THE MASTER PLAN STUDY
ON
SUSTAINABLE MULTIPLE-USE
RESOURCE MANAGEMENT
OF
NKHOTAKOTA WILDLIFE RESERVE, MALAWI

I. Overview

1. Introduction

In the Republic of Malawi, a rapid increase in population has accelerated the conversion of forests into farmlands and the pressure for land use on wildlife reserves. In this respect, the Nkhotakota Wildlife Reserve is no exception. Although most of the Reserve is covered with well-protected miombo forests, wildlife in the Reserve is low in density and requires a sufficient amount of protection. In areas surrounding the Reserve, a rapid increase in the local population and the subsequent conversion of forests into farmlands have resulted in a shortage of firewood. To cope with this situation, the Government of Malawi considered it urgently necessary to develop a master plan for the sustainable multiple-use and resource management of the Nkhotakota Wildlife Reserve and its vicinity, in consideration of the local life. The government made a request to Japan for cooperation in September 1991, in preparing a plan for the "sustainable multiple-use and resource management of the Nkhotakota Wildlife Reserve".

In response to this request, the Japan International Cooperation Agency dispatched a preliminary study team in April 1994 for "the master plan study on the sustainable multiple-use resource management of the Nkhotakota Wildlife Reserve". This was done in order to understand the background of the request, determine in what area Japan could cooperate with Malawi, and to discuss relevant matters with their Malawian counterparts. Based on the results of the preliminary study, the JICA again dispatched a S/W study team to Malawi in October 1994. The study team conducted a field survey concerning the contents and methods of a wildlife survey and social analysis, the details of the sustainable resource management plan, and discussed these with their Malawian counterparts. As a result, the S/W was signed in respect to "the master plan study on the sustainable multiple-use and resource management of the Nkhotakota Wildlife Reserve". At the same time, the minutes of the agreement concerning details of the study were also signed.

After the foregoing steps, this project entered the implementation phase of the study. A joint venture between the Japan Overseas Forestry Consultants Association and Pasco International, Inc. was entrusted with the study, and the first field survey was carried out in February 1995. To date, four field surveys have been carried out in Malawi, and other relevant work has been done in Japan before and after these surveys. A sustainable multiple-use and resource management plan was prepared as a draft final report of the study.

2. Purpose of the Study

The purpose of the study is to grasp the current state of resources in Nkhotakota Wildlife Reserve, the general situation of communities around the Reserve and the dependence of villagers on the Reserve. Then to develop a sustainable resource management plan for the Reserve. Therefore, various surveys were carried out as shown in Table 1-1, and a sustainable resource management plan was drafted.

Table 1-1 Outline of the Study

Phase	Stage	Field Survey		Work in Japan
		Period	Contents	
I	First	Feb-Mar.'95	① Explanation and discussion on the Inception Report ② General survey of the study area	① Preparation of the land cover classification map ② Compilation of data
	Second	June-Nov.'95	① Determination of the study area ② Various field surveys - Current reserve management - Resources - Actual use of resources - Economic conditions - Social analysis - Fishes - Field verification of the land cover classification map - Preparation for land use mapping - Initial environmental examination ③ Determination of workshop participants	① Compilation and analysis of data ② Preparation of principal maps ③ Preparation of the Progress Report ④ Preparation of material for the Workshop
II	First	Jan.-Feb.'96	① Explanation and discussion on the Progress Report ② Workshop ③ Study to produce a sustainable resource management plan ④ Supplementary survey	① Compilation and analysis of data ② Sustainable resource management planning ③ Preparation of the Interim Report
	Second	June-July.'96	① Explanation and discussion on the Interim Report ② Field verification of the provisional plan ③ Study to produce a sustainable resource management plan ④ Supplementary survey ⑤ Determination of seminar participants	① Compilation and analysis of data ② Preparation of the Draft Final Report ③ Preparation of seminar material
		Oct. 96-Jan. 97	⑥ Explanation and discussion on the Draft Final Report ⑦ Participation to Technology Transfer Seminar	④ Preparation of the Final Report

3. Necessity for Planning a Sustainable Resource Management

The eastern part of Malawi is where the Rift Valley can be found, while high mountains soar in the southern and northern parts. Such varied topography brings about various climatic conditions, which give rise to a variety of animals and plants in the national parks and wildlife reserves across the country. They are invaluable not only in terms of the economy but also of science and education. In particular, Lake Malawi provides a habitat for many indigenous fish species. The Government of Malawi manages the national parks and wildlife reserves for the purposes of the scientific and sustainable management of these invaluable resources, conservation of wildlife ecosystems, protection of indigenous species, and the sustainable use of an optimal amount of resources in harmony with land use.

