Appendix A
The Project in NE Kenya an Example of a Development Project Based on Groundwater, Following the Conceptual Model of Progressive Development

In the following appendix an extended summary of the report for Northeast Kenya, written in 1992, is presented. Although the principles of the policy of Progressive Development was not yet put in a proper outline, yet its basic philosophy forms its background. No wonder it was opposed by the proponents of the conceptual model of Sustainable Development. As mentioned, reading the news and seeing the TV documentaries about the poor people starving in this region the author cannot keep himself from thinking that if the recommendations brought up in his report, would have been applied, or in other words the philosophy of Progressive Development would not have been rejected by the devotees of Sustainable Development, then at least a few ten thousands (if not more) of these people would have been saved.

A.1 The Development of Perennial Water Resources for Irrigation for the Settling of the Nomad Population in the Arid and Semi-Arid (ASAL) Northeast Kenya

A.1.1 Preface

The series of droughts which has affected Northeast Kenya during the last few decades has caused devastation to the population and had a disastrous impact on the natural environment. This situation may become worse in the future, due to the global climate change and the rate of increase of the population of Kenya at about 4.3% (while in the ASAL provinces it is about 1%). This explosion of population will, sooner or later, result in an overflow of people into the scarcely populated regions. This may happen if a series of humid years occurs. When a series of dry years will follow, as expected, the impact on the indigenous population, as well as on the new immigrants (not to mention the environment), will be hazardous. On the other hand, with the development of the ASAL areas in a planned way, the newly developed resources of these regions will secure the supply of food even during years of drought. A higher level of income will bring about the promotion of other living conditions, such as education, health, etc. Moreover, development will prevent deterioration of the environment in the case of droughts, and may even absorb, in a positive way, the overflow of population from the regions of high potential.
An additional aspect of the development of the ASAL regions is making Kenya a front post and a center for study, experiment, and experience for fighting the hardships brought about by drought and desertification.

The ASAL regions are what they are because the water resources are not sufficient. Yet, it should be remembered that deficiency is only one aspect. The other aspects are the shortness and randomness of the periods with rain events. Throughout the ages this has caused the survival of the population which was wise enough to adopt the pastoral and nomadic way of life. Thus, if anything is to be done to change the present situation, it must start with ensuring a stable source of water, in space, quantity and time. The sources which fulfill these demands are either the rivers which flow into the ASAL regions from the highlands where high precipitation rates occur, and the groundwater aquifers underlying the regions. The other water resources, such as local floods which may be harvested by special methods of soil tillage, soil embankments and small dams, are important as auxiliary resources but cannot answer the basic demand for survival in years of drought. Yet, any development plan has to be comprehensive and has to cover all resources, physical as well as human. It also has to take into consideration all impairments, such as traditional ways of life, land ownership, etc. Yet, it should be remembered that the will for survival, and even that to secure a better income, will, in most cases, bring about a change in lifestyle. This, if not planned to be procured in a positive way, will take
place in a way harmful to the human as well as natural environment. It is, thus, suggested to trigger the change from an insecure mode of life to a safer one by the provision of a stable and safe water supply for human and livestock consumption and, wherever possible, also for irrigation. This does not imply that the other facets of the comprehensive development will be neglected. It does say, however, that priority in time and funds will be given to the prime factors. The development of the other factors will follow suit in the framework of a long-term development master plan.

A.1.2 Summary of Observations

The main observations which brought about the recommendations hereby presented are as follows:

1. Wherever perennial water sources, such as rivers, springs, or groundwater, have been located and made available in ASAL regions, a gradual change from a nomadic to a sedentary, socio-economic style of life has taken place.
2. In most of the provinces visited, groundwater can be located at a depth of several meters to 200 m. In other provinces pumping from perennial rivers, dams on seasonal rivers, and the tapping of springs can also be carried out. Yet, relative to groundwater, the management and distribution of seasonal surface water, needs long-term observations, elaborate planning, and the construction and maintenance of canals.
3. A major obstacle to the optimal development and utilization of groundwater is the dependence on motorized equipment, such as drilling machines and pumps. This is especially true in regions where the water table is deep. This obstacle was, and can be, overcome through the organization of a supply and maintenance system on a regional basis. Such systems are functioning successfully in the province of Nairobi. It can, thus, be concluded that this system can be extended throughout the country. In many regions where the water table is shallow, hand-dug wells are already successfully being used and are pumped by manual, wind, or motorized pumps.

