On Combatting Desertification / Land Degradation:

A Summarized Research Paper

September 1998

Committee for Research on Combatting

Desertification / Land Degradation

Foreword

In April 1997, the 'Committee for Research on Combatting Desertification / Land Degradation' was set up within the Global Environmental Forum, with the support of the Environment Agency of Japan. The objective of the Committee, as originally conceived, was to examine the major global environmental problem of desertification, and in particular, the measures being taken to prevent it in the Asian Region and to provide support for the Committee on Science and Technology (CST); this was to be combined with a consideration of the political implications for the Japanese government of acceptance of the UN Convention to Combat Desertification (UNCCD).

However, the Committee found it necessary to pose a couple of fundamental questions at the outset. The first of these questions was whether, considering the nature of land degradation, and the problems specific to Asia, it was appropriate to limit the scope of scientific enquiry to areas included in the conventional definition of the term - that is arid, semi-arid and dry sub-humid areas, although the Committee fully observes the definition. For example, salinization, which is regarded as one of the most characteristic consequences of land degradation, can be seen not only in hyper-arid lands like deserts but also in humid tropical rain forests. This means land degradation occurs outside 'deserts' areas. The point has particular relevance for the Asian Region. In Asia, there exist countries which are not designated as ‘affected countries’ by the definition of UNCCD but facing serious land degradation.

Therefore, the Committee, taking as its starting point the concept of land degradation as well as the official definition of desertification, decided to include certain areas which are not covered by the Convention. While fully respecting the agreed position of international society, the Committee thus sought a perspective upon the problem which combined scientific coherence and relevance to Asia's particular aspects. The name finally decided upon for the Committee was therefore the 'Committee for Research on Combatting Desertification / Land Degradation'.

The second preliminary question concerned the emphasis to be given to the development of activities conducted in Africa. Such an emphasis reflects the original focus of the UNCCD on Africa, and the fact the region was the first area where the desertification problem drew attention. Even now Africa, as well as Asia, is suffering from serious desertification, and this is developing with significant speed. It therefore seemed natural to give priority to the African Region, and some members of the Committee argued furthermore that the activities in Africa were of particular importance in view of Japan's international assistance programs. As a result, the Committee decided to work on both Africa and Asia .

Chapter 1 of the present report shows the current state of research on desertification / land degradation, and the problems. Chapter 2 then discusses the processes which lead to desertification / land degradation and the possibilities for constructing models for these. In Chapter 3, social systems and technologies needed for prevention and

rehabilitation measures are discussed, and case studies are introduced. Chapter 4 examines the support and assistance the international community should offer, and the role Japan could take.

Internationally Japan is expected to continue participating in concrete actions to combat desertification, and to take part in financial and scientific discussions to support them. This report is intended to respond to these circumstances, and reflects our expectation that Japan will continue to grapple with the issue.

September 1998

Kazuhiko Takeuchi
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Chapter 1. Present State of Research on Desertification/Land Degradation, and Related Problems

1.1. Characteristics of Desertification/Land Degradation as a Global Environmental Problem

This section discusses the definition of desertification and the characteristics of desertification/land degradation.

1) Definition of desertification

According to the definition used in the United Nations Convention to Combat Desertification, "desertification" is "land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climatic variation and human activities." The definition applies only to areas with an aridity index (obtained by dividing precipitation by potential evapotranspiration) of 0.05 to 0.65. This report has used the original intent of the UN Convention and has limited the scope of desertification to the above definition. And also, this report uses the term desertification/land degradation to apply to the deterioration of land that occurs in other regions, such as humid areas and hyper-arid deserts. Land degradation is a term that denotes the specific effects of desertification but both terms are used synonymously here.

2) Characteristics of desertification/land degradation

The following are the characteristics of desertification/land degradation.

(1) Complex factors and regional characteristics. Desertification/land degradation is caused by a synergy of both natural and human factors and is a result of complex background factors. Desertification/land degradation is also greatly affected by regional characteristics. These reasons make the establishment of a global framework for these issues very difficult.

(2) North-South Problem. Since most victims of desertification/land degradation are developing nations, "North-South issues" are ever-present in the background.

(3) Difficulty of numerical modeling. In the case of desertification/land degradation, since its causes are a complex interplay of human and natural factors, the creation of numerical models such as those for global warming is difficult. Also, even if modeling was possible in one particular region, its effectiveness as the basis for countermeasures elsewhere could not be assessed directly since desertification/land degradation is highly dependent on regional factors.

(4) Diverse nature of countermeasures. Solutions currently range from international political initiatives on the one hand to, on the other, localized greening as desertification prevention measures. The problem is that these solutions have yet to be systematized. There is a need for coordinated, comprehensive responses in order to create a path for the prevention of desertification/land degradation.

1.2. Developments in Desertification/Land Degradation Research and Current Issues

The characteristics of research in Japan on desertification/land degradation can be summarized as below, according to "Arid Lands Studies," a journal of the Japan Association for Arid Land Studies: (1) There is considerable research addressing Chinese regions. (2) There are a small number of researchers covering a vast field of research. Due to the fact that Japan does not have extensive deserts, the number of researchers of deserts and desertification in Japan is small. The field is very wide including research on climate and weather, vegetation, soil, social and economic factors, etc. There are still untouched areas such as policy sciences. (3) Not much research is done which treats desertification within a comprehensive perspective.

The issues in Japan on the research of desertification/land degradation are as follows:

1) Prioritize the topics in research in order to effectively use the limited research resources.
2) In order to effectively connect the results of research that tends to be done independently, there needs to be: (1) The creation of networks for researchers, and the sharing of data. (2) Actions including the development of comprehensive models that connect individual research projects and methods, the clarification of the interface between each research, and the like.
3) Increase cooperation with foreign researchers and seek an international division of labor and cooperation.

The priority topics listed in 1) above include the following: (1) Developing objective and quantitative methods to measure and evaluate the extent of desertification. The current evaluation methods for desertification are still poorly integrated and can be criticized for their lack of reliability. Linking large-scale surveys and small-scale field observations is an issue. (2) Clarifying the climatic and weather mechanisms related to desertification and droughts. (3) Clarifying the mutual influence of human activities and desertification. Explaining the process of desertification through study and research at local level. (4) Developing early warning systems for droughts. Some countries have already developed and implemented such early warning systems. There is ample room for Japan to make use of its advanced technology in weather observation and remote sensing. (5) Developing a sustainable land use system. The objectives here include systems to evaluate the optimal land uses for a given piece of land, evaluation of the vulnerability in each plot of land, reevaluating traditional farming technologies, and combining such technologies with modern farming methods. (6) Developing new technologies, which means appropriate technologies rather than advanced technologies. This includes developing systems to use solar energy and underground dams. Assessment to determine whether these technologies are suitable for a given region is also needed.