In Malawi, the population is increasing at an annual rate of over 3 %, and the density is remarkably high compared with the other African countries. Since there is no developed industry other than agriculture, forests have been exploited and cultivated in order to absorb the increasing population. The increase is above the national average especially in Nkhotakota (for example, the average population increase rates in the past decade until 1987 in the Nkhotakota and Kasungu Districts were 5.2% and 5.1%, respectively). This is why forests have been rapidly felled for agricultural use, and the pressure for land use has strengthened year by year on the Reserve. As a result, people in some areas have begun to have great difficulty in collecting firewood for their families, and resources in the remaining customary forests have gradually deteriorated. Such rapid deforestation and population increase have added further pressure to use resources on the Reserve. On the other hand, the living standards of people in the vicinity of the Reserve are low, and it is inevitable for them to use any natural resources available from the Reserve for their survival.

The Reserve's main intention is to conserve the ecosystems of precious animals and plants. At the same time, it provides an important habitat for lake salmons above the Bua and Dwangwa rivers flowing into the lake and also functions to yield water and flood control in agricultural areas in the lower reaches.

Accordingly, the ecosystems of precious animals and plants in the Reserve must be conserved by administering and managing the Reserve properly, encouraging the local people to use local resources in a sustainable way and reducing the current pressure on the Reserve. For this purpose, it is urgently required to develop a sustainable multiple-use and resource management plan.

4. Considerations in the Study

The study was implemented by taking the following points into account in order to understand the intentions of Malawian side, especially those living around the Reserve.

① The study was carried out in contact with relevant agencies, including the DNPW and the Forestry Department, the Ministry of Natural Resources, and the Ministry of Agriculture and Livestock Development.

② The study team made efforts to conduct as much talks with the local people as possible in order to understand their needs and intentions.

③ Social analysis survey was entrusted to the Bunda College of the University of Malawi, while a survey on fish resources and their use was entrusted to the

Wildlife Society of Malawi. The opinions of the local people were understood through these surveys.

④ A workshop was held to understand the intentions of the local people through their respective representatives and relevant administrative agencies.

⑤ The study team visited the study area as many times as possible to understand the local situation.

⑥ The provisional plan was verified in the field and specifically reviewed together with the concerned Malawian officials.

⑦ Technologies were effectively transferred to the DNPW staffs in the course of the study.

5. Study Area

It was mutually agreed in the preliminary study that the study would cover both the entire reserve and areas which might affect the environmental conservation of the Reserve, excluding national forest reserves and the plantation owned by Dwangwa Sugar Corporation.

The study area will cover a total area of approx. 400,000 ha, comprising the Reserve with an area of approx. 180,000 ha and the adjoining area of approx. 220,000 ha (see Fig. 1-1).

6. Survey Items

As mentioned above, the study area may be divided into the Reserve and its surrounding area. Plans for the Reserve include a plan for administration and management of the Reserve, and a plan for resources management and resources use. The resources use plan involves a plan for non-consumptive use of resources in the Reserve.

On the other hand, plans for the vicinity of the Reserve are intended to improve the living standards of the local people around the Reserve. This will be done by utilising resources in a sustainable way, awareness of the Reserve as a significant resource for themselves, and to reduce the high pressure on the Reserve.

Moreover, the survey results of the study provide basic data for a sustainable resource management inside and outside the Reserve. The initial environmental survey is to assess the impacts of a sustainable multiple-use and resource management plan on the environment. The results will be outlined in Chapter II.