A.1.3 Summary of Recommendations

As stated, the long-term aim of the policy of the project suggested in this report is to promote the potential of the arid and semi-arid zones in order to increase the economic safety and income of the people. This will serve to cope with the recurring hazards of drought and famine, as well as enable these regions to absorb the population overflow from other regions. For this purpose, it is suggested that a policy of development will be adopted, which will encourage the population of the ASAL regions, in the places where the nomadic-pastoral way of life is prevalent, to abandon their traditional livelihood and adopt, through a gradual evolutionary and voluntarily process, a sedentary way of life. At the same time in regions where the
population is already sedentary, but still dependent on livestock and dry farming, to gradually adopt the methods of irrigated agriculture. Part of the population will find its income in new urban centers which will supply various types of services to the rural sector.

This transformation will demand the preparation of a long term master plan for development of the ASAL areas. The time period of each plan will be 5-years. The up-staging of the master plan will be from the district to the provincial level. Namely, that after the principles of the overall policy on the national and provincial levels have been agreed upon, it will expand from the district level to the provincial scale. In each province there should be a steering committee in order to guarantee inter-distinct coordination and promote projects on the provincial level. A list of provinces and districts to be given priority and accordingly allocate the funds available, should be prepared by the government.

It is recommended that this planning be carried out simultaneously with implementation of the projects. It is, thus, essential to guarantee information flow from the planning team to the field team and vice versa. For this reason, the planning team will coordinate the operation stage to its completion. It is expected that variations in the plan will have to be made in accordance with feedback from the field team.

The budget needed for planning is, of course, a function of the decision of the government on the number of districts and on the existing development and availability of data from each district. It is estimated that the average time period needed for preparation of a preliminary plan for each district is approximately 6 months. The detailed plan, which will be done simultaneously with the execution of the plan, will take about 5 years. The planning teams will be comprised of about 5 experts working in the fields of regional planning, farm planning, economics, hydrology and water engineering. The team of experts should comprise foreign experts and local counterparts. The foreign team is expected to stay for about 2 years in order for the work to be continued by the local specialists, with one foreign expert remaining for special assignments.

### A.1.4 Development of Water Resources

As previously mentioned, it is recommended to start immediately with the implementation of a general plan to bring about gradual socio-economic change. For this purpose, it is essential to guarantee a reliable perennial water supply for use by man, livestock, and for irrigation. In order to make this feasible throughout the ASAL regions, it is suggested to embark on a long-term, inter-regional campaign in which surface and groundwater resources will be tapped and properly allocated and managed. This means the launching of an inter-regional comprehensive program for exploration, planning and research for water, and new agricultural practices.

All water resources such as rivers, surface and subsurface water will need to be developed. It should be emphasized again and again that as the ASAL areas are susceptible to droughts, groundwater is the substantial source guaranteeing supply when all other water sources have failed. Groundwater is the least influenced by the
random character of the climate. The development of the groundwater will need to be carried out in the framework of a comprehensive development plan which takes into consideration the socio-economic as well as environmental aspects within the regions.

It is thus suggested to give priority to groundwater development. It will start with hand-dug shallow wells, equipped with manual and other types of pumps thus upgrading exploitation of the shallow and surface water resources. In parallel comprehensive program for drilling exploration-exploitation wells will be carried out. Location of sites will be done in cooperation with the planning teams.

The drillings of the deep wells will need the organization of teams equipped with drilling machines, casing-pipes, and pumps able to carry out a crash program. After the wells have been drilled and equipped, a special organization in each district will have to be set up in order to maintain the pumps and the wells. The setting up of such organizations is feasible only if a large number of wells are drilled. It is recommended that at least 2,000 wells be drilled within the next 15 years. It is suggested that the drilling will be executed one stage at a time, starting in regions of high priority and being followed by the schedule of the master plans. The annual budget will, thereby, be decided according to the pace of execution.

It should now be mentioned that in order to avoid the already known, and frequently mentioned, phenomena of overgrazing near water sources, a sufficient number of well, shallow as well as deep, should be spread out over each district.

