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Natural Resources Management and Climate Change: Policy and Institutional Arrangement

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1. Natural resource management

Natural resource management refers to the management of natural resources such as land, water, soil, plants and animals, with a particular focus on how management affects the quality of life for both present and future generations. Natural resource management is congruent with the concept of sustainable development. It is a scientific principle that forms a basis for sustainable global land management and environmental governance to conserve and preserve natural resources (Wikipedia, the free encyclopedia, 2009).

Natural resource management specifically focuses on a scientific and technical understanding of resources and ecology and the life-supporting capacity of those resources. Sustainability of natural resource management relies on not only on suitable technology and prices, but also upon the institutions involved in resource management at the local level. Policies of transferring management responsibility from the state to users have become increasingly widespread in response to the performance deficiencies of government agencies, the economic crisis of the state, and broader policies of decentralization. The success of natural resource management policies depends upon the local capacity for collective action, but the factors that encourage or inhibit the collective action are insufficiently understood by different people (Rasmussen and Meinzen-Dick, 1995).

1.1. Natural resource management in Africa

According to Conserve Africa, the world's greatest concentration of biological wealth is found in tropical developing areas including Africa that are overwhelmed by acute poverty. In these regions, the loss of biodiversity is accelerating as poverty is increasing. African tropical forests represent one of the world's great remnant blocks of closed canopy habitat. This forest and other forms of biodiversity are under increasing pressure from population growth, unsustainable resource use, hotter and drier climate, poor management, clearing of natural habitats for agriculture especially for cash crop production and urban expansion, the demand for fuel wood and charcoal, oil and mining exploitation, excessive timber production and political instability. Excessive deforestation and loss of biodiversity again led to permanent loss of soil fertility. The loss of fertile soil is also aggravated by slash-and-burn practices, over grazing, and natural climatic events. The data from FAO indicated that the annual rate of deforestation in Africa was 0.7 percent between 1990 and 1995, with the highest rates being recorded in the moist western parts of the continent. The data also indicate that the rate of afforestation is far less than that of deforestation.

1.1.1 Traditional Knowledge and Natural Resources Management in Africa

In Africa there are many ingenious and effective ways through which indigenous and other local communities are rising to these challenges. Unfortunately, their innovations remain largely unknown. Whether for food, medicine, or income generation, these groups are using their biological resources in a sustainable way to improve livelihoods. Now it is important to mobilize the local communities and non-governmental organizations to promote local initiatives for natural resource management, which involve for example tree planting, nurseries development, and other means of generating income that do not harm wildlife or the environment. Sustainable natural resource management should focus on activities that conserve and protect the local environment and that contribute to alleviate poverty through increase natural resource base for food security for the welfare of the poor.

The UN Conference on Environment and Development in 1992 catalyzed the interest in the contribution of indigenous knowledge to a better understanding of sustainable development. The conference highlighted the urgent need for developing mechanisms to protect the earth's biological diversity through local knowledge. Many of the documents signed at UN Conference on Environment and Development reflected the need to conserve the knowledge of the environment that is being lost in communities.

Similarly, the World Conference on Science (Budapest, 1999) recommended that scientific and traditional knowledge be integrated in interdisciplinary projects dealing with links between culture, environment and development in areas such as the conservation of biological diversity, management of natural resources, understanding of natural hazards and mitigation of their impact. Local communities and other relevant players should be involved in these projects. Development professionals consider indigenous knowledge as an invaluable and under-utilized knowledge reservoir, which presents developing countries with a powerful asset.

The development of traditional knowledge systems, covering all aspects of life, including management of the natural environment, has been a matter of survival to the local communities who generated these systems. The oral and rural nature of traditional knowledge has made it largely invisible to the development community and to modern science. Indigenous knowledge has often been dismissed as unsystematic. As a consequence, it has not been captured and stored in a systematic way, with the implicit danger it may become extinct.

African traditional knowledge is unique to a given African community, culture or society. It is seen to contrast with the knowledge generated within the modern learning system. Traditional knowledge is

used at the local level by communities in Africa as the basis for decision-making pertaining to food security, human and animal health, education, natural resource management, and other vital activities. Various experience portrayed that secure access to natural resources for users, helps to bring effective and sustainable uses of the resources if it coupled with strong policies and institutional frameworks.

1.2. The effects of climate change in Africa

Climate change is one of the most serious threats the world faces. It will affect all of us, but will have a disproportionate impact on millions of poor rural people. It puts more people at risk of hunger and makes it more difficult to reduce the proportion of people living in extreme poverty. For development work to be effective, we must help poor rural people cope with and mitigate the impact of climate change. In rural areas of developing countries, nearly 2 billion people live on less than US\$2 a day (International Fund for Agricultural Development (IFAD)).

Poor rural people are the most vulnerable to the effects of climate change. Many live on ecologically fragile land and depend on agriculture, livestock, fisheries and forestry. Poor rural people do not have the access to financing and infrastructure that would allow them to withstand the impact of climate change.

According to Conserve Africa, crop failures and livestock deaths are causing higher economic losses, contributing to higher food prices and undermining food security with ever-greater frequency, especially in parts of sub-Saharan Africa. Rain fed crop yields could drop by 50 percent by 2020 in some countries. At the same time, rapidly increasing populations mean that demand for food is rising. Food production in developing countries will need to double by 2050 to meet demand. Generally climate change has the following impacts in Africa The historical climate record for Africa shows warming of approximately 0.7°C over most of the continent during the twentieth century; a decrease in rainfall over large portions of the Sahel (the semi-arid region south of the Sahara); and an increase in rainfall in east central Africa. Over the next century, this warming trends, and changes in precipitation patterns, are expected to continue and be accompanied by a rise in sea level and increased frequency of extreme weather events Africa's changing climate while the exact nature of the changes in temperature, precipitation, and extreme events is not known, there is agreement about the following

- Global mean surface temperature is projected to increase between 1.5 °C (2.7°F) and 6 °C (10.8°F) by 2100.
- Sea levels are projected to rise by 15 to 95 centimeters (6 to 37 inches) by 2100.

■ Climate change scenarios for Africa indicate that future warming across the continent ranging from 0.2°C (0.36°F) per decade (low scenario) to more than 0.5°C (0.9°F) per decade (high scenario) (Hulme et al. 2001; Desanker and Magadza 2001). This warming will be greatest over the interior of semiarid margins of the Sahara and central southern Africa. This change of climate also has multiple effects on biodiversity loss, decrease agricultural productivity, deteriorating glaciers coverage and water supply, and escalating human animal migration. Better land-management practices such as rehabilitating degraded crop and pasture land, better farming practices and planting forests can all contribute significantly to reducing greenhouse gas emissions.

To mitigate the impacts of climate change it is necessary to consider poor rural people. This is because they manage vast areas of land and forest and can be important players in natural resource management and carbon sequestration. They are often keeper of the natural resource base and can provide important environmental goods and services. Carbon-trading schemes need to include a way to compensate poor rural people for environmental services that contribute to carbon sequestration and limit carbon emissions. Support for soil and water conservation, incentives for sustainable production practices, and rewards for carbon sequestration and avoided deforestation are all part of the solution.