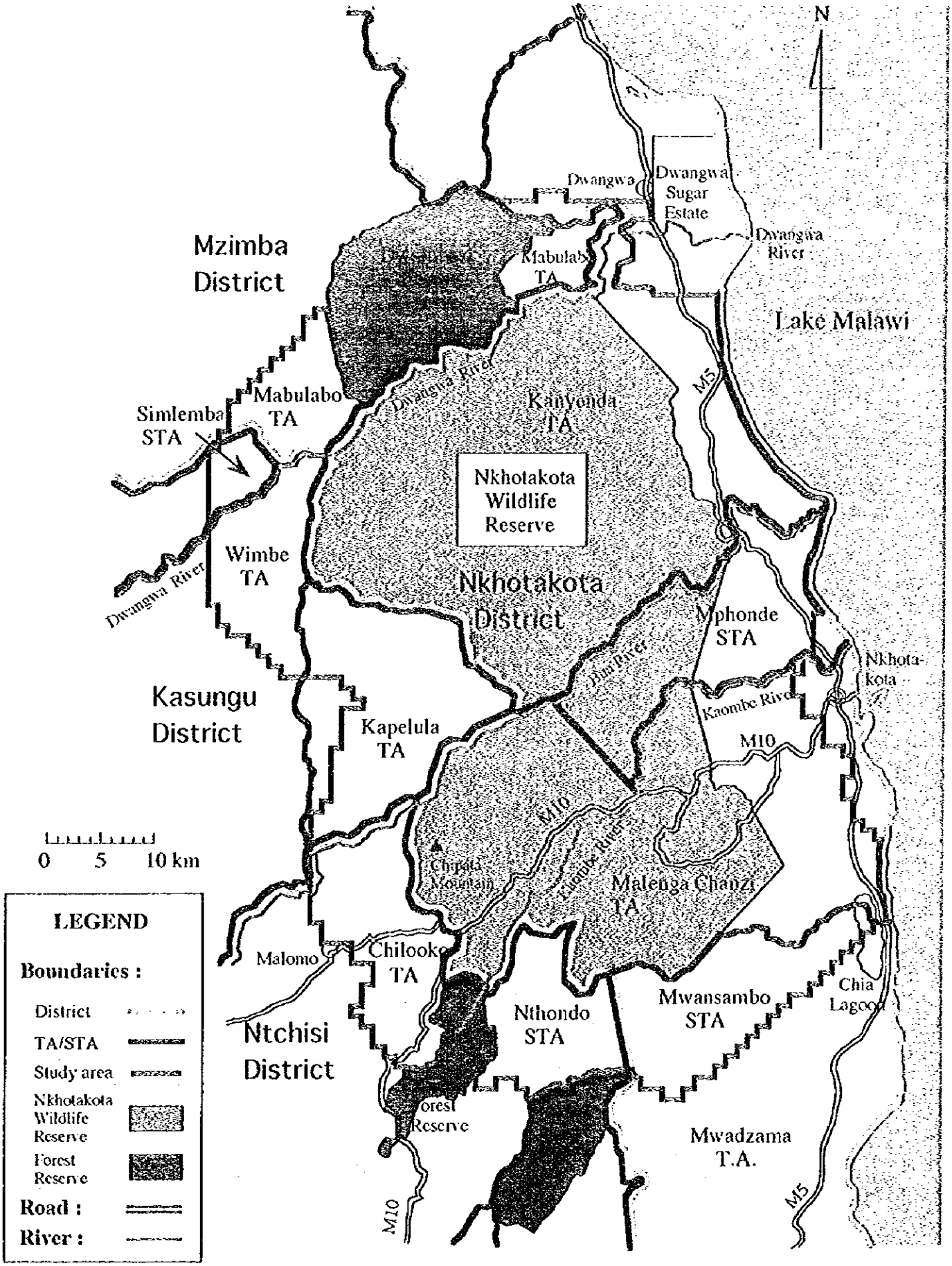

Fig. 1-1 Coverage Area of the Study

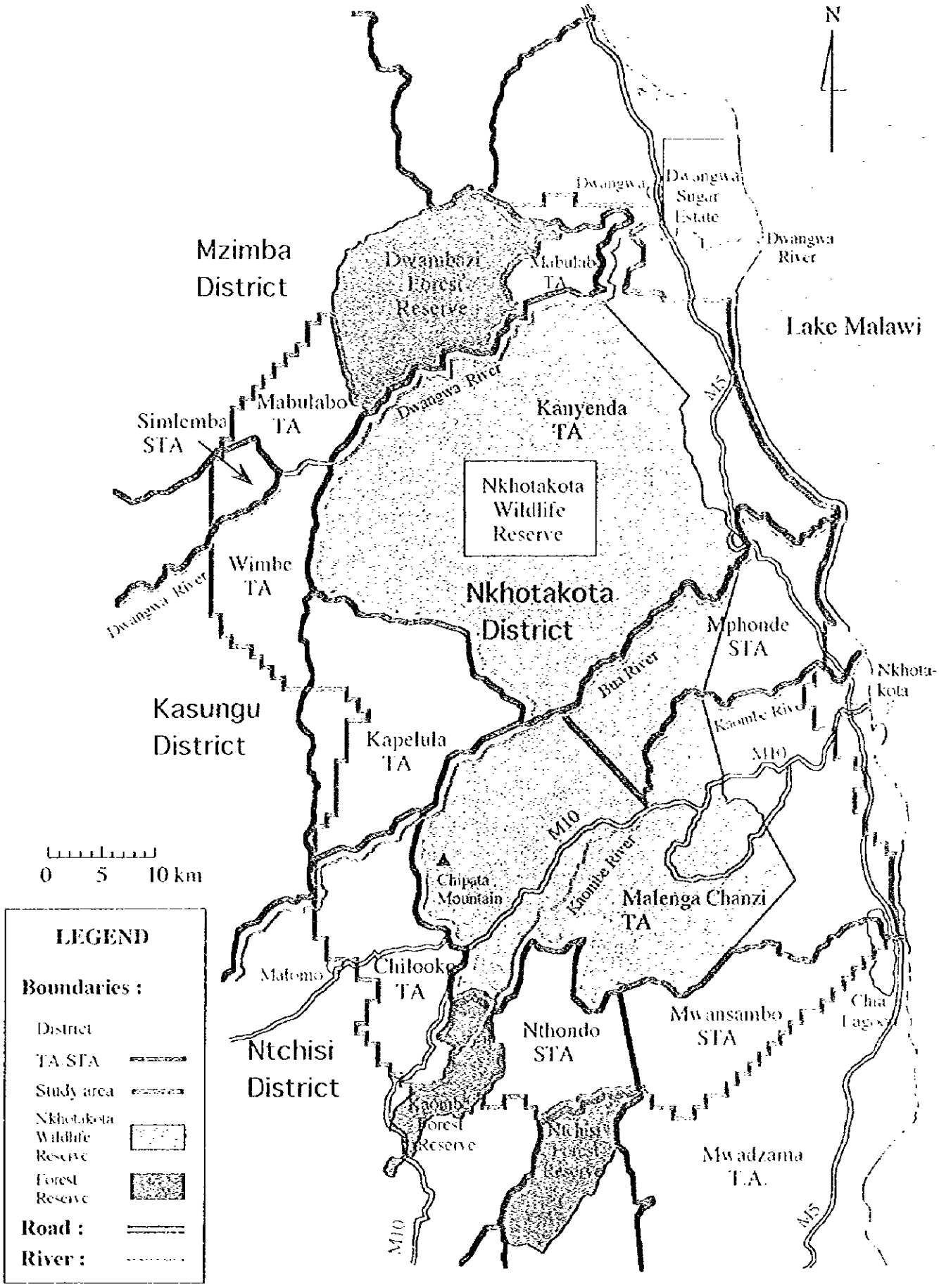

Fig. 1-1 Coverage Area of the Study

II. Results of Main Surveys

2-1 Overview of the Study Area

1. Current State and Administration of the Reserve

The Reserve has an area of about 180,000 ha, extending on the slope of the Rift Valley inclined from the Kasungu Plain toward Lake Malawi. It is mostly covered with miombo forests except for the summit of Chipata Mountain which is covered with an evergreen broad-leaved forest and dambo along the valleys. The inside of the Reserve has been remarkably dissected. The Bua, Dwangwa and Kaombe rivers flow from outside to inside the Reserve and into Lake Malawi. Forests in the Reserve are well-conserved and function as watershed of theses rivers. The evergreen broad-leaved and miombo forests in the Reserve are important, representing the local vegetation.