A problem which needs special reference is the impact of development on the environment. It is sufficient to say that the development recommended in this report can also be regarded as an environmental action plan, the aim of which is to change, in a positive way, the gradual degradation of the environment through the insurance of the existence and income of the local population. This will avoid the present trend of over exploitation of the available natural resources, a process which has reached the level of catastrophe in years of extreme drought.

### A.1.5 The Impact of Water Resources Development on the Environment

This question has been raised many times during the various discussions regarding strategies for development. Many of the arguments have been against development of groundwater, pointing out the negative impact on the environment which the development of this resource has had in the past. This is because such development has brought about the concentration of livestock around one area, which has caused overgrazing and, thus, deterioration of the natural environment.

The argument against this accusation is not because the remedy was not good enough but because it was not given in the appropriate dosage, and without the other measures needed in order to make the remedy effective. In other words, it is suggested to regard development of groundwater as a measure to be applied on a large scale and backed by other means, such as water harvesting, improvement of
It is thus suggested to regard groundwater development as the triggering impact for various changes necessary in order to make indigenous societies less vulnerable to the hardships caused by droughts. This can be achieved by the very nature of this resource, where its availability is not influenced by the random supply of water by rains. Thus, when surface reservoirs remain empty, or do not retain enough water to cover the demand during the dry season, the subsurface reservoirs can provide a steady water source. This can be increased in periods when total failure of the surface water resources occurs. Moreover, in contrast to the negative attitude towards groundwater development, it is believed that a positive effect on the environment can be achieved if enough wells are drilled and appropriately equipped in order to avoid the over concentration of animals in one area.

A positive environmental impact is believed to take place because of the availability of an assured water source which reduces the range of movement of nomads, as well as the encroachment of nomads into these areas where water resources have remained available. In many cases, these have been the same areas where wildlife has also taken refuge. The competition between nomads and their herds and wildlife feeding on the same resources has ended with a loss in the population of wildlife.

The gradual stabilization of the nomadic populations, although believed by some conservative sociologists to be a negative development, seems to us to be unavoidable in face of the changes in the socio-political changes in the African countries. On the one hand, these changes have limited the range of possibilities of migration due to the artificial limits imposed by the political borders. On the other hand, the marginal regions which were the traditional habitat of the nomads have become a prospective outlet for the explosion of the population in regions of higher potential. For example, in the Garissa district, along the Tana River, the District Commissioner and officers have reported that many people have started to settle along the river, pumping its water in order to grow various cash crops. Once this way of settlement becomes more popular, the growth rate of the population along the river may grow exponentially, causing destruction of the riverine forest. This will cause erosion of its embankment and an encroachment of desertification to all the land bordering the river. This will deprive the nomadic population of the flood irrigated lands along the river, not to speak of the wildlife which found refuge in the riverine forest and the surrounding flood irrigated lands.

The settlements along the river banks are to be carried out in the framework of a regional master plan and will be located beyond the belt of the riverine forest. The water supply for livestock will be provided by a network of wells spread out according to the carrying capacity of the area. Such a project will induce the nomads, depending on the flood plains, to settle down without causing damage to the natural environment and will encourage them to become part of the settlement process of these regions, envisaged by the population explosion in neighboring regions.

It is recommended to develop the surface and subsurface water resources in a gradual way, namely starting with small, simple pumping devices and to advance, stage by stage, to more complicated means. It is believed that the need to handle
and maintain this machinery will bring about the development of local know-how, as happened when the motorized car was introduced in these regions.

Another important aspect in environmental protection will be the economic security which the nomad population will achieve. This will encourage them to abandon traditional ways of life, which has a negative impact on the environment, such as communal ownership of land. It should be emphasized again, that any settlement project will have to be carried out in the framework of a comprehensive development project which will cover all aspects of the environment, including the safeguarding of regions set aside for natural reserves. It is expected that the increase in the food and water supply will cause an increase in the number of wildlife around settlements, similar to what has happened in the Negev desert of Israel.