1.4. International convention to combat climate change and natural resource management problems

There are various conventions to fight climate change and environmental development problems in the world. These include:

- The Rio Declaration on Environment and Development
- United Nations Framework Convention on Climate Change
- Montreal Protocol
- The Convention on Biological Diversity
- The Biosafety Protocol
- The International Treaty on Plant Genetic Resources for Food and Agriculture
- The Convention on International Trade of Endangered Species of Wild Fauna and Flora
- The Basel Convention on control of Transboundary movements of Hazardous Waste

2. Natural resource and climate change in Ethiopia

(extracted from environmental policy of Ethiopia and Ethiopia environmental protection authority (2004) annual report)

Natural resources are the foundation of the economy. Smallholder peasant agriculture, in some areas including forestry, is the dominant sector accounting for about 45 per cent of the GDP, 85 per cent of exports and 80 percent of total employment. Agriculture has also been the main source of the stagnation and variability in GDP growth caused by policy failures and recurrent drought, civil war, natural resource degradation, and poor infrastructure. Renewable natural resources, i.e. land, water, forests and trees as well as other forms of Biodiversity, which meet the basic needs for food, water, clothing and shelter, have now deteriorated to a low level of productivity. In many areas of highland Ethiopia, the present consumption of wood is in excess of unaided natural sustainable production. Estimates of deforestation, which is mainly for expansion of rain fed agriculture, vary from 80,000 to 200,000 hectares per annum. The burning of dung as fuel instead of using it as a soil conditioner is considered to cause a reduction in grain production by some 550,000 tones annually. In 1990, accelerated soil erosion caused a progressive annual loss in grain production estimated at about 40,000 tones, which unless arrested, will reach about 170,000 tones by 2010. Livestock play a number of vital roles in the rural and national economy but according to one estimate some 2 million hectares of pasture land was destroyed by soil erosion between 1985 and 1995..

3. Natural resource management and climate change institutional arrangement policies, & strategies in Ethiopia

The Constitution of the Federal Democratic Republic of Ethiopia

The Constitution of The Federal Democratic Republic of Ethiopia contains provisions, which recognize the importance of the environment protection and the need for its proper management. These provisions are a major springboard for subsequent legislations in the environmental management, as well as for mainstreaming environmental sustainability in the political, social and economic development sectors. Further steps such as good governance, devolution of power to district level, and issue of participation and sharing of revenues among the different levels of government have been adequately tackled in legislations. There is now a favorable atmosphere for assisting and empowering grass-root communities to initiate local environmental management including combating desertification and mitigating the effects of drought.

Regional Governments Establishment Proclamation

The regional governments' establishment proclamation recognizes the right of nations, nationalities and peoples to self-determination and to determine their own affairs by themselves as affirmed by the Transition Period Charter of Ethiopia and later by the Constitution. The Executive Organs of the regional governments constitute several line bureaus parallel to that of the Executive Organs of the Federal Government. This kind of regional political organizational structure underpins major transformation in undertaking environmental and development issues at district and grass root levels.

Environmental Organs Establishment Proclamation:

Environmental Organs Establishment Proclamation, Proclamation No. 295/2002 was enacted in 2002. This proclamation repealed Proclamation for the Establishment of the Environmental Policy of Ethiopia (EPA), (Proclamation No. 9/95). According to this proclamation, is accountable to the Prime Minister. It has also established the Environmental Protection Council (EPC). EPC oversee EPA's activities, as well as the activities of sectoral agencies and environmental units with respect to environmental management. It also ensures coordination among sectoral ministries and agencies on environmental matters. The proclamation stipulates the mandatory need for the establishment of environmental organs by regions. Mandates of the regional environmental organs are to enable regions to coordinate environmental activities, avoid duplication of efforts and improve the dissemination of environmental information. This proclamation also mandates the EPA to undertake studies and research, to develop action plans etc, in the area of combating desertification.

The Environmental Policy of Ethiopia

The Environmental Policy of Ethiopia, which was approved on April 1997, constitutes eleven-sectoral and eleven cross-sectoral policy elements. Its overall policy goal is "to improve and enhance the health and quality of life of all Ethiopians, and to promote sustainable social and economic development through the sound management and use of natural, human-made and cultural resources and the environment as a whole, so as to meet the needs of the present generation without compromising the ability of future generations to meet their own needs". The Environmental Policy of Ethiopia emphasizes the need for arresting land degradation. The policy's section on Soil Husbandry and Sustainable Agriculture, Forest Resource, Biodiversity Resources, Water Resource, Energy and Mineral Resource address the issue of combating desertification climate change.

Agricultural and Rural Development Policies and Strategies

Agricultural and Rural Development Policies and Strategies were adopted by government in March 2002. In the context of combating desertification and mitigating the effects of drought, the most relevant principles of this Policy and Strategy are: improving farming skills; improving the supply, replication and

dissemination of technologies; ensuring access to land and tenure security; resolving problems of drought prone regions; improving the agricultural marketing systems; promoting rural finance; developing the rural energy sector and rural telecom development

The National Capacity Building Programme

The National Capacity Building Programme was adopted by the government on December 1998. The programme aims at building: the necessary capacity to realize the Agricultural Development-led Industrialization Strategy at all levels; the capacity for an accelerated and private sector-led agric-based industrialization in the country by creating among others, conducive policy and institutional environment, and minimizing adverse impact of market failure; and the institutional capacity of the public, private and civil societies in discharging their respective roles in the democratization process.

Sustainable Development and Poverty Reduction Strategy

The Sustainable Development and Poverty Reduction Strategy Programme, issued on July 2002, outlines the fundamental development objectives of the government of Ethiopia to build a free-market economic system that will enable the economy to develop rapidly, and the country to extricate itself from poverty and dependence on food aid, where the poor people are the main beneficiaries of the economic growth. The programme recognizes the importance of environmental protection as a prerequisite for sustainable development and treats it as crosscutting issue. Accordingly, it points out three priority areas for action: strengthening and expanding on-going efforts to address land degradation, deforestation, overgrazing, soil erosion, loss of soil fertility and the disruption of the hydrological cycle, by giving special attention to highly degraded, drought prone and food insecure areas; strengthening regulatory and institutional capacity; and strengthening the measures currently under implementation to preserve, develop, manage and sustainable use biodiversity resources.

3. Natural resource management and climate change institutional arrangements in Ethiopia.

Government and other institutions, which have got significant contributions to combat desertification and mitigate the effects of drought, are briefly discussed here under.

Environmental Protection Authority

Environmental protection Authority in coordination with other sectoral ministries and agencies work on environmental matters. The authority also have mandates to undertake studies and research, to develop action plans etc, in the area of climate change and natural resource management and environmental protection.