Chapter 2. Discovering the Mechanism of Desertification/Land Degradation with Possibilities for Creating Models

2.1. Macro Mechanism of Desertification/Land Degradation

This section addresses desertification-derived changes in land-surface conditions and accompanying climate changes on the regional-large-scale. It also explains the impact of large-scale climate changes on droughts and desertification. It discusses desertification prevention from the viewpoints of environment and vegetation, vegetation in arid desert areas, climate change and desertification, and vegetation. The relationship between the growth of vegetation and the environment receives emphasis. By observing the shifts in flora and plant species, this section discusses the possibility of creating indices for changes in its ecosystem in terms of desertification/land degradation. As to the soil aspect of desertification/land degradation, which is soil degradation, it discusses concrete phenomena, their causal analyses, modeling methods for the process of soil degradation, and actual prevention measures.

2.1.1. Climate Changes and Desertification/Land Degradation

1) Effects of desertification on regional climate changes

The influences of desertification on climate changes have been investigated by the numerical experiments using general circulation models. Pioneering numerical modeling studies of Charney (1975) suggested that decreased vegetation, that is, increased albedo over the Sahel would lead, through less solar radiation absorbed at the surface and thus radiative cooling of the overlying atmosphere, to sinking and drying aloft and ultimately decreased precipitation.

Since Charney's work, numerous GCM studies have explored how Sahelian precipitation is influenced by each of the three major changes in land-surface parameters independently. That is, precipitation responds to increased albedo, decreased soil moisture/ evapotranspiration, and decreased roughness that result from desertification and/or drought. The experiments have demonstrated that all three changes, independently, result in decreased precipitation.

But currently, studies with these models have yet to provide for quantitative debates on how much effect such desertification actually has on the droughts in a given area. This is due to unrealistically large changes in the land-surface parameters specified in the experiments.

As for observational evidence: ground, aircraft, and satellite observations and research based on these on a local scale (less than 10^2km) have been conducted. From such a localized viewpoint, the changes in the land-surface conditions vary greatly from region to region and the studies of their effects on climate should also take this point into full consideration. Observational research on a wide regional scale (more than 10^2km) has mostly been done using satellites. The changes in land-surface conditions are thought to be affected more by the quantity of precipitation rather than long-term desertification. Such local and regional scale research does not provide any observational support for Charney's hypothesis that desertification causes a more severe drought.

2) Effects of large-scale climate changes on droughts and desertification

(1) Increases in greenhouse gases and droughts

The climate models predict that the increase in greenhouse gases will raise temperatures year round in arid regions (especially mid to high latitudes) and will intensify the aridity of these regions (IPCC, 1990 and Williams and Balling, 1994). In these cases, terrestrial ecosystems in arid regions will be the first to be affected by the warming due to their fragile nature. According to Jones (1994), the increase in terrestrial temperature between 1901 and 1993 was 0.44℃, while the increase in arid regions alone was significantly higher 0.62℃. What remains to be solved is whether this larger increased temperature over the arid regions is due to the regional desertification and/or regionally enhanced effect of global warming.

(2) Atmospheric and oceanic changes (El Nino/Southern Oscillation phenomenon) and droughts

The El Nino/Southern Oscillation (ENSO) phenomenon is a manifestation of the atmosphere-oceano interaction that occurs in the Pacific Ocean. They greatly influence rainfall in tropical semi-arid areas in East and South Africa, South Asia, Australia, and South America.

Over the Sahel, the effects of the phenomenon are small. On the other hand, recent studies (IPCC, 1990) indicate that the decreases in rainfall over this region are attributable more to changes in global sea surface temperatures than the changes in regional land-surface conditions. Recent trends include increases in the temperatures of the southern Atlantic and Indian Oceans (Parker et al., 1995) and these trends seem to be related to the decrease in rainfall in the Sahel.

2.1.2. Desertification/Land Degradation in Terms of Vegetation

In the relationship between the environment and vegetation on a global level, it is known that temperature and rainfall are the dominant factors that determine vegetation distribution. For example, in the tropics, when dry weather predominates throughout the year, these areas become thin forests, thistle shrubbery, and savanna. In temperate regions, they shift to open forests, shrubbery, and steppes. When aridity in these regions increases, they become semi-deserts or deserts. In regard to this, several semi-empirical equations have been proposed in order to estimate the net primary production of plant life in each ecosystem. Of these, the Chikugo Model developed by Uchijima and others (Uchijima and Seino, 1985) calculates the net primary productive capacity of vegetation by considering the process of CO_2 and water vapor exchanges between the plant cover and the adjacent level of the atmosphere, and the formula for heat balance of the land. The model can estimate the actual production relatively well. According to this model, net primary production drops significantly in arid lands.

In regions where the changes in vegetation are not keeping pace with global warming, there is a risk of progressing desertification. The increase in the amount of water vapor that accompanies global warming has the potential to exacerbate aridity in dry regions. Once the ecosystem is destroyed by desertification or land degradation, recovery is extremely difficult. The next page shows the distribution of vegetation in China using the linear multinomial logit model and a hypothetical map of vegetation distribution according to the warming scenario of 2℃ rise in annual temperatures and a 20% increase in annual precipitation proposed by Robock et al. (1993). The accuracy rate of multinomial logit models using vegetation distribution and climatic conditions in predicting vegetation distribution was, on average, 68.7%. Based on the vegetation distribution map obtained through this method using the aforementioned variables, there was a possibility that changes in water distribution caused by temperature increases and aridity could desertify steppes and savannas in western China, especially desert peripheries.

Since the presence of vegetation also affects the environment, in order to restore vegetation and so prevent desertification, it is necessary to establish, as the ultimate goal, the flora close to the climax of the affected areas.

2.1.3. Soil Deterioration and Desertification/Land Degradation

The causes of soil deterioration are (1) physical processes, (2) chemical processes, and (3) biological processes (Lal and Stewart, 1990 and 92). Models are currently being applied to the processes of water and wind erosion and soil salinization, with different parameters established through analysis of the structure of the degradation process in each case.

In the future, in order to avoid soil degradation and to use land in a sustainable manner, a system of land use which guarantees the cyclical replenishment not only of soil but also of water resources and the natural ecosystem, needs to be established. But the individual technologies that should be used in such systems must be chosen according to each natural and socioeconomic environment. Furthermore, in order to construct such systems, it is essential to collect superior weather data and to model current systems.

2.2. Natural and Socioeconomic Mechanisms of Regional Desertification/Land Degradation

This section describes how desertification/land degradation phenomena should be dealt with. It discusses the natural and social mechanisms of regional desertification/land degradation using China and Africa as examples.

2.2.1. How Should Desertification/Land Degradation Phenomena be Dealt with?

1) Efforts at generalization

Even though there are strong regional factors at play in the issue of desertification/land degradation, general explanations should be attempted. Most urgent is the construction of models for desertification/land degradation. These models should take account of both natural and human causes.