A.1.6 Education

A major obstruction to the advancement of the region is the reluctance of educated people, like high education teachers, agronomists, instructors and technicians to settle in this area. This is due to the distance from an advanced urban center and thus the lack of an educational and social infrastructure. Experience from The J. Blaustein Institute of Desert Research in Israel has shown that the success of such an institute, situated far away from an urban center, can be achieved when adequate facilities for pre-school, primary and secondary education, as well as technicians’ aid facilities are guaranteed for an adequate standard of living. It is thus suggested to initiate the building of a regional education center, starting from primary school to university in Wajir, the administration center of the province. This center will serve the whole region and will undoubtedly also boost the development of this town. The scientists and technicians will be able to commute from this center to the research and field stations, as well as to other projects in the neighboring districts. It is advised that a detailed scheme for such a center be prepared by the Kenyan government to be presented to a donor agency.

An agriculture school and research center will be part of this center. It is suggested to put special emphasize at the research center on irrigated pasture and fodder crops, as well as dairy cows on a zero grazing basis. The research will also include various types of irrigated agriculture.

A.1.7 The Construction of Dams

As was explained in the previous chapters, the philosophy intrinsic in the plan of Progressive Development suggests the gradual build up from low investment simple projects to more expensive, complex and larger scale projects, which require not only large investments, but a permanent complex infrastructure and thus a special administration for control and maintenance. Thus the shallow and later the deep groundwater are the first targets of development. Yet, in the future when the development of irrigated agriculture and urban demand reaches the level that the groundwater resources become exhausted, then the stage of building of dams and
projects of water transfer by canals or pipes from one part of the province, or even beyond, can start.

A few dams were already built in this and in neighboring regions, but their affect on the economy and stable water supply to the people was below expectation.

In the report submitted to the Kenyan government a list of such projects has been given and it is beyond the scope of the present book to go into the details of this issue. Yet it should be emphasized that the planning of a dam, or the extension of an irrigation system of an existing dam, should be part of a general plan of irrigation backed by an extension service. Special emphasize will be put on the introduction of irrigation methods which will avoid the waste of water and thus soil salination processes. A demonstration farm must be included in each such plan, in order to guarantee the efficient utilization of the vast investment involved in building a dam and a water distribution system.
Appendix B
A Call for Global Action Replant the Dry Lands!


Make better use of local water resources, provide food, wood and land for the people and mitigate the global greenhouse effect

B.1 Executive Summary

The following “CALL FOR GLOBAL ACTION” summarizes the discussions carried out by a group of scientists who convened at the Division of Water Sciences of UNESCO, in Paris, on the 14th and 15th December 1998. The group was concerned with the forecasts about the negative impacts of the greenhouse effect on the hydrological cycle in general, and on that of many of the dry zones of the world in particular, as these impacts are disastrous for the vulnerable socio-economic systems which subsist in these regions.

The group, looking for ways to try and mitigate these negative impacts, recommends that in addition to the targets agreed upon in Kyoto – namely, cutting down of carbon emissions and subsidizing sequestration of atmospheric carbon by forestation in the humid regions – an effort, on the international scale, should also be made to encourage planting of trees in the dry lands. Such activity should be considered, despite the natural constraint with regard to the limited precipitation of these regions, which may cause such projects to be regarded as uneconomical, when only carbon sequestration is considered. It is claimed that the additional benefits to the developing countries from such projects, by providing new food and wood resources as well as combating desertification, justifies the provision of extra support for such actions. To this end, the committee recommends that the international team working out the rules for subsidizing carbon sequestration projects should procure a special

A.S. Issar (✉)
Ben Gurion University of the Negev, J. Blaustein Institutes for Desert Research,
Sede Boker Campus 84990, Israel
e-mail: issar@bgu.ac.il

By the members of the steering committee for the project envisioned in the framework of World Water Vision and The International Hydrological Program (IHP), UNESCO.
financial mechanism for the countries in the dry lands, namely, countries classified as those combatting desertification.

If such subsidies are made available, then the constraints of limited precipitation can be overcome, in the first place, by planting trees for food and forage, irrigated through the efficient use of the existing surface and groundwater resources existing in these regions. That such resources, which are currently going to waste, do exist, has been proven by hydrological and agro-forestation research projects, which have been carried out in these regions.

Further similar projects, to be carried out following investigations with regard to their environmental sustainability, will have a positive impact on the natural environment, by reducing erosion of soils and checking encroachment of sand dunes. In many of these countries, such projects will involve the rejuvenation of ancient agricultural systems, which were destroyed due to climate changes and human incompetence. Modern, yet sustainable, agricultural methods will help in promoting the economy of these countries, and, at the same time will have a positive impact on the global environment. In other regions, only marginally economical agricultural practices, such as grazing, can be replaced by the replanting of the original savanna vegetation to create natural park lands, animate bio-diversity and promote the tourist industry.

