system for biodiversity established and functional.
- Comprehensive protected areas system design complete with initial PA site boundaries, supportive information, map and justification for each site developed and adopted by the government.
- Proposals, including budget estimates for all priority reserves prepared and implemented.
- Protected Area Management Plans for the priority areas prepared and implemented (potentials protected areas may include Socotra, Jable Bura, Hauf, Sharma/ Jathmoc Bir Ali, Autma and one Red Sea ecosystem)
- Institutional, technical and human resource capacity needs for protected area management and community conservation identified and supported.

Main Activities

- Data gathering and analysis (including Gap assessment and priority listing) and integration in existing functioning GIS systems
- Develop and complete Protected Area Management Plans
- Resource mobilization for protected area management and small scale community conservation initiatives.
- Protected Area Management activities
- Training and capacity building

Timeframe: 5 years

Estimated Cost (excluding secured funds):

6 millions \$US + Socotra 5 million US\$

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Project 2. Development and Implementation of an Integrated Coastal Zone Management Plan (ICZMP)

Lead agency and key partners: Ministry of Water and Environment, Environmental Protection Authority, Ministry of Fisheries, Ministry of Public Works, MAA, Marine Research Centers and Universities, NGOs, IUCN, local stakeholders, private sector, PERSGA, WB, UNDP and other potential donors (to be identified).

Goals: Conservation of coastal zone biodiversity of Yemen.

Objectives:

- Development and implementation of ICZMPs and creation of an effective national capacity to manage Yemen's marine and coastal resources.
- Protection of aquatic habitats, fisheries, rare and endangered marine species through formulation, implementation and enforcement of effective policies for conservation of the marine environment and regulations for fishing and harvesting marine organisms
- Integration of biodiversity conservation in the development of coastal zones.

Main Outputs:

- Biodiversity information integrated into coastal zone maps and database systems Yemen.
- Four management plans for Balhaf-Bir Ali Area (Sharma) and Jethmun-Sharr (Hadhramut), Aden and a Red Sea Ecosystem Prepared and implemented.
- Institutional capacity needs to manage and control illegal fishing practices, cost development, infrastructure, illegal logging of mangroves and tourism development identified and secured.
- Local branches for EPA in Al-Hudaidah, Al Mukallah established and functional.
- EPA local branches, community representatives, local administration, private sector and NGOs organized under appropriate mechanism for implementing ICZMPs and for the periodical revision of the plans.
- EPA staff adequately trained and equipped to efficiently implement, update and enforce ICZM policies, legislation, regulations and guidelines.
- Adequate infrastructure, land and sea transportation and communications means available to staff responsible for implementation of ICZM plans.
- Awareness of public, decision makers, local community, private sector and other target group on ICZMP adequately promoted.
- Major coast pollution from land sources identified and pilot projects to minimize such pollution prepared and implemented.

Main Activities:

- Data gathering and analysis (including Gap assessment and priority listing) integration in existing functioning GIS systems
- Monitoring programs
- Management plan development and implemented including, Public consultation
- Policy, legislation, guidelines preparation, review and enforcement
- Technical training and public awareness programs
- Equipment acquisition
- Protected area management
- Development of eco-tourism for the areas

Timeframe: 5 years

Estimated Costs: 10 million US\$

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Project 3. Development, Implementation and Enforcement Policies, Legislation and Regulations on Biodiversity Issues Yemen

Lead agency and key partners: Ministry of Water and Environment, Environment Protection Council, Ministry of Agriculture, Ministry of Legal Affairs, Ministry of Public Works, General Cooperation of Roads and Bridges, Ministry of Culture and Tourism, Ministry of Trade and Industry, Ministry of Defence, Ministry of Interior, Standard Authority, governorates, private sector, NGOs, IUCN, Legal Specialists, coast guards, police, military, local judges, sheiks and WB, UNDP, UNEP; other Donors (to be identified).

Goal: Ensuring that adequate and effective policy, legislation and regulations and support systems are in place and enforced for the management and sustainable use of biodiversity and for the preservation and rehabilitation of the environment.

Objectives:

- Identification and review of existing policies, legislation and regulations biodiversity, related natural resources and environmental issues and development required supplementary policies, laws and regulations to fill gaps.
- Build the capacities and institutional structures and support systems to coordinate, integrate, implement and enforce biodiversity, natural resource and environmental policies, laws, regulations and by-laws.
- Develop, enforce and follow up EIA including recommended mitigation measures in priority sectors, such as infrastructure and industry, tourism and urban development, waste management and water treatment.