The administration office of the Reserve is located in Nkhotakota Town and has seven scout camps locally responsible for several duties. These camps are all located within the Reserve, and five or six scouts belong to one camp. They live together with their families but feel it inconvenient that schools, hospitals, churches and stores are distant from these camps. All these camps are faced with a problem of water supply and most of them take pains in secure drinking water especially in the dry season.

Scouts are not sufficiently provided with means of communication, transportation and relevant equipment. A deficiency of equipment inhibits the performance of their duties and their lives in emergency, not to mention daily activities at ordinary times. Their equipment should be improved. Moreover, they need to be repeatedly trained in shooting, required for performing their duties, and mastering techniques for control over animals and plants so that the Reserve may be properly managed.

Although seven scout camps are located to cover the entire Reserve, the steep and complicated terrain of this area makes it impossible to completely patrol the northwestern part of the Reserve that becomes inaccessible due to flooded rivers in the rainy season. In the southeastern part, remote from the camps, areas near the Reserve have been remarkably cultivated and full patrol is difficult (Location map of scout camps is indicated in Appendix 2).

The visitors of the Reserve are concentrated on two visitor's camps, at Bua and Chipata, that provide necessary facilities for them. The number of visitors is not high due to the low density of animals inhabiting the Reserve, the capacity of facilities and less accessibility. However, it is expected that these centers will receive more visitors if the improvement of the national road M10 is completed to give them access to Lake Malawi, the Reserve and the Kasungu National Park.

There are some suitable sites for ecotourism along the Bua and on Chipata Mountain in the Reserve. However, these sites are not appropriate for watching animals because of the low density of animals. The well-conserved forest of the Reserve is a promising site for tourists who seek wilderness.

2. Results of the Fauna and Flora Survey in the Reserve

(1) Fauna

The habitat state of major wild animals in the Reserve were analysed by aerial and ground surveys. An aerial survey was conducted for the entire Reserve in October 1995, when the leaves of miombo forests fell (Aerial survey method is indicated in Appendix 3). A ground survey was conducted by fixed automatic photography and reconnaissance. A survey of fishes was conducted by subcontract by the Wildlife Society of Malawi.

The major animals confirmed in the aerial survey were African elephant, African buffalo, kudu, reedbuck, roan antelope, sable antelope, waterbuck, bushbuck, warthog, and zebra. Their density is low and the distribution of animals on the Reserve varies. Their density is low especially in the north and high in the south. Zebra, kudu and grysbok were confirmed to survive in small numbers in the south but not in the north. Lions and leopards were also confirmed to survive in small numbers in the south. The aerial survey of miombo forests during the falling period of leaves showed that the density of animals was low, though some small animals might have been overlooked (Refer to Appendix 4 and 5).

In the ground survey, aardvark, ratel, genet and yellow baboon were identified through automatic photography. This method proved effective in confirming the nocturnal medium-sized mammals.

The reconnaissance of the Reserve was conducted from mid August to mid September 1995, covering a total distance of about 80 km. In the survey, pellets of inhabitants were found to confirm the presence of major herbivorous animals and otter, velvet monkey, hare, civet and hyena. As major animals, ten species were directly observed, including African elephant, waterbuck, warthog, sable antelope, and zebra. Some species were observed in relatively large numbers:e.g., 37 African elephants, 19 waterbucks, and 14 warthogs. Whereas there were many African elephants and waterbucks at the basin of the Bua, and various species were observed in Wodzi (Refer to Appendix 6).

A survey of birds was carried out in the evergreen broad-leaved and miombo forests and along the rivers, and a total of 111 species were identified. There is a list of 217 bird species inhabiting the Reserve based on this survey and existing records, 10 of which were confirmed to survive for the first time in this survey (Refer to Appendix 7).

Poaching by habitual offenders, among illegal activities, is the most serious problem in the Reserve. People living around the Reserve use guns, pitfalls and snares to catch animals from the Reserve for self-consumption. According to scouts, poaching is rampant in the Dwafuni Valley. Pitfalls, snares and poachers base were also observed during the reconnaissance. Many pitfalls were also detected during the aerial survey. Pitfalls are equally distributed in the northern part of the Reserve and concentrated on the southern boundary of the Reserve (Reder to Appendix 5, Fig. 16).