The committees in charge of the accomplishment and realization of the Kyoto and Buenos Aires protocols, as well as the international society of scientists, international governmental and NGO agencies, are herewith requested to put on their agenda this call for action, secure the funds and initiate projects to make better use of the water resources existing in the dry lands, in order to turn them into greener areas, and in this way, combat desertification, assist the economy of the developing countries and in parallel, mitigate the greenhouse effect.

B.2 Introduction

Many observations indicate an increase in the concentration of carbon dioxide in the atmosphere and thus, climatic warming, as a greenhouse effect is the most logical conclusion of this condition. In order to reduce the possible environmental impacts of such an increase, an international agreement was signed by the representatives of the countries participating in the Kyoto conference, to curb the amount of emissions by the industrialized countries.

The goal is to reach a reduction of 5% in the period of 2008–2012, from the level of emissions during 1990. In addition to the reduction effort, the Kyoto protocol (article 3.3) recognizes that projects, which involve sequestration of atmospheric carbon could be used to offset emissions. Carbon sinks can be created by afforestation projects, due to the fact that trees and other vegetation absorb carbon dioxide by photosynthesis and fix it as cellulose. Thus, it is expected that an international effort of rejuvenation and creation of new carbon sinks, through re- and afforestation projects, will develop. This will be stimulated by a further economic payoff,
in addition to the usual profit from forestry projects in humid regions. Subsequent to the signing of the Protocol, a certain sum will be paid per ton of sequestered carbon. Negotiations are still underway with regard to the rules that will decide the accreditation of sequestration, namely which activities and what time dimensions will be taken into account. Once the Kyoto protocol’s rules encouraging the reward for the offset of emissions are formalized, it is expected that many countries will be encouraged to proceed with large scale afforestation projects as, for example, in Western Australia where “It is estimated that it will be possible to sustain a carbon sink of approximately 200 million tonnes assuming a 30-year accounting cycle” [1].

Yet, based on past experience, it can be forecast that the major effort of re- and afforestation, on the international level, will be invested in the humid parts of the world, since the growth rate and thus, the sequestration rate, as well as cost/benefit ratios from wood products, exceed those of the dry lands. It is estimated that areas with between 400–600 mm of precipitation per year sequester annually between 103–140 tonnes carbon per ha, while areas over which annual precipitation is only 250–400 mm only sequester an average of 30 tonnes, and those over which annual precipitation is less than 250 mm, sequester only 5 tonnes of carbon per ha [1]. Nevertheless, it should be taken into consideration that in many humid countries, re-afforestation projects on a wide scale, have their socio-economic constraints, due to the competing demands for land for many other purposes, such as urbanization, agriculture, industry, transportation facilities etc. Thus, the gain from afforestation projects, have to counterbalance (at least) the value of land, and loss of alternative income, arising from alternative usage.

This is not the case in most dry lands, where the density of the population is low, and thus the demand for land is insubstantial. Surveying the Earth from a satellite vantage point reveals that the yellowish color, demarcating semiarid and arid zones, covers about 30% of the continents. In these regions, population and agriculture are concentrated in areas where water is obtainable, either from rivers or shallow groundwater. When one looks beyond these areas, the densities of population and vegetation diminish abruptly and vast stretches of land, in many cases covered by sand dunes or loess deposits, are practically treeless. If only a part of these vast stretches of land can be forested, then large amounts of carbon dioxide can be sequestered. This is, of course, more easily wished than done, as the main reason such land is underutilised and bare, is the scarcity of water – the essential requirement for the existence of bio and phyto systems. This awareness is deeply imprinted in human thinking, which may explain the fact that to date, practically no serious attempt has been made to suggest promotion of carbon sinks, in the form of trees, in the dry lands. One can learn of this failure while surfing the Internet for afforestation projects aimed at fixing carbon dioxide.Hardly any of the voluminous references, dealing with this issue, relate to the yellow belts of our globe.

Thus the first and main question which must be answered before one recommends the planting of trees in these regions, is whether enough water resources can be procured to enable the promotion of woodlands. Once this question is answered
in the positive, the next question must be whether such an initiative is practicable from the economic point of view?