Main Outputs

- An integrated participatory assessment of current biodiversity legislations, regulatory framework for meeting the goals of the CBD, sustainable use management of biological resources completed, and legislative gaps identified.
- ICZM policies, legislation, regulations and guidelines on critical habitats, resources, species, fisheries, plankton, and rare or threatened species reviewed, updated and enforced.
- Legislations, regulations and guidelines on agro-chemicals import, plant quarantine, water use and harvesting, and protected areas prepared and enforced.
- Based on results of the assessment, existing biodiversity laws, by-laws, norms, standards and regulations reformulated, enacted and enforced.
- Recommended policies, legislation and regulations to legalize and guide protected areas management and development completed.
- An overall review and assessment of mandates and management responsibility for biological resources developed, the adequacy of mandates and management responsibility identified and clarified in harmony with EPL; appropriate institutional and organizational structure is established, and strengthened.
- Development and implementation of by-laws and guidelines for approved 1 documents, drafted, endorsed and in place.
- A nationwide management and coordination mechanism, such as an "Interagency implementation task force" for biodiversity conservation with appropriate role for NGOs, private sector and local community created and functional.
- National and local training to meet CBD and other Rio Conventions commitments for government, non-government, local administrators and other partners.
- Legal experts and relevant governmental and non governmental staff conversant with the policies, laws and rules for the conservation and sustainable use of biodiversity, natural resources and environment in Yemen are designated with specified capacity and responsibility to apply and enforce policies, laws and regulations with respect to biodiversity, natural resources and environment.
- EIAs and recommended mitigation measures have been implemented in major sector developments.

Main Activities

- Experts' consultation in legal issues related to biodiversity.
- Compilation, review, assessment and development of Laws, policies and regulations.
- Preparation of policies, legislation and regulation for protected areas.
- Training programs for different target groups e.g. coast guards, police, military, judges.
- Programs development, implementation and monitoring.
- Public and target group oriented awareness programs on legal and policy issues.
- Inter-agency consultations and task force (workshops and seminars).

- Legislation Development and enforcement
- Policy harmonization

Timeframe: 5 years

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Estimated Costs: US\$ 2 300 000

Project 4. General Measures for the Conservation of Agricultural Biodiversity in Yemen

Goal: To protect Yemen's agricultural diversity from degradation, maintain agricultural resources and develop sustainable agricultural programmes.

Lead agency and key partners: Ministry of Water and Environment, Ministry of Agriculture and Irrigation, Sana'a and Aden Universities, Environment Protection Authority and local communities.

Objectives:

- Improve AREA to include national agriculture biodiversity data .
- Maintain agricultural and pastoral ecosystems and indigenous agro-biodiversity and promote their rational and sustainable use., through pilot projects and awareness campaigns.

Main Outputs:

- A computerized system for storage, processing, retrieval, dissemination and publication of agro-biodiversity information established, functional and accessible to various data-end users.
- A GIS-based information system for environmental application and land-use planning introduced to the Agriculture Biodiversity Center (ABC) and made operational.
- A library building for housing, scientific journals, research papers, technical reports, documents, the GIS and database systems in place and functioning.
- Research and pilot projects on land use management, terrace management, desertification, and *in situ* conservation of rangeland prepared and implemented.
- Pilot projects and awareness raising in propagation of local and crop varieties and replacing Qat plantations with cash crops, coffee, almonds, grapes and other environmentally friendly systems prepared and implemented.
- Set quotas for indigenous plants in public and private forest and garden projects.
- A comprehensive training program including overseas training, special courses for women, upgraded courses in agricultural biodiversity and forestry for technicians and specialists is developed and implemented.
- Capacity of local communities and extension staff in implementing conservation friendly agro-pastoral and agro-forestry programs and systems sufficient strengthened.
- Local communities and general public more aware and supportive of programs.

Main Activities

- Information management, Technical exchanges and information sharing, Networking, consensus building, community partnership and inter-agency coordination
- Pilot projects and Programs development, implementation and monitoring

- Broad-based capacity building and training programs
- Public awareness raising, Eco-practices propagation

Timeframe: 3-5 Years

Estimated Cost: [8 million US\\$](#)

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Project 5. Reviving Traditional Indigenous Natural Resource Management Systems

Lead agency and key partners: Ministry of Water and Environment, Environmental Protection Authority, Ministry of Agriculture, Universities, NGOs, and local community donor and funding agencies to be identified.

Goal: Apply appropriate and effective traditional and indigenous natural resource management systems for biodiversity conservation and sustainable use of natural resources.

Objectives:

- Secure and assess all available information on traditional and indigenous natural resource management systems in Yemen.
- Re-deploy and reinforce appropriate traditional and indigenous management systems as part of government's overall strategy to improve biodiversity conservation, combat desertification and agricultural pests and increase natural productivity.