The Fish survey showed that 9 families and 35 species inhabited three major rivers in the Reserve. If species identified in the past surveys are included, they will amount to 9 families and 40 species (Refer to Appendix 8). On a family basis, the number of fishes falling under Cyprinidae is highest (18 species), followed by Cichlidae (8 species) and Mormyridae (5 species). The Bua is an important river for *Opsaridium microlepis* and *O. microcephalum* to spawn. However, their catches have been decreasing since the 1960s due to excessive fishing, population increase, droughts and unproper fishing methods. People strongly desire permission to catch fish in the Reserve within a certain limit. On the other hand, some fishermen claim that the use of poison is not necessarily a harmful method of fishing and should be permitted. As many fishermen use fishing tools which do destructive damage to fishes, they obviously need education.

(2) Plant

Since the majority of the Reserve is covered with miombo forests, a survey of plant resources corresponds to a survey of forests, mainly miombo forests. As a rule, plots sized 50m x 50m each were established to survey growing stock and dead trees by taking the different types of miombo forests into consideration. Forest types, understorey vegetation and fodder plants, were also surveyed (Forest survey method is indicated in Appendix 9).

As a result, it was found that the volumes of standing trees and branches of miombo forests in the Reserve were estimated at 6,568,000 m^3 and 4,194,000 m^3, respectively, totaling 10,762,000 m^3. The volume of dead trees was estimated at 68,000 m^3.

Study plots were established in each of evergreen and semi-evergreen broad-leaved forests and miombo forests, where 103 tree species were identified and showed a diversity of flora (Results of Forest survey and identified tree species are indicated in Appendix 10 and 11 respectively). Although only two plots were established in the evergreen broad-leaved forest, currently remaining at no more than 54 ha, as many as 15 species were found (Results of forest survey by plots is indicated in Appendix 12). This forest has three stories and natural regeneration occurs to fill any gaps. The semi-evergreen broad-leaved forest extends less and lower on the east side of the evergreen forest. The survey showed that in volume the ratio of evergreen trees to deciduous ones was 2 to 1. Although miombo forests in the Reserve are classified as Msuku forest, *Brachystegia* and *Julbernardia* are dominant in almost all the plots, and Msuku (*Uapaca kirkiana*) is dominant in only a few plots. There are unique stands at the riverside, which are high in density and composed of multiple stories. Many species are different from those in the miombo forests and an important for animals to hide (Refer to figures in Appendix 13).

The number of plants recorded in the plots of understorey vegetation survey was 52 families and 179 species (Refer to Appendix 14). Understorey vegetation is reduced by the closed upper story on the floors of the evergreen and semi-evergreen forests. In miombo forests, by contrast, Gramineae herbs prevail, while Cyperaceae grow in ill-drained areas. Grasslands are divided into dry and

seasonally wet types. Grasses are not high in the former and are dominated by Gramineae herbs and Cyperaceal herbs. In seasonally wet grasslands, grasses are over 1m in height and grow densely. The number of herbal species is 3 or 4 per quadrat (2m x 2m) in grasslands, less than that in miombo forests with 9 or 10 species (Refer to Appendix 10 and 15).

The gross volume of understory vegetation in the Reserve was estimated at 160,000 tons in air dry weight, based on the results of the survey from January to February 1996. Of them, fodder plants were estimated at 130,000 tons in air dry weight. On the other hand, the annual amount of plants eaten by animals may be estimated at 27,000 tons, from consumption per weight based on the results of the animal survey[1),2)] (Refer to Appendix 10, table 7, 8 and 9). Thus, obviously the required amount of fodder can be secured for the current density of animals. In addition to these plants, tree leaves are also fodder eaten only by African elephants. An attempt to survey the consumption of plants by animals was unsuccessful through establishing exclosures.

Those who cannot easily receive medical treatment from hospital and clinic physicians distant from their houses, depend on medicinal herb, which are a vital resource for their lives. In this respect, they considerably depend on resources available from the Reserve (List of medicinal plants is shown in Appendix 16).