Ministry of Agriculture and Rural Development (MOARD)

Proclamation No. 300/2004 issued on 13th January 2004 amended the proclamation for the reorganization of the Executive Organs of the Federal Democratic Republic of Ethiopia, Proclamation No. 256/2002. Thus, the MOARD replaced the former Ministry of Agriculture and Ministry of Rural Development. The powers and duties vested in the new ministry includes, among others, conservation and utilization of forest and wildlife resources, food security programme, water harvesting and small-scale irrigation, monitoring events affecting agricultural development and early warning system, enhancing market led agricultural development, issue guidelines and procedures for agricultural input evaluation and release, ensuring the distribution of high quality agricultural inputs to users, and establishing and directing training centers of agriculture and rural technology. The New Ministry strives to solve chronic problems associated with: deforestation, land degradation, lack of land use planning, decline in crop & animal production, dependency on biomass fuels, and lack of alternatives livelihoods, etc.

Ministry of Capacity Building (MOCB)

The Proclamation for the reorganization of the Executive Organs of the Federal Democratic Republic of Ethiopia, Proclamation No. 256/2002 established Ministry of Capacity Building. Under the National Capacity Building Programme, there are currently 14 sub-programmes. Out of these sub-programmes: District Level capacity building; establishment of Agricultural, Technical, Vocational & Educational Training (ATVET); the Cooperative Development Programme; the Information Communication Technology (ICT) service through the establishment of government information network and community based information system and services; and Civil Society and NGO capacity development programmes are directly relevant to combating desertification and mitigating the effects of drought.

Ministry of Federal Affairs (MOFA)

Ministry of Federal Affairs [MOFA] assists the regional states through trainings in policy issues to regional leaders as well as the public at large. It also strives to enhance their capacity and maintain peace and promote development, conflict management, social and environmental awareness, among others. The Regional Affairs divisions of MOFA focus mainly in supporting regions, which are relatively underdeveloped and recently emerging. These include the pastoral regions of Somali and Afar and the semi -sedentary regions of Gambella and Benishangul-Gumuz. These enhance the capacity of the regional states to be prepared and respond to drought and also contribute to vulnerability reduction and creating sustainable settled livelihood for the people of the region.

Ministry of Education

In collaboration with the relevant environment related institution, the Ministry is responsible for promotion environmental education and awareness that focuses mainly on formal education.

Disaster Prevention and Preparedness Commission

The Disaster Prevention and Preparedness Commission by virtue of its operational strategies and implementation modalities in general, have a direct role in a matter of drought. Especially the Early Warning System of the DPPC has been identifying acute problem areas regarding drought induced food shortage as well as it has been providing early warning information to the public and international humanitarian organizations.

Ethiopian Agricultural Research Organization (EARO)

Ethiopian Agricultural Research Organization [EARO] has a directorate dedicated to the research in dry land related theme. The directorate is known as Dry Land Agricultural Research Directorate. It is established to carry out multifaceted and community based Dry Land Agricultural research programmes. The research subjects of the directorate include: crop, livestock (Pastoral and Agro Pastoral Research Programme), soil and water, and dry land forestry. This approach is envisaged to ensure integration among production systems, natural resource management and socioeconomic considerations.

Institute of Biodiversity Conservation (IBC)

The former Institute of Biodiversity Conservation and Research [IBCR] has been re-established as Institute of Biodiversity Conservation (IBC) by Proclamation No. 381/2004. The Institute is engaged in undertaking ex situ, and in situ conservation of biodiversity. The materials acquired by the gene bank in IBC through collection, repatriation and donation over the years (circa 62851 accessions of some 105 species) are being conserved using appropriate ex situ, conservation practices. IBC in collaboration with regional states and other stakeholders is preserving recalcitrant species in field gene banks and botanical garden at different parts of the country.

Higher Learning Institutions

Higher education institutions undertake some educational and research initiatives in environment management including the combating desertification and mitigating the effects of drought. The institutions also are engaging in activities relevant to combating desertification. The Addis Ababa University is running Post-graduate study in Environmental science, research programmes in Biology Department such as the Herbarium; The Mekelle University has an Undergraduate study in Environment and Natural Resource programme and is running projects on dry land agriculture and conservation, and the Debu, Alemaya, Arbaminch and Jimma Universities address combating desertification through their regular education and research programmes.

National Meteorological Services Agency

National Meteorological Services Agency is preparing and disseminating Agro Meteorological Advisory Bulletins at real time basis, which can assist planners, decision makers and farmers at large. The agency disseminates agro meteorological reports on ten daily, monthly and seasonal in which all the necessary current information relevant to agriculture is compiled. NMSA also issues agro-meteorological bulletins through World Agro Meteorological Information Service Web site. Moreover, NMSA prepares and disseminates monthly, seasonal and annual Climate Bulletins and seasonal and annual Hydro-Meteorological Bulletins.

Regional Environmental Agencies

Under Proclamation No. 295/2002, all regional states are expected to establish their own environmental organs. Following this, six regions and two city administrations have established their respective environmental organs and two regional states are in the process. Regional environmental organs are vested in, among others, the responsibility to coordinate environmental matters including the issue of combating desertification in their respective region.

Ethiopian Rural Energy Development and Promotion Centre

The Ethiopian Rural Energy Development and Promotion Center is accountable to the ministry of Agriculture and Rural Development. It is mandated for adoption, research, to develop and disseminate efficient and appropriate energy technologies and facilitates, as well as to develop renewable energy development projects in rural areas. The center can have an important role in designing and implementing projects that directly contribute to combating desertification and mitigating the effects of drought. Moreover, the center can have an important role in identification of appropriate alternative energy sources and technologies. Its activities are envisaged to reduce the pressure on natural biomass resources, and eventually contributing to combat desertification.

Ministry of water resources

Ministry of mines and Energy

NGOs/CBOs

There are more than 650 registered NGOs/CBOs in Ethiopia. These NGOs and CBOs are engaged in various fields including environmental protection and natural resource management. Recently they have established a network, called Ethiopian NGOs/CBOs Coordination Committee for Combating Desertification. Some of the major activities accomplished by the committee are: maintain network among its members and other organizations working in the field; share various information and experiences; provide information and feedback on different studies conducted in association; participate

in training and awareness raise activities; participate in several meetings representing NGO/ CBOs nationally and internationally.

3.1 Undertaking activities through concerned stakeholders institutions

3.1.1 The Conservation of Natural Resources

With the participation of all concerned stakeholders, various activities have been carried out throughout the country in combating desertification and mitigate the effects of drought. The major activities are:

- Moisture conservation and utilization, which include water harvesting, small-scale irrigation etc,
- Physical and biological soil conservation measures and agro-forestry practices;
- Area closure and afforestation;
- Rehabilitation of degraded patches of remnant forest areas through enrichment planting and enclosure by local communities;
- Upgrading of two control hunting areas to national parks and the establishment of one new national park;
- Based on the investment policy of the country, five eco-tourism based investments have been established by local and private investors;
- Woody Bio-mass Inventory and Strategic Planning Project which was designed to develop national and regional planning and monitoring capabilities, including inventory of natural resources and to provide recommended land management options has been completed;
 - The introduction and dissemination of fuel saving stoves and utilization of renewable energy sources (solar, wind etc). Tree Nursery, ORDA Area Closure, North-Wollo (ORDA)

3.1.2. Improving Institutional Arrangements

Cognizant of the urgent need to address the wide array of capacity constraints that hinder the performance of public institutions in Ethiopia, the government has embarked on a comprehensive Civil Service Reform Programme (CSRP) since 2003. Indicative of Ethiopia's "first generation" capacity building efforts, the CSRP aims at building a fair, transparent, efficient, effective and ethical service primarily by focusing on strengthening core technocratic systems within the public sector.