Main Outputs

- Traditional knowledge including systems, techniques, practices, skills and methods studied, documented, and made available and is used for extension services for sustainable use and management of biodiversity resources.
- Widespread adoption and/or adaptation of appropriate traditional and indigenous technologies and management systems by agricultural, pastoral and fishing communities.
- Good examples of traditional systems and practices such as water harvesting, rangeland use, terrace maintenance, fertilizer use revived and replicated among agricultural, pastoral and fishing communities throughout the country.
- Incentive and technical and financial support provided to farmers for rehabilitation and repairing terraces.
- Public awareness on acceptance of indigenous natural resource management systems strengthened through government sponsored cross-visits to case study and demonstration sites, extension services, and incentives.
- Nurseries, seed banks, fingerling supplies, etc. developed as/if necessary through appropriate line agencies to provide supplies of 'starter materials' to the public
- Pilot projects in and around protected areas

Main Activities

- Gathering of traditional information
- Identification of resource persons on traditional knowledge
- Data verification.
- Consultations with knowledgeable people on traditional knowledge
- Systems identification for investigation and revival
- Documentation and reporting

- Public awareness campaign
- Experts' consultation to investigate feasibility of replicating traditional management systems
- Provision communications equipment and public awareness campaign
- Incentives provision for expanding use of indigenous systems
- Pilot projects

Timeframe: 3-5 years
Estimated costs: [2 million US\\$](#)

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Project 6. National Biodiversity Education and Awareness Program

Lead agency and key partners: Ministry of Water and Environment, Environmental Protection Authority (lead agency), Ministry of Education, Universities, Research Centers, NGOs, Local Communities, World Wide Fund for Nature, IUCN; WB, UNDP and other Donors and Funding Agencies (to be identified).

Goal: Enhance the level of education and awareness for environmental conservation, and sustainable management to increase the scope and capacity for stakeholder and public participation in effecting positive changes in Yemen's biodiversity.

Objective:

- Promote public appreciation for biodiversity conservation and the protected areas program and a positive change in attitudes and behavior towards Yemen's environment through conservation promotion interventions.

Main Outputs

- Increased public collaboration, including government authorities, NGOs, private sector, university and other parties concerned in knowledge improvement and conservation of Yemen's natural environment, protected areas and conservation of their benefits.
- Greater public role in planning, executing and monitoring of village/community development projects.
- A clearly defined local community, NGO and private sector role and partnership in the country's conservation program and protected areas management.
- Advocacy groups for the protection of nature and the environment such as Youth organizations, conservation clubs, wildlife and nature clubs, and NGOs established and expanded.
- Biodiversity awareness and traditional knowledge enhanced among youth through curriculum reform and improved facilities of educational institutions.
- Several environmental themes introduced into the curricula of key schools and universities.
- Functional capabilities of government agencies, NGOs and private sector in the development and implementation of conservation programs.
- Increased local government awareness on the interrelationship of conservation and sustainable development.
- Regional and national press and broadcast media fully employed in nature conservation and protected areas programs.

- Increased local youth awareness and appreciation for nature conservation participation in protected areas educational programs.
- Targeted campaigns on key environmental threats
- Islam and Environment campaign

Main Activities

- Conservation clubs establishment and strengthening
- Workshops
- Public information and mass media campaigns
- Training activities for various target groups
- Program development for newspapers, radio and television
- Ecotourism promotion at national and international level
- Production of educational/awareness materials, extension materials, learning mod and programs for various target groups
- Inter-agencies efforts to integrate biodiversity-related issues into the curriculum schools and universities
- Mobilize key stakeholder e.g. imams, private sector political leaders to support publicly environmental issues
- Curricula development for school and universities.

Timeframe: 5 years with an additional phase of five years

Estimated Costs: US\$ 4 000 000

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Project 7: Preparation and implementation of Nation Biotechnology/Biosafety Frameworks

Goals: To minimize health and environmental hazards from developing and introducing genetically modified organisms.

Lead agency and key partners: Ministry of Water and Environment, Environment Protection Authority, Universities, Research Centers, Custom Authority, Ministry of Trade and Industry, Donors e.g. related to Food Aid.

Objectives:

- To promote safe development and application of biotechnology for conservation and sustainable use of genetic diversity.