B.3 On the Availability of Untapped Water Resources in the Dry Lands

It is the opinion of the authors of the present document that this questions can be answered in the positive, and that the main restraint is human inventiveness. This is because hydrological and hydrogeological investigations carried out in the arid and semi-arid regions all over the world show that ample resources of water can still be found in these regions, and as in the past, it will be a question of human ingenuity whether this water can be utilized to a positive end. Indeed, since the invention of agriculture about ten thousand years ago, farming societies have found ways to make use of the available water resources in midst of the desert.

If man could achieve this when technology was rudimentary, we should be able to make use of the existing water resources, even if they are scarcer, due to the negative impact of climate change in modern times. Moreover, in many areas forsaken by past civilizations unable to cope with the worsening environmental and economic conditions, their terraced lands now abandoned, water is now wasted, flowing freely and eroding the soils, year by year.

Once it is decided to reforest these regions, the water available for such projects can come from the following sources:

1. Surface water. Various investigations of the hydrological regime in arid countries (Reviewed in Issar and Resnick [2], and in Prinz [3]) have shown that the percentage of the volume of water of runoff, relative to the total volume of the precipitation over a certain area, decreases as the size of the catchment area increases. This means that the larger the catchment basin, the more water is lost by evaporation. The ancient farmers were aware of this, and diverted water from small catchment areas to irrigate their terraces, where they grew fruit trees and cereals. These methods and even the old abandoned structures built for “water harvesting” in many places, can be renovated, and the water which is now wasted can be utilized for reforestation.

2. Groundwater. Based on the results of the many surveys (extended list of references in Lerner et al. [4]) it can be guaranteed that under most of the deserts of the world there exist aquifers containing non-utilized fresh and/or brackish groundwater. Some of these aquifers are recharged yearly and some only once in a few years by precipitation falling on the desert, by infiltration from floods into alluvial fans, or by subsurface flow from adjacent highlands areas where precipitation is more abundant. In many areas, this subsurface water emerges at the surface and evaporates to form salt marshes.

Of special interest is the subsurface water found in sand dunes, even in areas receiving not more than 80 mm of rain per year. It was found (extended list of references in Adar et al. [5]) that in such areas, the moisture content of the soil at
the end of the dry season under forested dunes, is higher than that of bare dunes, which emphasizes the positive impact of tree cover on the subsurface water balance of the dunes.

3. *Paleo-groundwater.* Under most of the deserts of the world, there exist tremendous amounts of groundwater which were recharged when climate conditions were much more favorable, tens of thousands of years ago (extended list of references in Issar and Nativ [6]). This water moves very slowly, either towards springs (like the Mound-Springs in Central Australia, salt marshes (like the schotts of the Sahara) or towards inland lakes (like the Dead Sea). In Australia, Saudi Arabia, Libya, Jordan and Israel, some of this water is utilized for agricultural and industrial purposes. Needless to say, the use of this water means its “mining”, which may be regarded as a non-sustainable approach, yet at the same time, one should also regard this resource as a potential to ameliorate the ill effects of the burning of fossil fuels. Thus, if humanity cannot avoid the use of fossil fuels, and thus causes harm to environment, why should not fossil – namely paleo – water be used to correct this harm? Of course, once other economical fuel sources can be developed that are more friendly to the environment and still supply the energy required by human society, then the use of this water can also be discontinued.

4. *Sewage from urban centers.* Due to the current world urbanization trend, metropolitan centers in the arid and semi-arid parts of the world and in the more humid parts of the world are growing continuously. These centers produce large amounts of sewage which has to be treated and then disposed of. Utilizing this source for plantations has its environmental and economic benefits as well as constraints, which must be considered.

**B.4 Aspects of Sustainability**

During historical and pre-historical periods, vast areas, which are presently bare dry lands, sustained an arboreal vegetation. This means that, from the point of view of the ecological system, once the original species are reintroduced, (and this can be done on the basis of the pollen assemblage found buried in the subsurface) reforestation can be a rejuvenation process, rather than the invasion of an alien system. Yet, the knowledge acquired recently that the more green conditions of the past were a function of more humid climate conditions, requires us to put special emphasis on maintaining the sustainablity of the hydrological system from the point of view of the quantity, as well as the quality of the water. In other words, measures have to be taken to manage the resources so to avoid its deterioration, as for example, by salt concentration in the soil and the subsurface. Such measures include water harvesting methods by terracing, which introduce extra water, otherwise wasted, into the hydrological cycle. This enables the management of the water, soil and tree system on a higher level of efficiency and supply.