Key challenges for the government in this "full implementation phase" of CSRP will be to ensure a regional and district-level focus, maintain strong coordination across line ministries and government institutions, provide clear incentives for behavioral change among civil servants, and establish benchmarks against which to measure impact. These reforms will make a qualitative change in governance, transparency and accountability within the public sector.

3.1.3. Improving the Knowledge of the Public on Desertification, Climate change and Mitigation of the Effects of Drought.

Awareness and education plays a critical role for the development and appropriate use of environmental resources in general and combating desertification in particular. Strengthening environmental education and raising the awareness of the society is one of the strategies required for combating desertification and mitigating the effects of drought. In line with this, the following major activities have been undertaken at all levels: incorporation of environmental science in the school curriculum; the establishment of environmental clubs; awareness creation through the media, publications and audiovisual materials; formation of environmental forums, and the celebration of public events such as World Desertification Day, Tree Day & the World Environment Day.

3.1.4 The Implementation of Early Warning System to combat Drought

Mitigation Capacity The Disaster Prevention and Preparedness Commission (DPPC), via its strategies and implementation modalities in general and that of the Early Warning System in particular, identifies acute problem areas and gives early warning information to the public and international humanitarian organizations to mitigate the effects of drought. At federal level, the government has built up a Crisis Management Committee whose members are drawn from different relevant sectors and chaired by DPPC with the responsibility to monitor and evaluate the effects of drought. The committee submits a periodical report to the National Committee led by the Deputy Prime Minister of the country for immediate action and resource mobilization. Moreover, base line information over a long period of time that aid in designing policies and strategies has been provided to the government, donors, NGOs and international aid agencies. This include among others, Vulnerability Development Index (VDI) and Vulnerability Analysis and Mapping (VAM) which is funded by WFP.

3.1. 5. Improving the Role of Science and Technology

The National Science and Technology Policy addresses a number of science and technology issues that promote sustainable development and proper management of the environment in the country. The government has also taken measures to create conducive environment to scientists and technologists. Incentive mechanisms for scientists and technologists have also been put in place and scientists are more encouraged to come up with different project proposals. The collection and characterizations of the country's flora and fauna, collection of the principal vegetation types, dynamic change and land use and ecological restoration of the central plateau of the country are some of the on-going projects relevant to combating desertification and mitigating the effects of drought.

3.1. 6. Improving Agricultural Research

The current policy of Ethiopia gives special attention to agricultural research and development and market-oriented economy. The development of crops and cropping systems, including grain legumes that can assist in conserving and enhancing the natural resources base are also the focus of this policy. The Dry Land Agricultural Research Directorate established, which focuses on issues of dry land agriculture that includes crop, livestock (Pastoral and agro-pastoral research programme), soil and water conservation, forestry and others in a holistic approach by conducting basic and applied research. This approach contributes to the development of technologies that help improve the farming system, coordination of national dry land research activities under dry land agricultural research directorate, the generation of appropriate training, and communication methodologies for accelerating transfer of technologies as well as collaborating with relevant national and international agencies.

The country has also established joint research activities with International Center for Agricultural Research in Dry Area (ICARDA), International Crop Research Institute for Semi Arid Tropics (ICRISAT), International Livestock Research Institute (ILRI), and International Institute for Tropical Agriculture (IITA), among others. The areas of co-operation include evaluation of genetic material, collaborative research, experience sharing, information exchange, etc.

Among the major steps taken in the research capacity of the dry lands of Ethiopia is the opening of new research centers in the previously inaccessible regions of the country. In order to cover these dry land agro-ecologies of pastoral and agro-pastoral production systems, EARO is establishing six new research centers. In these regions, there has been food and feed insecurity, variability of vegetation cover, drought, and disease outbreak and land degradation. These research centers are located in major dry land agro-ecological zones of the pastoral and agro pastoral production systems. Moreover, Pastoral Community Development Project funded by the World Bank with particular interest in pastoral community development and research is closely collaborating with Dry Land Agriculture Research. In addition, the dry land research programmes are planned and executed in collaboration with the higher learning institutes such as Mekelle University. These collaborations enable to increase the contribution of research results on the constraints identified in the strategy and development of research capacity. Currently, there are several research activities being conducted in the pastoral and agro-pastoral areas under both rain-fed and irrigated conditions by focusing on, among others, different food crops, forage crops, livestock, natural resource management (rangeland management) and forestry. The research activities can generally be classified under three categories: (a) sustainable management and utilization of existing woodland and tree resources, (b) tree planting in an agro forestry scheme, especially using drought-tolerant multipurpose trees which are designed to increase tree cover in the dry lands, and (c)

forage species development using drought tolerant species. These activities have significant contribution in combating desertification and mitigating the effects of drought.

3.1.7. Enhancing the Role of Indigenous Knowledge on Combating Desertification and Mitigating the Effects of Drought Ethiopia,

together with the African Union (AU), has developed a model law for regulating access to biological resources and for enforcing the protection of the rights of the local communities to their traditional knowledge, technologies, innovations and practices and their biological resources in line with Article 8. j of the CBD. This model law was adopted by the AU summit that took place in Ouagadougou in June 1998. In these regard, Ethiopia's draft law based on the African Model Law is being finalized prior to submission to the parliament. The objective of the draft law is to ensure that the genetic resources of the country are conserved, developed, and sustainable utilized; the knowledge, innovations, practices, and technologies of local communities on the conservation and use of genetic resources are respected; and the benefits derived from the use of genetic resources, and community knowledge, innovations, practices and technologies are fairly and equitably shared by local communities. The Ethno-biology Department of the IBC has been studying the role of women in the development, maintenance and sustainable utilization of biological resources with emphasis on food crops and cosmetic plants. Some measures have been taken to support the Ethiopian National Traditional Medicine Preparation and Therapy Association in recording medical knowledge, innovations and practices of healers in local communities. In addition, various research activities have been carried out including on the use of biological resources, particularly plants by the various ethnic societies of the country, by the Institute of Ethiopian Studies and the Sociology/Anthropology Department of Addis Ababa University.

3.1.8. Enhancing the involvement of women in natural resource management and combating desertification

In rural areas of Ethiopia, where the majority of the population live, natural resource is the most important base for life. Although natural resource degradation affects every segment of the society, women, girls and children are the most vulnerable ones in regard to limitation of access to resources. Poor women usually do not own land or money; they depend on other natural resources, especially on forest products such as fuel wood, medicinal plants, animal feed both for consumption and source of income. The country's Constitution has guaranteed women equal rights to men in every opportunity. Several articles of the Constitution give emphasis to women right. In addition to this, the government issued policies that commit itself to the advancement of women. These policies state that in order to attain overall economic and political development, opportunities for women in decisions making process

must be guaranteed. As prerequisite for sustainable development, the Environment Policy of Ethiopia states “as key actors in natural resource management, women shall be treated equally with men & women to be totally involved in policy, programs & project decision making and implementation.” Accordingly, the involvement of women in conservation programmes of the rural areas has grown significantly with their share reaching between 50-70 % of the total labour force. Along side these, development agencies across the country have been running projects that benefit women through food for work programmes, employment generation schemes and by promoting access of women to key resources; such as the forests, land and water. The full involvement of women in natural resource management has resulted to better natural resources management and in increasing household incomes.