Main Outputs:

- The risks associated with the use and release of living modified organisms (LMOs) the introduction of biotechnology controlled through development and enforcement adequate legislation
- Guidelines for introductions, research and use of living modified organisms produce
- An appropriate and authorized entity responsible for the management and control biotechnology and biosafety issues created and functioning
- Feasibility studies and researches on the potential use of genetically engineered stocks for introducing drought resistant varieties of fruits and vegetables in replacement of those currently in cultivation completed and available for applications

- A national biotechnology policy and biosafety frameworks prepared and approved
- Institutional and national capacity on biosafety monitoring developed and strengthened
- Stock-taking and assessment of existing biotechnologies and state of safety in their application completed
- Priority activities and information exchange implemented
- Ban for GM living organisms for Socotra archipelago e.g. seeds

Main Activities:

- Stock-taking and assessment of state of imported and used safety/biotechnologies
- Options analysis and tracking biotechnology applications
- Policy preparation for biotechnology/ biosafety
- Implementation of priority activities and national capacity building programs
- Institutional capacity building on biosafety
- Data-base and national infrastructure establishment
- Public awareness activities
- Decree to ban the import of GM living organisms for Socotra archipelago

Timeframe: 3 years

Estimated Costs: US \$1 [million US\\$](#)

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ANNEX 1: Working groups, team members, contributing experts and organizations.

The NBSAP is the outcome of resource mobilization and broad-base consultation among institutions and individuals listed below:

Strategy Facilitators:

Throughout the strategy development, the below listed names of Government officials worked as Facilitators of the strategy development and in this capacity they have provided valuable input and advice in addition to patient and insightful facilitation of the overall strategy production and approval.

- Mr. Mahmoud Shidiwah Chairman of the EPA and Steering Committee chair

Formulation Team

The first and subsequent drafts of the strategy were prepared by a team composed of: [Mr. Abdul-Hakim A. Rajeh Aulayah](#) as coordinator, Ms. Ellen von Zitzewits as assistant coordinator, and Mr. Ali Abdulbari Al-Adimi as Editor. The formulation process was quick and supervised by Mr. Jacques Prescott, IUCN adviser, in close consultation with the national team members and relevant government agencies.

Working Group 1 (WG1):

Reviewed the following Sections of the strategy

1. Protected Areas
2. Endemic and Endangered Species
3. Ex situ Conservation
4. Alien Invasive Species

Members of WG1:

- Dr. Abdulkarim Nashier, Dean, Faculty of Science, Sana'a University, Team leader
- Mr. Ahmed Yahya, Forestry Specialist, General Department for Forestry and Combating Desertification (GDFCD)
- Dr. Amin Abdo Al-Hakimi, Professor of Plant Breeding, Head Yemen Genetic Resources Center, Sana'a University.
- Dr. Abdurahaman Dubai, Prof. of Botany, Sana'a University.

Working Group 2 (WG2):

Reviewed the following Sections of the strategy

5. Terrestrial Wildlife Resources (Fauna and Flora)
6. Coastal/Marine Life and Fisheries
7. Agro biodiversity (Agriculture and Animal Production)

Members of WG2:

- Dr. Aref Al Hammadi, Prof. Of Genetic Plant, Sana'a University, Team Leader
- Dr. Abdulwali Agbary, Flora and Fauna specialist, Taiz Research Center.
- Mr. Lutf Al Ansi, Ministry of Agriculture.
- Dr. Musa'a Al-Jumial, Prof. zoology, Sana'a University.
- Ms. Mariam Ahmed M. Taher, Ministry of fishery Resources.
- Mr. Mohamed Abdullah Saad, Oceanographer, Marine Research Center Aden
- Dr. Mahmoud A. Rajeh, Biologist, Sana'a University.

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Working Group 3:

Reviewed the following Sections of the strategy

8. Infrastructures and Industry
9. Biotechnology and Biosafety
10. Tourism and Eco-Tourism
11. Urban, Rural Development and Land Use Planning
12. Waste Management
13. Water Management
14. Climate Change and Energy

Members of WG3:

- Mr. Naser Mohamed Naser, Hydrologist, National water Resources Authority (NAWRA) , Team Leader
- Dr. Mansour Al Aqel, Genetic Plant, Ministry of Agriculture
- Mr. Anwar Abdul Aziz, Head Climate Change department, EPA
- Mr. Mohamed Shamsan, GD of Planning Department, ministry of Water and Environment.

Working Group 4 (WG4):

Reviewed the following Sections of the strategy

15. Public Awareness and Participation
16. Indigenous Knowledge and Traditions
17. Capacity Building
18. Equitable Sharing of Biodiversity Benefits
19. Policy, Legislation and Institutional Structure
20. Monitoring and Reporting
21. Regional and International Cooperation

Members of WG4:

- Dr. Saylan Al-Abidi, secretary General of High Council for Education Planning
- Dr. Mohamed Abubaker, Oceanographer, Sana'a University, Team Leader
- Dr. Gamal Al-Lawzi, EPA Aden Branch.
- Mr. Khalid Mohamed Alshubi, ministry of Planning and International cooperation.
- Dr. Ali Qasim Ismaial. Prof. Of Agriculture Extension, Sana'a University.
- Mr. Yasin Al-Tamimi, Saba News Agency

The plenary meeting was opened to all above names and to the members of the formulati team mentioned above.