Distribution of Vegetation in China Using a Linear Multinomial Logit Model and Map of Hypothetical Vegetation Distribution according to Warming Scenario of Robock et al. (1993)(2℃ rise in annual temperatures and 20% increase in annual precipitation) by Robock et al.)

2) Similarity between desertification phenomena in Asia and Africa

The phenomena of desertification/land degradation that can be seen in Asia and Africa exhibit fundamentally similar aspects. Broadly, the creeping desert frontiers are the front lines of a clash between the desert on one hand and farmers and nomads on the other. The causes of desertification/land degradation can be clarified by reaching beyond the traditional differences in culture, society, and politics in each region and using commonly applicable principles to grasp the process of desertification/land degradation. Only then should the peculiarities of the regions be considered.

3) Approaches for prevention measures for desertification/land degradation

The results of attempts to explain the phenomena of desertification/land degradation must lead to ways to prevent it. Among the goals of such prevention should be included, in addition to direct prevention of desertification/land degradation, indirect stabilization of society and the economy.
In order to combine the two, it is essential (1) to restructure social systems, (2) to take full account of the fact that the ultimate sources of sustainable resources are biological resources and natural energy, and (3) to give due consideration to technology transfers and to develop appropriate technologies.

4) Desertification/land degradation prevention in the Asia-Pacific region

One of the most important roles that Japan can play in preventing desertification/land degradation is in its contributions to the rest of Asia. In order to debate the issue of desertification/land degradation phenomena in the Asia-Pacific region, the meteorological characteristics of the natural environment of Asia as a whole need to be understood. Then the state of social and human land use and the environmental changes that are caused by the interactions of such uses need to be classified into appropriate categories.

The general applicability of these phenomena needs to be understood. For example, before conducting separate research projects, it is considered necessary to set up an 'East Asia Environmental Transect' stretching from Indonesia to Mongolia and to define the specific issues in each region.

2.2.2. Progression of Desertification/Land Degradation and Natural and Social Mechanisms

Desert and degraded land area in China is still expanding. Land defined as "degraded" comprises 27.3% of the country ("China Desertification Report" Ministry of Forestry, China, 1997) and in the past 20 years, has expanded at a rate of 2,460km^2 per year. In this section, the following have become clear after monitoring desertification with LANDSAT data in the three regions of Eastern China and analyzing the natural and social mechanisms of desertification in the Naiman Settlement, Inner Mongolia Autonomous Region.

In the long-term expansion of desertification, contemporary land use is always a major factor. After 1950, rapid increases in human settlement and numbers of domesticated animals and specific cultivation have been causes of desertification. In addition to the increased aridity caused by the loss in rainfall, the dry winters and strong spring winds, characteristic of the region, have exacerbated desertification. On the other hand, alterations in agricultural methods, shifting threatened lands to pastures and wind barrier forests, prohibiting the raising of goats which cause severe damage to pastures, and planting feed grains have all been effective measures against encroachment by deserts. In the future, sustainable land use and the reclaiming of lands lost to deserts must be done by evaluating the productivity of land and considering its appropriate uses.

2.2.3. Drought and Desertification/Land Degradation Prevention Policies from the Vantage Point of Human Livelihood

It is possible that existing desertification prevention measures, such as preventing soil degradation, have placed too much emphasis on desertification as a natural phenomenon and failed to consider the improvement of human living standards. For example, the concept of prohibiting grazing because it leads to land degradation fails to take into account the fact that grazing developed in arid lands precisely because it was adapted to such conditions. The important aspects of desertification prevention are those that ultimately improve the lives of people hurt by desertification. From such a viewpoint, there are two fundamental problems that must be faced for effective desertification prevention:

1) Need for an international political science at global and human environmental level

Why are arid lands like those of the southern Sahara, a region which historically has been a center of civilization and certainly not impoverished, now counted among the Least Developed Countries, and suffering from encroaching deserts? This cannot be explained by desertification as an only natural phenomenon. The cultural and historical background of these regions that previously enjoyed a rich variety of productive occupations and regional economic exchange mechanisms needs to be understood. Thus, steps such as recreating the regional exchange and mutual support systems that once existed need to be taken.

2) Comprehensive study on water resources, technologies for water use, and social contexts

Arid regions contain many water sources, and complex and detailed systems for water use have been developed since ancient times. If this knowledge acquired by the arid lands can be studied and combined with comprehensive research into the water resources of arid lands and their possible uses (and applications of complex irrigation systems like Japan's rice farming), major contributions can be made to solving the problem of desertification.

2.3. Possibilities for Modeling Desertification/Land Degradation

This section reviews models related to desertification and examines the directions for future model development.

Models related to desertification can be classified into models for particular processes of desertification and comprehensive models that take into account multiple aspect of desertification processes all of the above. Former models explain the major processes of desertification/land degradation such as water and wind erosion, salinization, and overgrazing, and also the driving force of the human factors, the key parameter of population. Since the process of desertification/land degradation is also caused by an imbalance between supply and demand for various environmental resources, models are being proposed to cover this aspect as well.

1) Models for specific desertification processes

(1) Water erosion
Empirical models: these find a statistical correlation between observed data for the degree of water erosion and data related to various factors which contribute to water erosion. A typical model is the USLE model which calculates soil loss from rainfall intensity, soil erosion rates, and the length of slopes. Physical models: these predict the behavior of soil particles by means of erosion mechanisms and hydrological principles. Such models include those that predict the runoff of insecticide and fertilized caused by soil erosion in farmland.
(2) Wind erosion
For example, there are formulae that express the amount of blown sand caused by wind erosion using the three parameters of wind erosion potential, the proportion of bare land, and sand coarseness.
(3) Salinization
There are many models that predict the level of salinization but none that measure salt accumulation.
(4) Vegetation
Much research has been done on models for vegetation in grazing land.
(5) Population
Analytical methods: these show current population trends and produce future projections using demographic time-series data. Factor-based estimation methods: these show the content of changes using statistics for population shifts and population movement .
(6) Models concerning the balance between the supply and demand of environmental resources
The models most relevant to desertification in this sphere, are those that factor soil degradation into calculations of food consumption and production.

2) Models that combine multiple aspects of desertification processes

(1) Models for desertification at regional level

(a) Conceptual models. There are two types of models: those that assume desertification to be a one-way, irreversible process and those that assume it is reversible and that recovery is possible. Anti-desertification policies will vary depending on the model chosen.
(b) Quantitative models. There are models that quantify the danger of desertification according to the five factors of water erosion, grazing pressure, vegetation degradation, settlement, and wind erosion (Grunblatt et al., 1992). There are also evaluation models which use such environmental indices as erosion potential, grazing pressure and climatic stress and express these numerically on GIS (Mouat et al., 1997).