3.1. 9. Improving Environmental Information System

Information is very crucial for decision making on environmental issues and for dissemination of current environmental information to the public at large. In view of the pivotal role that information plays, the Environmental Policy has incorporated it as one of the cross-sectoral policy issues. At present, however, it is difficult to say that there is an efficient and consistent environmental information system in the country. As a result, one could say that the environmental controlling and monitoring of desertification is not supported by adequate information, which is also reflected in the preparation of the country profile. Much effort is being made at present in the collection and storage of environmental data. A meta-database on environmental and natural resources is being developed under the auspices of the Ministry of Water Resources to create one central national database in order to ensure consistency of data. In addition, EPA has also taken some initiatives in the field by setting up an environmental information system.

4. Major natural resource and climate change policies in Ethiopia

(Extracts from the Environmental Policy of Ethiopia)

4.1 Soil Husbandry and Sustainable Agriculture Policies

- To foster a feeling of assured, uninterrupted and continuing access to the same land and natural resources on the part of farmers and pastoralists so as to remove the existing artificial constraints to the widespread adoption of, and investment in, sustainable land management technologies;
- To base, where possible, increased agricultural production on sustainably improving and intensifying existing farming systems by developing and disseminating technologies which are biologically stable, appropriate under the prevailing environmental and socio-cultural conditions for farmers, economically viable and environmentally beneficial;
- To promote the use of appropriate organic matter and nutrient management for improving soil structure, nutrient status and microbiology in improving soil conservation and land husbandry;

- To safeguard the integrity of the soil and to protect its physical and biological properties, through management practices for the production of crops and livestock which pay particular attention to the proper balance in amounts of chemical and organic fertilizers, including green manures, farm yard manures and compost;
- To promote effective ground cover as one of the most important factors in soil erosion control, taking advantage of the wide range of sustainable agronomic, pastoral and silvicultural approaches used in various areas of Ethiopia as potentially flexible alternatives to mechanical soil conservation systems;
- To promote in drought-prone and low rainfall areas water conservation which is as important as physical soil conservation for more secure and increased biomass production, including crop production;
- To ensure that, for reasons of cost and acceptability, improvements in land husbandry are made with an appreciation of existing husbandry systems, technologies and knowledge;
- To ensure that, given the heterogeneous environment of the Ethiopian highlands, agricultural research and extension have a stronger focus on farming and land use systems and support an immediate strengthening of effective traditional land management systems;
- To promote, for the relatively more environmentally uniform Ethiopian lowlands, a long-term approach to agricultural research programmes to develop appropriate farming and land management systems that yield high outputs;
- To ensure that planning for agricultural development incorporates in its economic cost-benefit analysis the potential costs of soil degradation through erosion and salinization as well as soil and water pollution;
- To ensure that inputs shall be as diverse and complementing as the physical, chemical and biological components of the soil require, and shall not focus solely on a quick and transitory increase in plant nutrients to the long-term detriment of soil structure and microbiology;
- To institute the stall feeding of domesticated animals through a combination of providing agricultural residues, on-farm produced forage and fodder as well as the cutting and carrying of grass and browse from meadows and hillsides in order to encourage revegetation of grazing lands and the reduction of soil erosion;
- To develop forestry on the farm, around the homestead and on eroding and/or eroded hillsides in order to increase the stock of trees for fuelwood, construction material, implements and crafts, for forage and for other tree products ;

- To shift the emphasis in crop breeding from single line plant varieties and animal breeds to multiple lines involving as many different but adapted lines as possible in order to increase both plasticity in adapting to environmental variations, and resistance to pests and diseases;
- To use biological and cultural methods as well as resistant or tolerant varieties or breeds, pheromones or sterile male techniques in an integrated manner as a pest and disease management method in preference to chemical controls;
- To safeguard human and environmental health by producing adequate regulation of agricultural (crop and livestock) chemicals;
- To use the precautionary principle in assessing potentially damaging impacts when taking decisions that affect social and economic conditions, natural resources and the environment, especially in the pastoral areas, which are perhaps the least studied in the country;
- To ensure that new technical recommendations are compatible with existing pastoral and agricultural systems, agro-ecological conditions and the prevailing socio-economic environment; and
- To undertake full environmental, social and economic impact assessments of all existing irrigation schemes in the rangelands and wherever needed establish programmes of correcting their negative environmental, social and economic impacts.

4.2. Forest Resource Policies

- To recognize the complementary roles of communities, private entrepreneurs and the state in forestry development;
- To encourage all concerned individuals and communities as well as the government to actively involve in the planning and implementation of forestry programmes to ensure sustainability, minimize cost, and forestall conflict;
- To ensure that forestry development strategies integrate the development, management and conservation of forest resources with those of land and water resources, energy resources, ecosystems and genetic resources, as well as with crop and livestock production;
- To ensure that afforestation with exotic species be restricted to backyard woodlots, to peri-urban plantations and to plantations for specific industrial and other projects; otherwise until reliable information and knowledge on exotic species are available afforestation shall use local species as these are in tune with the environment and thus ensure its well-being;
- To assist the natural process of afforestation of uncultivable areas by controlling felling and grazing and by planting judiciously selected local species, as well as by other affordable interventions.

- To adhere to the principle that "sustainable forest management" is achieved when social acceptability and economic viability have been achieved and the volume of wood harvested in a given period is about equal to the net growth that the forest is capable of generating;
- To pursue agricultural and other policies and programmes that will reduce pressure on fragile woodland resources and ecosystems; and
- To promote changes in agricultural and natural resource management systems which will limit the need for free grazing of animals in protected forest areas.
- To find substitutes for construction and fuel wood whenever capabilities and other conditions allow, in order to reduce pressure on

4.3. Biodiversity resource Policies

- To promote *in situ* systems (i.e. conservation in a nature reserve, farmer's fields, etc.) as the primary target for conserving both wild and domesticated biological diversity; but also promote *ex situ* systems (i.e. conservation outside the original or natural habitat) in gene banks, farms, botanical gardens, ranches and zoos as supplementary to *in situ* conservation;
- To promote *in situ* conservation of crop and domestic animal biological diversity as well as other human made and managed ecosystems through the conscious conservation of samples of such ecosystems, even when change as a whole is taking place;
- To ensure that the importation, exportation and exchange of genetic and species resources is subject to legislation, e.g. to ensure the safeguarding of community and national interests, the fulfilling of international obligations, quarantine, etc. Above all biological material which is self-regenerative and impossible to control once allowed to get out of control may result in the most insidious and damaging form of pollution which is biological pollution, thus the importation and use of biological material including those genetically engineered should be under stringent regulations;
- To ensure that factors such as the level of vulnerability, uniqueness, importance and economic and environmental potential of the genome be taken into account in determining priorities in conservation;
- To ensure that the conservation of genetic resources *in situ* maintains a dynamic system of genetic variability in an environment of constant selection pressure that is normally present in the natural or human made ecosystem as the case may be;
- To promote the involvement of local communities inside and outside protected areas in the planning and management of such areas;
- To ensure that the conservation of biological diversity outside the protected area system be integrated with strategic land use plans, local level plans and sustainable agricultural and pastoral production

strategies; h. To include in protected areas as wide a range of ecosystems and habitats as possible and where appropriate to link them by corridors of suitable habitats along which species can migrate;