To ensure sustainability, projects should be planned and carried out as an integral component of a comprehensive plan of regional development, preceded by
hydrological, pedological and ecological research, and followed up by monitoring and re-assessment procedures.

**B.5 Economic Aspects**

It would be difficult to dispute the argument that if the forestation of dry lands had been feasible from the economic point of view, then these areas would have been green by now. Yet, in the same time, the recent negative history of the rain forest shows that what pushes many activities of human society are the short term gains, rather than the long term benefits, not to speak of the rather low value assigned to benefits, like bio-diversity, that can not be quantified.

This being said, it is here argued that plantations in the dry lands can still become profitable enterprises, due to the incorporation of immediate local agricultural benefits, long-term local fringe benefits, and long-term global benefits. However, to encourage the spin off of such enterprises, enlarged subsidies for sequestration of carbon dioxide are required.

The committee was encouraged by the account, given by the chairman, of a plantation project of thousands of hectares of olive trees carried out by a private enterprise in the highlands desert of Southern Israel (average annual precipitation 100 mm), to be irrigated by brackish (ca. 4,000 mg/l TDS) paleo-water.

Needless to say, an economic feasibility investigation of a specific environmental sustainability project must be undertaken before any such project is launched, as was the case with the above mentioned project. What can be said at the present stage, is that plantations, irrigated by flood water and by groundwater, extend over thousands of hectares, all over the dry lands of the world, and their further expansion, encouraged by special subsidies will most probably contribute, not only to the sequestering of carbon dioxide, but also to the welfare of the population of these countries. In a world where water resources are scarce and the supply of food is becoming increasingly uncertain, the development of these additional sources of water, food and wood is a challenge not to be neglected.

**B.6 Conclusion, Recommendations and a Few Words of Caution**

1. The present call for action is aimed at the agencies in charge of carrying out the recommendations of the Kyoto protocol, to promote global comprehension and practical steps with regard to the role which large-scale plantations in the dry lands may play in sequestering atmospheric carbon. For this purpose, the committee recommends special subsidies in order to encourage such plantations in these regions. This, in the framework of the steps envisioned to carry out the recommendations of the Kyoto protocol in order to offset carbon emissions.

2. This call is also addressed to the international scientific community, who was first to ring the alarm, with regard to the negative impacts of the greenhouse effect. The steering committee suggests the promotion of an international web
of scientific centers, interested to be involved in research projects which will advance knowledge concerning all aspects of reforestation of dry lands. This web will enable the formation of database terminals, at once, and a net-work of data exchange, and initiation of cooperate projects. Cooperation between scientists in industrialized and developing dry countries will be one of the main goals of this net-work.

3. The steering committee recommends to convene in the year 2010 an international conference, which will deal with the various scientific aspects of plantations in the dry lands, namely the climatic, the hydrological, the ecological and the economical aspects.

4. A call is addressed to the other UN agencies, EU authorities, USA government offices and NGO foundations, to commit the required budgets in order to promote research, pilot projects, and later on full fledged projects of reforesting the dry lands. The initiation of Bi & multi-lateral projects, involving developed and developing countries is highly recommended.

5. The international media, whether scientific journals, popular science journals, or the general press, which have done so much to make the people of the world aware of the looming hazards of Global Change are requested to aid in promoting the idea of planting the dry lands, yet, without subduing the demand from the industrial countries for the reduction of emissions required by the Kyoto protocol.

6. Once the understanding of the direct and fringe benefits, which such a project could bring forth are engrossed by the government agencies, scientists, NGOs, and the media, an action on a global scale have good chances to follow. When this happens, planners, entrepreneurs and executives, must be aware of the fact that such projects must be approached in a comprehensive way, in order to ensure the sustainability of the environmental system. Thus any scheme must be based on the results of a comprehensive research and development plan, which will involve forest experts, hydrologists, biologists, soil scientists, economists etc. Once this approach is adopted and a monitoring system is installed to warn against irreversible results, then there is hope for this project to spread over the more arid parts of the globe and benefit human society and global natural environment.

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