(2) Models at the village level. These are models that treat the balance between the supply and demand for environmental resources, and they are effective for sustainable land use systems (research in this field remains limited).

3) Present state of model development and current issues
One of the characteristics of the desertification/land degradation problem is that it includes multiple aspects and the overall phenomenon of desertification generally lacks any universally applicable criteria. The status of model development reflects these peculiarities of desertification. First of all, in individual regions, there are sophisticated models developed for certain issues. For example, for water erosion, population dynamics, and grazing land vegetation, much research has been accumulated. Secondly, there are a few cases of research into comprehensive models that treat multiple desertification processes in conjunction. These evaluate the danger level of desertification considering several desertification processes over a relatively wide area. There are also a few studies that evaluate the balance between population and resources based on the supply and demand for environmental resources at the village level. Thirdly, there are as yet no models that completely explain the process of the causes, results, and effects of desertification. Models that explain the causal relationships of desertification are still at the conceptual level. Major issues therefore remain to be resolved.

Chapter 3. Ideal Social Systems for Combating and Rehabilitating from Desertification /Land Degradation and its Technologies

3.1. Principles for combating and Rehabilitating from Desertification/Land Degradation

In light of the principles, goals, and the ultimate aims of the United Nations Convention to Combat Desertification (UNCCD), this section discusses the preconditions and priorities for combating desertification/land degradation, with an emphasis on the existing problems which Japan has been most occupied with.

A variety of desertification/land degradation control and related projects have been conducted in arid and semi-arid areas in the world since the late 1970's, based on the PACD (Plan of Action to Combat Desertification) which was adopted at the UNCOD (United Nations Conference on Desertification) in 1977. But all of large-scale top-down projects using abundant funding ended in failure.

Reflecting on such past failures, the UNCCD (UN, 1994) has adopted a bottom-up approach at village community level, that gives importance to the participation of local populations and the role of NGOs, as their main strategy (Article 2, paragraph2). This is nothing other than a comprehensive strategy that aims to rehabilitate and improve land productivity at community level and to achieve sustainable development in the areas affected by desertification/land degradation, focusing on the proper management of land and water resources. In order to implement this, it is critical to eradicate poverty and reform land tenure in the affected areas, promote subsidiary, set up food security systems, and eliminate disadvantageous conditions in international trading and marketing. The preconditions and priorities for combating desertification/land degradation are shown below:

1) Preconditions for combating desertification/land degradation

(1) The basic understanding of the issues:
The recognition that desertification/land degradation is caused by socioeconomic factors and that it hinders sustainable development of the region.
(2) Understanding the need for international efforts:
Technological and financial assistance especially for regions in developing nations.
(3) Considerations for changing socioeconomic environments:
Considerations for changes in socioeconomic factors such as the spread of market economies, international recessions, and changes in aid policies.
(4) Considerations for climatic changes:
Understanding of the phenomena of severe droughts that, through the destruction of food production bases and water and energy supply systems, result in numerous starvation fatalities and environmental refugees.

(5) Thorough review and evaluation of existing projects:
Review in detail the results of each project and clarify the conditions for success and the reasons for failure. Evaluation from medium to long-term viewpoints is especially desirable.

2)Priority issues

(1) Monitoring and evaluation at local site level:
The development of convenient and effective methods and technologies that can be adopted by even the leaders of local community and farmers is desirable.
(2) Stressing socioeconomic aspects:
Aiming at eradication of poverty and sustainable development in the affected areas, it is necessary to tackle problems tp realize local inhabitants' participation and to reform land tenure system in a comprehensive manner.
(3) Stronger support for the activities of NGOs and CBOs:
Looking for the needs of the local inhabitants and support for creating organizations.
(4) Considerations for regional character:
Considerations for special natural environments and socioeconomic conditions at local/regional level.
(5) Coordination of existing and planned programs and elimination of duplication:
Categorize domestic organizations for coordination and related activities.
(6) Improving response abilities and new issues in technology transfer.
(7) Predicting climatic changes and assuring food security.
(8)Innovation in information system, alternative livelihoods, alternative energy sources, and water resources management.
(9) Education of experts

3.2. Review of Social Systems and Technologies in Case Study Regions

This section examines social systems and technologies of five different countries in case studies.

3.2.1. Case Study in Niger

The urgent issues for developing nations can be summarized as poverty, population expansion and food shortage. To combat these problems, JALDA (Japan Agricultural Land Development Agency) has been conducting research for conserving tropical rain forests and preventing soil erosion on a world-wide scale.

In phase I (1985-89), basic data was gathered in the Sahel region. This data provided the basis for an investigation which determined the level of desertification and analyzed its causes. In phase II (1990-95), a demonstration study was conducted with the aim of identifying the practical technologies appropriate for the region and capable of being put into widespread use. For this purpose, experimental farms were set up near the capital Niamey. The results of the research included the compilation of technological manuals for local agricultural leaders in the fields of water management, cultivation, farmland protection, grazing, and afforestation. A model development program was drawn up for the village of Magou. In the program, the technology introduced in the manuals was applied to set up plans for the use of land and water. Plans were also drawn up for reviving plant life, self-sufficiency in food and feed stock, and increasing incomes. Such "Model Programs" and "Technological Manuals" need to be adapted for other regions with different natural conditions.

Phase III (1996-2000) is currently in progress and focusing on the following two points. The first is the need to raise the comprehensive manuals giving instructions on desertification prevention which were tailored to Magou village. There is also a need to prepare a technological package that can be applied within the whole Sahel region. Second, in order to prepare an environment conducive to desertification prevention projects in each of the Sahel countries, the necessary information on nature, society, and the economy will be gathered, analyzed, and maintained. The data, once collected and analyzed, along with the technology package, will be made available to relevant individuals as a database. In the completion of these studies, the assistance of the Niger River Basin Association (NBA), the government of Niger, and the CILSS is of great importance.

3.2.2. Case Study in Ethiopia

All regions of Ethiopia in varying degrees suffer from desertification/land degradation. But in the more than 2,000 year history of Ethiopian civilization, there are only a few cases where agriculture, which is conducted everywhere in the nation, has caused the land to be degraded beyond recovery. Rather, prevention measures were taken before catastrophic conditions were reached, according to the agricultural and social systems of the time and region. This section summarizes and discusses the three representative agricultural and social systems of Ethiopia and their features.