- To ensure that pricing policies and instruments support conservation of biological diversity;
- To ensure that park, forest and wildlife conservation and management programmes which conserve biological diversity on behalf of the country allow for a major part of any economic benefits deriving therefrom to be channelled to local communities affected by such programmes; and
- To recognize that certain animal and plant species are vermin or pests or may be a reservoir of disease to humans, crops and livestock, and to control them.

4.4. Water Resources Policies

- To ensure that the control of environmental health hazards be a necessary condition in the design, construction and use of dams and irrigation systems;
- To recognize that natural ecosystems, particularly wetlands and upstream forests, are fundamental in regulating water quality and quantity and to integrate their rehabilitation and protection into the conservation, development and management of water resources;
- To ensure that any proposed introduction of exotic species into water ecosystems be subject to detailed ecological studies and environmental impact assessment;
- To promote the protection of the interface between water bodies and land (e.g. lake shores, river banks and wetlands);
- As most large and medium scale irrigation potential is located in the rangelands of the lowlands occupied by pastoralists, to consider the opportunity costs of irrigating important dry season grazing areas of the pastoralists for crop production in any cost benefit analysis of such irrigation projects;
- To involve water resource users, particularly women and animal herders, in the planning, design, implementation and follow up in their localities of water policies, programmes and projects so as to carry them out without affecting the ecological balance;
- To subject all major water conservation, development and management projects to the environmental impact assessment process and to include the costs and benefits of protecting watershed forests, wetlands and other relevant key ecosystems in the economic analysis of such water projects; and
- To promote, through on-site training, effective water management techniques at the farm level for improved performance of medium to large-scale irrigation schemes.
- To promote, to the extent possible, viable measures to artificially recharge ground and surface water resources.

- To recycle waste water when it has been found to be safe for health and the environment or when it has been made safe without entailing high cost.

4.5. Energy Resource Policies

- To adopt an inter-sectoral process of planning and development which integrates energy development with energy conservation, environmental protection and sustainable utilization of renewable resources;
- To promote the development of renewable energy sources and reduce the use of fossil energy resources both for ensuring sustainability and for protecting the environment, as well as for their continuation into the future;
- To make institutions and industries which consume large amounts of wood fuel establish their own plantations or make contractual arrangements with plantations to meet their wood requirements;
- To encourage Government leases for private entrepreneurs to plant fuel woodlots in peri-urban areas;
- To ensure that feasibility studies for hydroelectricity facilities and other significant generating facilities include rigorous environmental impact assessments to allow informed decision-making that maximizes benefits to the community and to the country at large and eliminates or at least minimizes damage to the natural resources base and/or to environmental well-being;
- To review current institutional, pricing and regulatory arrangements in the energy sector to suggest reforms that will better meet community energy needs and maximize the opportunities for private commercial and community sector initiatives to develop and market environmentally sound energy sources;
- To recognize that water resources play an important role to meet Ethiopia's energy demand and that, by generating power cause no pollution on the environment;
- To focus extension programmes on farm and homestead tree planting to ensure that each homestead grows enough trees to satisfy its wood requirements; and
- To locate, develop, adopt or adapt energy sources and technologies to replace biomass fuels.

4.6 Atmospheric Pollution and Climate Change Policies

- To promote a climate monitoring programme as the country is highly sensitive to climatic variability;
- To recognize that even at an insignificant level of contribution to atmospheric greenhouse gases, a firm and visible commitment to the principle of containing climate change is essential and to take the appropriate control measures for a moral position from which to deal with the rest of the world in a struggle to bring about its containment by those countries which produce large quantities of greenhouse gases;

- To recognize that Ethiopia's environmental and long-term economic interests and its energy prospect coincide with the need to minimize atmospheric inputs of greenhouse gases as it has a large potential for harnessing hydro-, geothermal and solar energy, none of which produce pollutant gases in significant amounts and to develop its energy sector accordingly;
- To actively participate in protecting the ozone layer since, as the highlands of Ethiopia already have a thin protective atmosphere and are liable to suffer agricultural losses and adverse health effects from exposure to ultraviolet rays;
- To recognize that the continued use of biomass for energy production makes no net contribution to atmospheric pollution as long as at least equal amounts of biomass are produced annually to compensate this and to maximize the standing biomass in the country through a combination of reforestation, agro-forestry, the rehabilitation of degraded areas, a general re-vegetation of the land and the control of free range grazing in the highlands and to seek financial support for this from industrialized countries for offsetting their carbon dioxide emission;

4.7. Population and the Environment Policies

Ethiopia's National Population Policy, developed in 1993, identifies major obstacles to the country's development effort and proposes measures to address these obstacles. The National Population Policy seeks the "harmonization of the rate of population growth and the capacity of the country for the development and rational utilization of natural resources to the end that the level of welfare of the population is maximized over time". Specifically, the policy seeks to increase contraceptive usage from 4 percent in 1993 to 44 percent and to reduce fertility from 7.7 children per woman to 4 by 2015. So, it is necessary to integrate population and environment through designing policy.

- To integrate population planning, resources management and the rehabilitation of and care for the environment to achieve a sustainability of life styles;
- To give attention to the education and care of children, especially in the context of development and the sustainable use of natural resources since virtually all values and the discipline of work are established during childhood;
- To tackle simultaneously the issues of poverty, health, education and empowerment as these are interlinked with those of population growth, availability and access to resources and the well-being of the environment;
- To undertake a comprehensive and country-wide assessment of the human carrying capacity of the natural resources and the environment to identify potential areas for voluntary resettlement;

- To ensure a complete empowerment of women especially to enable their full participation in population and environmental decision making, resource ownership and management; and
- To promote off-farm and on-farm income generating programmes which aim at the alleviation of poverty, especially, among women whether they have access to land or not and among men who have no access to land.