2-2 Agriculture around the Reserve

1. Overview of the Vicinity

In order to grasp the general situation of communities around the Reserve, a social analysis survey was entrusted to the Bunda College of the University of Malawi which could conducted the survey in the local languages (Results of social analysis survey, Questionnaires for typification and sampling surveys are attached in Appendix 17, 18 and 19 respectively). The study area extends to four districts, including eight traditional (sub-traditional) authorities comprising of 12 group villages and 30 villages.

According to the 1987 census, average population density per square kilometer for the Districts of Nkhotakota, Ntchisi, Kasungu and Mzimba were 37, 73, 41 and 42 persons, respectively. Annual average rates of population increase in the decade from 1978 for these Districts were 5.2%, 3.3%, 5.1% and 3.7%, respectively[3)]. Remarkably high rates in Nkhotakota and Kasungu were notable. The lower density of population in Nkhotakota compared to the other districts is due to the presence of the Reserve which occupies an uninhabited area of 180,000 ha.

The social analysis survey covered 489 families in 12 villages. The average number of members per family is six persons and there is no large variation among the villages surveyed. Many households are maintained by women, accounting for 23% of the total.

With regard to the educational background of the heads of households, those who did

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1) Collins 1984 Mammals of Africa

2) Sukumar, R. 1989 The Asian Elephant: Ecology and Management, Cambridge University Press

3) National Statistical Office, "Malawi Population and Housing Census 1987".

not receive any school education accounted for 38%. Even those who received some education as primary school graduates or lower, accounted for 84%. Among them, about half completed the fifth grade. As for their children, those who have reached the school age but do not attend school represent about half the total. Those who cannot go to school because of distance account for 47%.

The majority of local people around the Reserve are engaged in agriculture and depend on agriculture for their lives. The average area of farmland, except for estates and families who do not possess farmland, is about 2 ha per family but varies from village to village. On the whole, farmers which possess farmland less than the average area of 2 ha account for about 60%. In the Nkhotakota District, the average area of farmland possessed is generally small, but relatively large on the west side of the Reserve. However, there are many estates in the southern part of the Nkhotakota District, where the average area of farmland possessed is also large.

In every village, agriculture is mainly maize cultivation, but there is large variance between the east and west sides of the Reserve. In the Nkhotakota District on the east side of the Reserve, cassavas are vigorously cultivated for self-consumption with tobacco only slightly cultivated. In the Kasungu and Ntchisi Districts on the west side, by contrast, the cultivation of tobacco and peanuts prosper.

Stock farming is mainly the breeding of poultry, which are important as a source of income as well as for self-consumption. Cattle is mainly raised on the west side of the Reserve, but not on the east side where Tsetse flies do damage. Goats are widely raised.

Average income per farm tends to increase in villages where the cultivated area is large and tobacco is cultivated. Their income come from the sale of crops particularly tobacco. Although a large market is open for tobacco and it is wildely grown in Kasungu, smallholders cannot easily have access to the market.

Since people living around the Reserve depend on forest products excluding the agricultural crops, such as fuelwood, thatching grass, mushrooms, medicinal plants and poles, the pressure on the Reserve will inevitably increase as customary forests decrease or deteriorate.

Families around the Reserve use fuelwood as a fuel source, which is collected in their villages or surrounding woodlands. The quality of forest resources has degraded year by year because the increasing use of fuelwood exceeds the growth of customary forests. As the relation between fuelwood supply and demand is already out of balance, it is obvious that forest resources, as a source of fuelwood, will be depleted in the very near future. To prevent this, it is recommended that the stable fuelwood provision system should be developed as soon as possible. Tobacco cultivation requires much fuelwood for curing leaves. If customary forests, as a source of fuelwood, decrease or deteriorate, it will possibly affect tobacco cultivation. In the 12 villages surveyed, the population is increasing at a high rate with increasing population density. As a result, customary forests are increasingly transformed into farmlands. Therefore, some villages in the Nkhotakota District have only a small area of customary forest and local people take pains to secure fuelwood.

Mushrooms, medicinal plants, fruits and honey are important resources for the local people. Many who eat mushrooms collect them from both customary forests and the Reserve. More mushrooms are collected from the customary forests. Medicinal plants are one of their important necessities, as well as honey.