1) Grain-based agricultural social systems of the Semitic people in the northern highlands

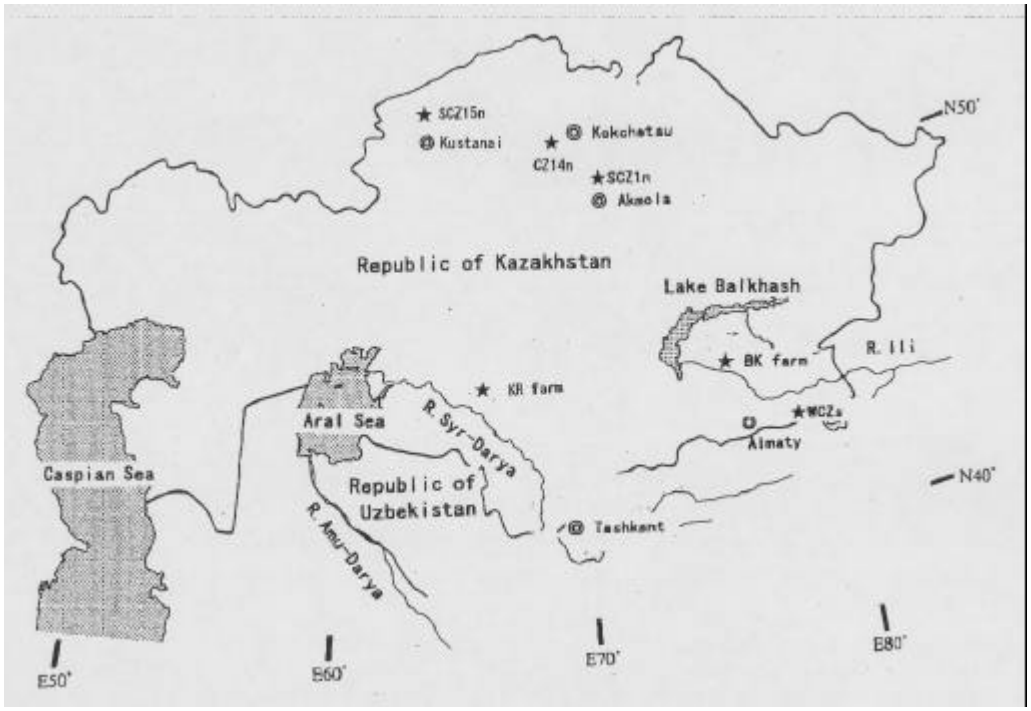
A system that yielded appropriate and stable harvests on a long-term basis with minimal investment has, in recent years, given way to a system with high investments and high returns.

An example of soil erosion in the farmland (Near Sodo, southern part of Ethiopia)

2) Yam-type root crop-based agricultural social systems of the Omotic people in the southwestern highlands

A system is in place that skillfully combines root crops, which gradually use the nitrogen in the soil, and beans and cereals that supply proteins.
3) Combined pastoral-agrarian social systems of the Cushitic people in the semi-arid areas in southwestern Ethiopia
This system combines farming and grazing, and includes the mixed cultivation of many crop types, vigorous use of manure, and related activities.

3.2.3. Case Study in Kazakhstan



Survey site

The major constraint in developing agriculture in this region is obviously low precipitation, less than 100 mm in desert regions and less than 350 mm even in the northern steppes. In order to increase agricultural production under these conditions, large scale irrigation farming was introduced in the former and original cultivation methods using specialized large farming machinery in the latter.

Agricultural productivity in the northern steppe is, however, expected to decline in the near future, because the farming methods promote the decomposition of soil organic matter and soil nitrogen release with favorable moisture condition produced by innovative cultivation methods such as summer fallow resulting in the degradation of ecosystem. This farm ecosystem is far apart from natural ecosystem and exploitative in terms of organic matter and mineral nutrients cycling. The major problem of this farming system is that summer fallow contributes only to the increase in agricultural production in a short term, but not guarantees long-term sustainable production with conserving ecosystem.

In contrast, large-scale irrigation agriculture practiced in the southern deserts has dramatically changed the cycling pattern of water and distribution of nutrients in the region. It caused the decrease of water flow of the major river, resulting in the shrinkage of an inland lake such as Aral Sea. It is also enhancing salinization problem of the irrigated farms. Tentative countermeasure is the improvement of drainage network system, but the real issue is the consensus of the countries involved on how much changes can be allowed for the desert ecosystem with installing irrigation system in the region.

With the breakup of the former Soviet Union and the ensuing gradual loss of existing social and economic ties, the following need to be done for combating land degradation: (1) to establish the status of agriculture in the region within a new system of market economy, (2) to reconsider the use of land and water in large scale irrigation farming, and (3) to replace the current cycling system of organic matter and nutrients in cereal farming in the steppe zone with a balanced sustainable system.

3.2.4. Case Study on India

The Thar Desert is a tropical desert approximately 2.6 million km^2 that stretches between India and Pakistan. Its population density, 16 per km^2 in 1901, has increased to 83 per km^2 in 1991 (estimate). It is one of the most densely populated deserts in the world.

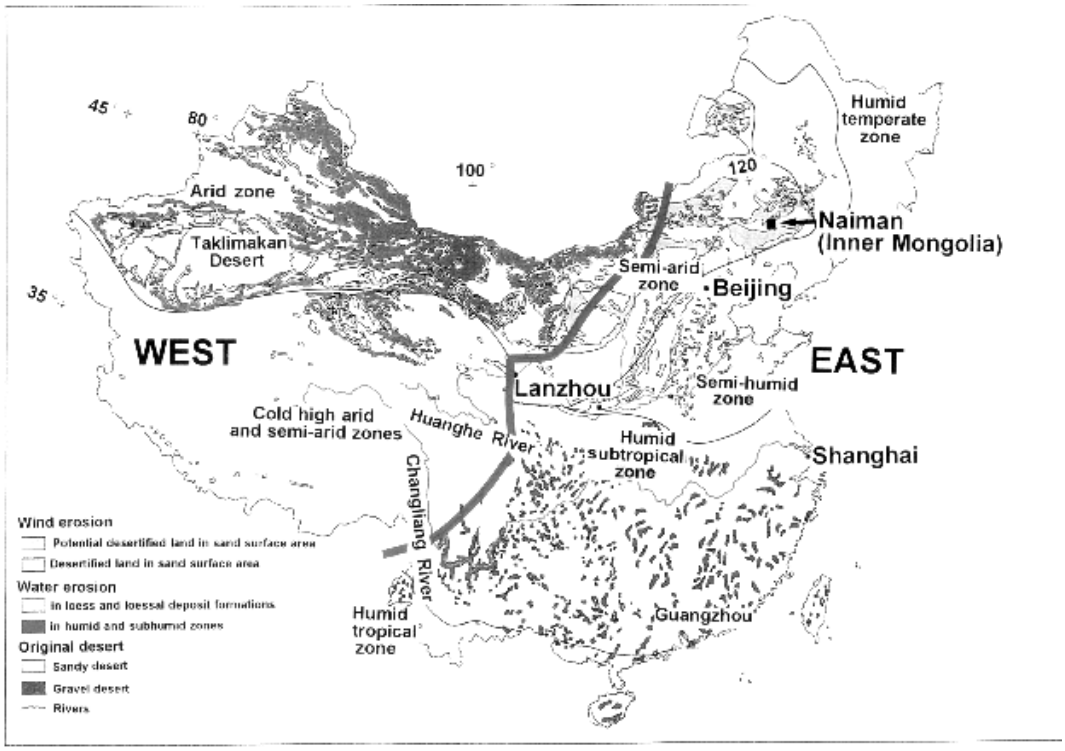
The desertification process involves wind erosion, sand movement and accumulation, long-term loss of vegetation, and decreased soil productivity through continuous cultivation. The direct causes include overgrazing, excessive harvesting of trees, farming in marginal lands, continuous cultivation, and tractor ploughing. The Desertification Research Group of the National Institute for Environmental Studies has been conducting surveys into the process of desertification at the Khabrakalan village, Osian tehsil, Jodhpur district.