4.8. Community Participation and the Environment Policies

- To ensure that all phases of environmental and resource development and management, from project conception to planning and implementation to monitoring and evaluation are undertaken based on the decisions of the resource users and managers;
- To reorient management professionals employed in natural resource and environmental extension programmes to embrace participatory development, and to strengthen their communication skills so as to more effectively disseminate both the results of scientific research and the practical experience of local farmers;
- To develop effective methods of popular participation in the planning and implementation of environmental and resource use and management projects and programmes;
- To develop the necessary legislation, training and financial support to empower local communities so that they may acquire the ability to prevent the manipulated imposition of external decisions in the name of participation, and to ensure genuine grassroots decisions in resources and environmental management;
- To authorize all levels of organization to raise funds locally from the use of natural resources to fund the development, management and sustainable use of those resources;
- To greatly increase the number of women extension agents in the field of natural resource and environmental management; and
- To ensure information flow among all levels of organization including the Federal and Regional States and the people at the grassroots level by developing a two way mechanism for data collection and dissemination.

5.9. Tenure and Access Rights to Land and Natural Resource Policies

- When taking decisions to recognize that the constitution now ensures that the user of land has the right to a secure and uninterrupted access to it and to renewable natural resources on it (e.g. trees, water, wildlife and grazing);

- To recognize and protect wherever possible the customary rights of access to and use of land and natural resource which are constitutionally acceptable, socially equitable and are preferred by local communities.

4.10. Social and Gender Issues

The Policies are:

- To ensure that formal and informal training in environmental and resource management include methodologies and tools for analysis and elimination of inequities;
- To make environmental awareness and public education programmes include both men and women in all social, economic and cultural groupings of society;
- To subject all policies, programmes and projects to impact assessments in order to maximize equity for economic, ethnic, social, cultural, gender and age groups, especially the socially disadvantaged; and
- To facilitate the participation of women across all sections of society in training, public awareness campaigns, formal and informal education and decision making in environment and resource management.

4.11. Environmental Research Policies

- To develop strategic environmental research which aims at identifying the social, economic and technical factors which influence resource management;
- promote the training and the improvement of the working conditions of researchers so that they become technically competent and familiar with the agro-ecological and socio-economic conditions of the potential end users;
- To put in place an appropriate information exchange system and institutional structure which facilitate closer interaction among farmers, pastoralists, government professionals, development NGO's, and researchers;
- To support research on appropriate technologies for environmental management and sustainable development through a partnership between scientists and potential end users so as to benefit from the universal knowledge of the former in science and technology and the unique knowledge of the latter in the very often site specific conditions under which the technology is to be used;
- To coopt existing traditional systems of research and learning into a new system which incorporates both modern and traditional components;
- To allocate funds to support strategic, applied and adaptive research programmes and projects;
- and g. To establish Science and Technology Associations in all communities to identify and

support their traditional systems of research and development and provide a channel for feedback of information concerning the suitability or otherwise of research outputs;

4.12. Environmental Education and Awareness Policies

- To promote the teaching of environmental education on a multi-disciplinary basis and to integrate it into the ongoing curricula of schools and colleges and not treat it as a separate or additional subject, though this should also be done at the tertiary level;
- To target the public, particularly those involved in public and private sector activities that have significant environmental impacts, for environmental education and awareness programmes;
- To formulate environmental awareness programmes in such a way as to make them address specific environmental problems of particular localities in view of the extreme variability of environmental conditions and problems in Ethiopia;
- To recognize the important role the mass media play and to effectively use them in creating and promoting environmental awareness in view of the physical problems of access and communications in Ethiopia;
- To strengthen existing higher level training and education institutions so that they can offer programmes and courses in sustainable resource and environmental management for economists, planners, lawyers, engineers, sociologists and medical practitioners as well as for natural resource and environmental scientists;
- To provide in-service training in such specialized subjects as environmental economics, environmental law, environmental monitoring, geographical information systems (GIS), pollution monitoring and control, and hazardous waste management;
- To encourage the local development of environmental awareness associations and programmes specific to particular agro-ecological zones and support them with scientific inputs;
- To develop environmental awareness programmes for urban environments for dissemination by the mass media and foster the development of urban environmental awareness associations; and
- To initiate, encourage and support the involvement of local community and religious leaders in programmes to promote environmental awareness.

5. Policy implementation

5.1. Institutional Framework, Responsibilities and Mandates Policies

- To give political and popular support to the sustainable use of natural, human-made and cultural resources and environmental management for effectiveness at the federal, regional, zonal, wereda and community levels;
- To ensure that legally established coordination and management bodies from the federal down to the community level handle the sectoral and cross sectoral planning and implementation issues identified as the responsibilities of concerned line ministries, commissions, authorities and bureaus, as applicable to the level of organizations, including those of the relevant federal executive organs as well as regional and municipal governments, elected councilors, non-governmental organizations, community representatives, representatives of professional or other environmental associations and the private sector;
- To use to the maximum, whenever possible, existing institutional structures;
- To determine institutional arrangements for the formulation of conservation and natural resource development and management strategies, legislation, regulation, monitoring and enforcement using the following criteria:
 - (i) conformity with the Constitution, especially with respect to the decentralization of power;
 - (ii) harmonization of sectoral interests; (iii) integration of environmental planning with development planning;
 - (iv) minimization of incremental financial requirements;
 - To avoid conflicts of interest by assigning responsibilities to separate organizations for environmental and natural resource development and management activities on the one hand, and environmental protection, regulation and monitoring on the other;
 - To ensure that enforcement of government laws and regulations with respect to environmental protection remain the responsibility of federal and regional courts and administrations; nevertheless, where government's own development activities are controlled by laws and regulations, the monitoring of such laws and regulations to ensure compliance of specific ministries and other government entities should be carried out by the government organization responsible for environmental protection and regulation.

6. Best Practices on natural resource management

There are various best practices to combat land degradation/ desertification and mitigate the effects of drought. The selected ones are described here under.

6.1. Konso's Indigenous Terrace building

The Konso district is found in the Southern Nations/ Nationalities People's Region (SNNPR). The District has an area of 2,354.3 km² inhabited by 212,235 population. Out of the total area of the district, about 80% is terraced. The farmers of Konso are well known for their own home grown/special terrace building, which is one of the best locally available techniques for soil and water conservation. In addition, the Konso's are well known for their crop diversification to minimize risk, mixed cropping and multi-story crop and tree production in traditional intensification. Unlike the tradition such as in the northern parts of Ethiopia, weaves, smiths, potters etc., are not outcastes but having equal status in the society. Merit is given to hard work, productivity and natural resource conservation.

As a result, the Konso's people have controlled land degradation even in hilly and mountainous areas. Each terrace has been in place for more than 50 years. All Konso people participate in terrace building. Konso's terracing and agro forestry practices have significant contribution to combat desertification and mitigate the effects of drought and needs to be replicated in other parts of the country.

6.1.2 Gedio's Agro-forestry system

Gedio zone, found in the SNNPRS, has a total area of 1347 km² inhabited by 773,514 populations. In Gedio, nearly all people live virtually in a home garden land use system. In this system slopes as steep as 80 degree are under production. Out of the total zonal population, about 86%, living in the rural area is involved in agro-forestry development activities, which is one of the best measures to combat desertification and mitigate the effects of drought in the zone. Plots are covered with multi-story vegetation and crops like *Cordia africana*, *Coffee arabica*, *Enset ventricosum* and several root crops. Mainly, biological measures are being practiced in the area.