The Khabrakaran villagers conduct a form of farming typical of this region, based on rainfed agriculture and supplemented by a dozen or so goats and sheep. The population was 401 in 1951 but increased to 1253 by 1991. Such population increases have raised the demand for fuel energy and prompted the excessive harvesting of logs from surrounding areas. The increase in population has also led to growth in herd sizes and, in consequence, excessive overgrazing. According to this survey, average household plot sizes have been halving every generation. In order to attain previous production levels, crop rotation is decreased (causing an increase in continuous cultivation) and land such as sand dunes that has not been previously cultivated is put to use (causing exploitation of marginal farmland). These factors are believed to have accelerated land degradation (Miyazaki and Tsunekawa, 1996).

In the region, the following measures are being taken to combat desertification: (1) afforestation; (2) planting shelter belt; (3) agro-forestry systems; (4) cultivation technologies that limit wind erosion; and (5) systems to utilize solar energy.

3.2.5. Case Study in China - Example of Naiman Settlement, Inner Mongolia Autonomous Region

The desertification process in this area dates back a millennium and throughout history, there have been alternating periods of encroaching deserts and stable steppe ecosystems. This section discusses the social systems operative after the 1947 establishment of the Inner Mongolia Autonomous Region, which is thought to be responsible for the current phase of desertification, and technical measures to combat desertification. Naiman Settlement lies on the transition belt between the agricultural regions of North China and the grazing regions of Inner Mongolia. It is a mixed pastoral-agrarian area. In the areas where settled farming is practiced, although the land area under cultivation has decreased, the portion left uncultivated has not yielded high-quality grazing land. On the other hand, land clearing for farming continues.



Location of the Naiman Settlement

Since herd size has not decreased, it is clear that pressure on the grazing land is increasing even without taking into account the decrease in productivity caused by the degradation of the grazing land.

In an atmosphere of increasing herds and population on a limited land area with increasing demand for food and feed stock, the necessary steps in regions that are not economically wealthy, like the Naiman Settlement, will be to increase production efficiency in the region and to introduce recovery technology appropriate for the regional economy. From 1992, a research group from the Agricultural Environment Technology Research Center conducted a five year grazing experiment to study grazing pressure, a direct cause of desertification. As a result, it was discovered, for example, that whereas level sand dunes can permit up to four sheep per hectare, hilly sand dunes could only sustain about two sheep per hectare.
In response to this experiment, the following steps were taken: (1) prohibiting the grazing of goats; (2) improvement of grassland and creation of artificial grassland; (3) fencing in of grassland; and (4) the use as feed of the stems of crops produced in the farms and some cereal seeds. In Naiman, starting from the mid 1970's, windbreaks have been planted as a national project and these have stopped the encroaching desert. Intricate networks of windbreaks, large and small, have been planted. These create small plots of farmland and pasture measuring 1 km by 1 km, which have been leased to farmers.

The farmers have every year been using hay and straw left over from the harvest to bring level ground adjacent to sand-dunes, and the lower slopes of the dunes, into agricultural land and to prevent the movements of sand, by laying these materials to form mats or nets on the surface of the dunes. Comparative tests showed that even these relatively simple methods were effective.

An approach based on environmental considerations, and harmonizing with both the natural features of the region, and its social conditions, thus not only produces appropriate measures but also creates the possibility for sustainable land use, as reliance on high-technology engineering projects (such as by desert greening projects) does not.

Chapter 4. International support and Japan's role

4.1. The current state and issues of international action

The international action is reviewed in accordance with different modes of cooperation in this section.

(1) Action based on the UNCCD

(a) At the global level

Characterized by a bottom-up approach in contrast to the top-down approach adopted in the Action Plan to Combat Desertification of 1977, the UNCCD has attracted so many states as 119 as Parties to it (as of 1989).

The COP1 held in Rome in autumn, 1997 successfully made basic logistical arrangements, reaching consensus on the establishment of the Convention secretariat, program of the activities of the Conference of the Parties, terms of reference of the Committee on Science and Technology, etc. Further agreement on substantive mattes such as the mobilization of financial resources by the Global Mechanism and coordination with other international organizations and forums for the environment and development is necessary by the COP4 to establish a firm basis of effective implementation of the Convention. Ensuring mobilization of intranational resources and participation of such states as USA are also essential.

(b) At the national level

It is encouraging that many Parties, particularly those of Africa, have already started arrangements for the bottom-up approach in accordance with the provisions of the Convention. However, to make the bottom-up approach effective, there are still many to do, including capacity building of local governments so that they can effectively respond to the needs and initiatives of the communities and inhabitants.

(c) At the regional level

Not a small number of regional meetings have already been held. However, cost-effectiveness should be seriously considered in regional action, which requires substantial resources for logistical arrangements. Integrating action to combat desertification in existing various activities for socio-economic development, rather than creating free-standing desertification forums, may be an option to ensure such cost-effectiveness.

(2) Other multilateral actions

In view that the problems of desertification are an integral part of socio-economic problems of the society as a whole, it can be said that certain activities to contribute to combating desertification have already actually been done by various international organizations. Such international organizations, including UNDP, IFAD, FAO and multilateral development banks, should clarify and strengthen their roles in combating desertification. The activities of the CILSS and IGADD which are aimed at combating desertification should also be strengthened and effectiveness of their activities should be further sought.

To ensure appropriate and effective preparedness and responses to desertification, monitoring of desertification and the climate is essential. In this regard, the relevant activities of UNEP, WMO and OSS should be coordinated. The political role of the UN General Assembly, particularly for coordination of the programs of the UN System and the role of Regional Economic Commissions in integrating combating desertification into various socio-economic development in respective regions are also important.

The Conference of the Parties should encourage and coordinate these multilateral actions.

(3) Bilateral cooperation

It is noted that the Japan International Cooperation Agency (JICA) already issued so early as in 1994 a policy paper on the cooperation to combat desertification and that the paper effectively encompassed various socio-economic development issues from the national to community levels. However, Most bilateral agencies have yet to formulate policies to cooperate with developing countries to combat desertification.

(4) Actions by NGOs

The introduction of the concept of desertification and the adoption of the UNCCD have helped many NGOs at the community and national levels, most of which had launched socio-economic development activities without the notion of desertification, effectively address their activities to combating desertification. Also, the Convention has led to rapid emergence of an international coalition of NGOs for combating desertification.

4.2. Japan's Current Contribution and Future Tasks

This section discusses the present state of Japanese efforts and the issues facing them. International cooperation projects and efforts by government departments have been listed separately.

4.2.1. Policies by Japanese Government on Combatting Desertification/Land Degradation: Japanese Government Policy and Future Tasks

Our government considers the problem of desertification to be a global environmental issue and places great emphasis on it. We see it as a fundamental problem associated with the issue of sustainable development in developing nations and have been implementing various preventive policies.

1) On the responses to the UNCCD by our government in preventing desertification

We have been actively participating in the intergovernmental conference of the contracting parties of the UNCCD in order to combat desertification. Japan has been contributing in the process and selection of the conference by such acts as having our representatives serve as bureau members and as the chair of the second task force. We have also been contributing funds continuously to the UNCCD convention secretariat (US$1,076,000 contributed in fiscal 1997, including conference expenses and expenses for delegates from developing countries).

Japan participated in the Asia-Africa Forum of the UNCCD held September 1997 in Niger and also made active financial contributions to host the forum. In Japan, the UNCCD was passed by a cabinet meeting of September 11, 1998 and Japan decided to formally become a member of the Convention as of December 10, during the 2nd Conference of the Parties (held in Senegal, from November 30 to December 11).

2) On the anti-desertification policies by various government departments
The concrete policies being undertaken by various government departments can be conveniently divided into the following categories.

(1) Surveys
The Environment Agency (EA) is conducting model projects for policies combatting desertification in Burkina Faso, Western Africa, which include providing water supplies by installing facilities for the efficient use of aquifers, tree planting, and the formation of sustainable communities with the participation of the local residents. Also, specialists were organized to discuss comprehensive measures on desertification and they compiled the "Desertification Prevention Handbook." In Niger, the Ministry of Agriculture, Forestry, and Fisheries (MAFF) is conducting demonstration studies which are intended to establish technologies for desertification prevention by encouraging the development of these technologies at village level. They are also conducting surveys as a step forwards

creating resource management and monitoring systems for farmland and water. These systems will be based on distribution maps showing areas where desertification conditions are operative and improvement plans applicable. The Forestry Agency is conducting a Survey Project on reforestation of desertification-affected areas. This will establish technological guidelines for research into the growth conditions for forests, survey cases of reforestation measures, and draw up technological guidelines for the use of scientific experimentation in relation to reforestation.

(2) Research

Since 1992, research has been conducted into the process of desertification, using Global Environment Research Comprehensive Survey Funds, mainly operated by the EA, in collaboration with the national experimental research institutes of the various governmental agencies involved. Previous research has included research on the evaluation of the mutual interaction between desertification and human activity, the development of evaluation techniques to measure the effectiveness of desertification prevention measures in North China and Western Australia, the establishment of technology for the recovery of salinized soil in Kazakhstan in Central Asia, and a pilot study on the effective use of desulfide gypsum for improving soil quality in China. The Ministry of Education is also conducting basic research on desertification prevention and the development and use of arid lands at the Arid Land Research Center of Tottori University, thus promoting innovative research programs.

(3) Aid to developing countries

The Ministry of Foreign Affairs (MOFA) sent teams made up of 5 to 10 Japan Overseas Cooperation Volunteers (JOCV) members and specialists to Senegal, Niger, and Tanzania. They have been conducting green cooperation projects which involve planting the seedlings of drought resistant plants, providing leadership for planting drives in agricultural areas, and promoting agro-forestry projects like tree planting. In 1995, the MOFA provided grants to Senegal for the "Seedling Growing Site Construction Plan."

(4) NGO support

Aid is given to NGOs through the Japan Fund for Global Environment, managed by the Japan Environment Corporation. Eight organizations received funds for combatting desertification in 1996 and six organizations in 1997.

(5) Domestic education

The EA writes up and distributes pamphlets on the UNCCD. They also cooperate with the editing and distribution of the pamphlet "Considering Global Scale Desertification" from the environment series published by the Japan Environment Association. At the annual Eco Life Fair, exhibitions and video presentations are organized.

3) Tasks of Japanese government efforts on preventing desertification

Japanese government efforts are at present made individually by each government department. In considering the government's role in the issue, it is first necessary to settle on the proper role of relevant organizations in Japan in desertification prevention and to organize the departments involved in the policies on desertification more systematically. Especially when debating the ratification of the UNCCD and the contributions which membership will entail, it is imperative to systematize the various efforts in desertification prevention currently dispersed between many different organizations, and to make a coherent international contribution.

4.2.2. Current Situation and Future Tasks of International Cooperation Projects on Desertification/Land Degradation

This section discusses the current status of and the issues facing Japan's international cooperation in combatting desertification/ land degradation. Japan's past achievements have been focused on technical cooperation and grant aid.

1) Technical cooperation

The following types of technical cooperation activities are being conducted:
(1) Dispatching experts:
At present, one each is sent to Brazil and Burkina Faso. Experts are also sent as leaders of the Green Promotion Cooperation Project.
(2) Sending study teams
Two are currently in the Republic of Mali in West Africa.
(3) Dispatching JOCV members
Members are currently overseas on the Green Promotion Cooperation Project. The project has been implemented in Senegal (since 1986), Niger (since 1990), and Tanzania (since 1986) and have cooperated in diverse fields such as tree planting, forestry management, growing fruits and vegetables, gardening, surveying work, and agricultural engineering.

2) Grant aid

The projects include tree nursery construction, rural water supply system construction, farming village development, and drought damage assistance. The recipients include Senegal (26.793), Mali (8.834), Niger (16.135), Chad (1.121), Mauritania (9.978), and Burkina Faso (9.481), etc.
They include virtually all the regions affected by desertification (MOFA, 1997. Parenthesis indicates the cumulative aid amounts in billions of yen).