As a result, soil and water resources are well conserved, home garden agro-forestry and biodiversity have been enhanced; and most area of the zone is covered by evergreen vegetation. Gedio "agroforests" contain an organized mix of mosaics of crops (starting from annual herbs through medium-aged ensete (10years) and coffee (30 years) to long living multi-purpose trees (over a century old). This disposition allows farmers to derive maximum benefits on a sustainable basis, as different components at different phases of development provide continuous harvests. High biomass production is ensured because of the capacity of the land use system. Perturbing forces are thus well buffered too. This also explains the high carrying capacity of these systems (582.3 persons per km² ,CSA, 2004) in an undulating and rugged terrain. While Gedio agroforests are most ancient, they cannot be said to be primitive, i.e., archaic or

unfit for the present age, as their capacity of production is comparable to most high input conventional modern agricultural systems. There is a lesson to be learned from these “agro forests” that maximum yield can be obtained also from complex systems. Therefore, ensete based Gedeo systems today as compared to contemporaries of modern day agriculture and forestry have retained the qualities of the original ecosystem by conserving their capacity for high biomass production. Unlike agro forestry systems proper that only cast a bridge between specialized agriculture and specialized forestry, Gedio “agro forests” fully integrate aspects of forestry and agriculture. The Gedio systems can therefore be thought of as indirect progenitors of modern-day agriculture and forestry. The Gedio manage agro-ecosystem complexity, and through it agro-ecosystem properties such as biodiversity, productivity, sustainability, and so take care of themselves. The success of this strategy is for instance manifested in the high diversity of life forms giving these ecosystems the appearance of forests due largely to “place-making” by woody perennials and diverse herbaceous “weedy” ground flora.

Ensete proved to be the highest-yielding Ethiopian food crop. Ensete yields over 5.6 tons ha⁻¹ year⁻¹ under Gedio agroforests. Ensete can be planted as fodder in good times and for human consumption during both drought and good seasons. Ensete can also conserve and/or restore soils in erosion-prone highland areas. Soil conservation then goes with ensete consumption in good and bad times. Thus, Ensete should get due emphasis as it is the cheapest remedy to the recurrent drought & food problems in Ethiopia. Gedeo Agr⁸.

6.1.3. “Lakech” and “Mirt” Stoves

Ethiopia is highly dependent on biomass energy that includes fuel wood, charcoal, agricultural residues, animal dung that account more than 90% of the total domestic energy demand. The high biomass energy consumption, along with inefficient utilization, has created, among others, deforestation, biodiversity loss and land degradation. In general, the fuel wood demand of the country is far exceeding the sustainable supply, for instance, leading to a total of fuel wood deficit of 47 million m³ by the year 2000. The diminishing natural forest resources are much affected by the expansion of agricultural land in general and inefficient utilization of biomass fuels in particular.

To address these problems, various efforts have been made. Among these efforts, the most important and significant one is the development and dissemination of the improved charcoal stove known as “Lakech” and the biomass “Enjera” stove known as “Mirt. Lakech and Mirt provide a saving of 25% and 47 % over traditional stove and open fire stove respectively. This indicates that these stoves are useful to reduce the pressure on the biomass energy sources. To date, about 2,000,000 Lakech and 328,000 Mirt stoves have been distributed throughout the country. Therefore, large-scale distribution of improved stoves will help to reduce pressure on the biomass resources, including forests, increase land

productivity by reducing crop residue and dung usage for fuel wood, and improve family health. The intervention benefits women and children in particular, minimizing their high workloads to collect and supply fuel wood, and their exposure to flame hazard, high smoke emission and harmful pollutants. It is assumed that if the whole rural and urban households (estimated to be about 14.44 million) in Ethiopia shift to the improved Lakech and Mirt stoves, a saving of about 7,778,800 tones of fuel wood which requires clear cutting of 137,192.24 of forest will be achieved in an annual basis. This implies that sufficient distribution of these improved stoves will have significant contribution to save the biomass resources of the country in general and forest resource in particular and to combat land degradation and mitigate the effects of drought. “Gounzie” (closed Enjera Stove) efficiency “about 47% during test. “Laketch Charcoal Saving Stove” also has 25-35% efficiency during operation compared to the previous one..

6.1.4. Tigray Experience

Tigray is one of the National States located in the northern part of Ethiopia. In Tigray region, crop yields are very low due to the prevalent land degradation and the associated environmental problems for so many years. To increase soil fertility and crop yields, external agricultural inputs have been introduced for years now. As an alternative to external agricultural inputs, the Institute of Sustainable Development (Local NGO) in collaboration with Bureau of Agricultural and Natural Resources of the Tigray region (BoANR) has been implementing a pilot project on sustainable agriculture, particularly emphasizing on promoting the ‘package’ of making compost, trench building and planting multi-purpose trees. This approach is to help local communities develop a sustainable system of high agricultural and renewable natural resources production through the application of ecological principles so as to achieve self-reliance and depend largely on locally generated agricultural inputs. As a strategy, the programme enables communities to collectively embark on implementing sustainable development packages after thorough evaluation and prioritization by community members themselves. A given community therefore, devises its own by-laws that govern all its members in order to administer, enhance and utilize common resources. Currently, the pilot project has expanded from four (the original core sites established in 1996/97) to 15 sites. The results obtained from the pilot sites indicated that, in most cases, crop yields by using compost are comparable to the yield obtained using chemical fertilizer. Based on the results of the pilot project, BOANR has been promoting the activities into over 90 communities within 25 districts of the region. The dissemination of such activities in marginalized and degraded areas is highly relevant for combating desertification through mitigating the effects of drought by preventing free-range grazing to increase forage productivity and encourage natural regeneration. In the pilot and other intervention areas of the Tigray region, cultivated land is protected through stabilizing terraces by

planting multipurpose trees, grasses and legumes, and constructing trench bunds to capture both water and soil. These activities have resulted in quick overall land rehabilitation and marked increases in productivity per unit area. Farmers living adjacent to the project sites witnessed positive changes in the livelihoods of the communities resulting from the implementation of the project. This has prompted to these witnessing farmers and development workers to adapt the system in this respective domain and beyond agro-forestry System.

7. Challenges of natural resource management and climate change institutional arrangements and policies in Ethiopia.

1. Lack of suitable coordination among institutions in mitigating the impacts of climate change and appropriate natural resources management.
2. Unable to decrease rapid population growth which creates immense pressure on natural resources
3. Unable to attain the best result as the government and the society wishes in short period of time to minimize tremendous effects of climate changes and natural resource depletion.
4. The government owned land tenure system may create suspicions on the part on land owner to invest long life plants

8. Recommendations

1. In order to control the population growth of Ethiopia “The Central Statistical Agency Ethiopia” should established as a population ministry to inculcate and broaden its activity clearly to the community level.
2. For effective natural resource management, the government should try to secure land tenure policy
3. The higher officials of government of Ethiopia should be committed to control alarming population growth.
4. The miniseries of Ethiopia should create smooth and suitable coordination to combat the effect of climate change & natural resources depletion.
5. To get plausible results on impacts on climate change & natural resources depletion, the government & the society should broaden best practice of community based natural resource management.

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