3) Trends and issues in Japanese ODA cooperation projects

As can be seen from the Green Promotion Cooperation Projects of the JOCV and drought damage assistance through grant aid, Japan's cooperation with developing nations on desertification/land degradation prevention was initiated after the massive African droughts in the early 1980's. JICA sees desertification prevention as one of its large-scale environmental assistance research topics. It drew up the "Study on Assistance for Desertification Prevention" in April 1994. The conclusion of the report states three methodologies for Japan to implement assistance in this field: (1) selecting comprehensive approaches and small projects with large multiplier effects as a priority, (2) supplementing Japan's lack of expertise by cooperative assistance with international organizations, (3) cooperation with NGOs in tackling issues of concern. It cites as such issues “concern for people's needs and consensus formation among relevant organizations”, “concern for women,” “concern for nomadic peoples,” accelerated promotion for local middle class management officials as “counterparts for expatriate staff”, “combining short- and long-term benefits”, emphasizing “rehabilitation” in regions that have implemented desertification prevention measures, instilling “respect for traditional technologies” in the struggle against desertification, “utilization of local personnel” (separately from the “counterpart policy”), “cooperation based on Japanese technology”, and information exchanges with other organizations supporting desertification prevention measures (Japan International Cooperation Agency, 1994).

4. 3. Action by NGOs

The action of NGOs and their roles are reviewed in this section.

4.3.1. The action by NGOs and their roles: An introduction

NGOs' roles include the following:

(a) Awareness building;
(b) Criticism;
(c) Research and collection and provision of information;
(d) Community-level practices;
(e) Funding;
(f) Technical assistance; and
(g) Liaison among NGOs.

With regard to the UNCCD, NGOs are expected to play more important roles for awareness building and for encouraging improved community-level practices through provision of information of techniques and other activities rather than criticizing governments and international organizations. NGOs are playing a more and more important role in the international society of complex interdependence.

However, to play a further effective role in the interdependent international society, it is recommended that each NGO improve its capacities in various aspects, which include the following:

(a) Ensured financial resources;
(b) Professional expertise consistent with the needs of the society and interdisciplinary;
(c) Stability of the organization and operation;
(d) Accountability and transparency; and
(e) Understanding of international relations and respect of the local conditions.

4.3.2. Role of NGOs' in the Sahel Region

In this section, two representative cases of non-Japanese NGO activity will be introduced, and the current activities of some Japanese NGOs will then be discussed.

1) International NGO - CARE International

CARE was founded immediately after World War II in the US for post-war reconstruction. They have been active in providing relief in various areas affected by natural disasters and warfare all over the world. In the droughts in the Sahel between the late 1960's and 1973, CARE had been active in many locations.
The "Masia Valley" project of windbreaks was begun by American Peace Corps members and taken over by CARE in 1973 toward the end of the drought. It has received critical international acclaim as one of the few success stories of all the tree planting projects in the Sahel region.

2) Local NGO - FUGN (Federation des Unions des Groupement NAAM)

NAAM means "a young farmer" in the Maure language. It was founded in 1967 from mutual support organizations in farming societies. As one of the major farmers union in Burkina Faso, it has 3604 organizations and approximately 230,000 farmers as its members(FUGN, 1993/94). The basic philosophy of NAAM is neither adherence to traditional societies nor rapid modernization (Westernization), but a harmonized internal development. Their activities include, (1) training for vegetable cultivation, grazing, dried vegetables, weaving, small scale credit, farmers banks, etc., (2) environmental conservation measures such as stone diggets, permeation dams, tapierpase, soil fertilization with manure, (3) various types of economic activities, and (4) medical and cultural activities.

3) Case of a Japanese NGO - #1: Association Sahel

There are only a few NGOs in Japan that are active in the Sahel and even fewer which are involved in desertification-related activities. After its founding in 1987, the Association Sahel conducted surveys in Tinnaisha village on the northern shores of Lake Fagibinne in the Republic of Mali and started a project the next year. In the forestry field, they opened seedling fields for trees in the forest, distributed tree seedlings to Tinnaisha and its surrounding regions, and educated the local residents on environmental issues. A program to improve the agricultural environment was introduced in cropland on the former lake bed, by setting up an “agro-forestry belt” linked to a system of windbreaks and sand prevention belts. At the same time, experimental trees were planted in the village and in the sand dunes. Agriculturally they created individual vegetable gardens for the villagers in the agro-forestry belt, tested various drought resistant vegetable species, investigated water-conserving farming methods, distributed vegetable seedlings to the residents, and leased seeds for crops and other species at planting season.

4) Case of a Japanese NGO - #2: CARA - Association pour Cooperation l'Autogestion Rural en Afrique de l'Ouest

The members of CARA (Association pour Cooperation l'Autrogestion Rural en Afrique de l'Ouest) were originally participants in the activities of a local farming NGO in Mali that was attempting to eradicate poverty. In 1992, they set up the Society for the Support of Medical and Health Self Sufficiency in the Republic of Mali. The following year, the name was changed to the current name. In the beginning, its activities were mainly environmental maintenance, health and sanitation, and appropriate technology. But its main operations were moved to Babougou village (about 100 km northeast of the capital Bamako and with 600 mm annual precipitation) and it is presently active in 17 villages, 32 settlements, and deals with about 15,000 people.

In the field of desertification, CARA's activities for environmental maintenance include the following:

(1) Seedling cultivation

It set up four sites for planting seedlings for afforestation and by 1997 had cultivated about 16,000 trees, including fruit trees .

(2) Afforestation

Projects include the planting of windbreaks, sand prevention forest barriers, forests for

firewood, agro-forestry, and school forests.

(3) Producing and promoting improved cooking stoves
In order to use wood efficiently, traditional stoves were improved and efforts made to spread the use of the improved stoves.
(4) Placing deep wells
In order to secure aquifer water unaffected by droughts, deep wells are being dug.

5) Case of Japanese NGO - #3: Action for Green Sahel

Action for Green Sahel was set up in 1991 with the aim of preventing the desertification of the Sahel region and helping the people of Sahel achieve food self-sufficiency. In 1992 the organization launched its activities in the Republic of Chad based on three aims: (1) active efforts to increase green areas; (2) efforts to prevent further decrease of green areas; and (3) the improvement of agricultural productivity and living standards.

Activities under the first heading include concentrated cultivation and management of seedlings by mixing exotic species such as fast growing tree species with fruit trees and local species, distribution of seedlings, preservation of seedlings, training on the cultivation of seedlings. Small-scale village seedling cultivation methods are also used, and based on the condition that the local agricultural unions bear their respective responsibilities, the organization loans seedling materials and provides technological guidance. For (2), the organization is engaged in activities to spread thermally efficient stoves to save firewood.

The above three organizations actually send Japanese citizens to carry out activities in the Sahel region. The members of each organization live in remote villages and try to lead the same lives as local residents as much as possible in order to implement their goals through their own experiences. With less experience than the NGOs from Europe and the US, and less funds, it cannot be denied that Japanese NGOs lack strength. It is therefore very necessary for Japanese NGOs to deepen relations with the local residents and government, and to cooperate with related organizations such as the countries and governments providing support and other international groups, in that their desertification prevention activities might transcend international and regional boundaries.

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