The Reserve has abundant forest resources in this area, which people are not permitted to use except for some specially permitted product . However, the results of the survey revealed that they actually use various products from the Reserve, and this trend seems to continue in the future.

On the other hand, farm crops close to the boundaries of the Reserve are damaged by the animals which come from the Reserve. Such damage is very often done by monkeys, followed by wild boars and birds.

With regard to the people's awareness of the Reserve, those who think that the Reserve should not be used represent the majority. Even many of those who agree to the use of the Reserve think that animals should not be killed. This is contradictory to the fact of poaching, which is, however, a habitual act of some residents around the Reserve. Nevertheless, when they were asked what they expected from the Reserve if they were permitted to use it, those who answered the use of timber including fuelwood had the highest share.

In terms of the social infrastructure, there is no power supply. Water is available from wells on which all villages depend. These wells are shallow and tend to dry during the dry season. Wells with sanitary problems are not few. New facilities for supplying water are demanded by 80% of all villagers surveyed. Hospitals are distant from their houses and other medical facilities are not well equipped, but medical charges are very high. Therefore, people cannot help but depend on medicinal plants. Roads are not well consolidated and become impassable especially during the rainy season, and as a result local people cannot perform their activities. Moreover, markets as facilities for distributing farm crops are insufficient. Many children cannot attend school, only because no school is located near their houses.

2. Agricultural Management in the Vicinity of the Reserve

Smallholders who earn less than an annual cash income of MK 1,000 represent over 55%. The use of natural resources is essential for this type of low-income group to sustain themselves. Therefore, it is required for a sustainable resource management to mitigate the pressure on the Reserve by improving the income level of smallholders and reducing their dependency on natural resources. There are two possible measures to improve their level of income: i.e., one is an active measure to raise their incomes and the other is a measure to prevent from income decline by preserving the productivity of their farmland.

Many customary forests which could be cultivated have been converted into farmland in the vicinity of the Reserve. There seems no room for further conversion and expanded agricultural management. The fertility of farmlands of smallholders has been declining because they can neither fallow nor sufficiently fertilize their farmlands. Although soil fertility can be maintained by cultivating leguminous plants such as peanuts and soybeans instead of repetitive maize cultivation, smallholders cannot help cultivating maize above any other crop. In this situation, the maintenance of soil fertility is a possible solution to the problem of soil fertility without much capital or multiple use of a large area. It is also possible to use dungs as a compost material .

When taking any measure for improving the income of smallholders, local markets must be taken into full consideration. However, self-consumption should be also taken into account in the process of production from currently available resources. As it is extremely difficult for individual farms to have access to markets, a key to success is collective access.

Possible measures to improve the income of smallholders include the small animal farming, irrigated agriculture using a small reservoir, fish culture, vegetable cultivation, beekeeping, and fruit cultivation. Vegetable cultivation in dambo and beekeeping have already been seen in the study area.

The small animal farming and beekeeping are suitable tasks for women. However, women have already been overworked in the vicinity of the Reserve, and it is severe to impose additional labour on them. In this respect, family cooperation is indispensable, and power to finally dispose of products must be given to the women. If women assume the labour and the men take the products of their labour, any good measure cannot be successfully carried out. Such attitude must not be allowed, as a problem of gender. To ensure equality of the sexes, the intention of women should be reflected in the structure of all the respective committees.

3 Forest survey around the Reserve

A forest survey was also carried out to grasp forest resources in the vicinity of the Reserve. Whereas stands near the Reserve are similar to forest types in the Reserve, shrubs often found in other areas are low and thin due to an excessive collection of firewood. (Results of forest survey around the Reserve is indicated in Appendix 10, Table 10). The conversion of forest into farmland in the vicinity of the Reserve makes it difficult to estimate the area of natural forest at this time. However, the forest area was 68,556 ha according to aerial photographs taken in July 1990. Therefore, the gross stumpage volume and branch volume were estimated at 1,947,000 m^3 and 1,299,000 m^3, respectively, on the assumption that the average stumpage volume per hectare did not change.

Man-made forests are mostly composed of *Eucalyptus* species in the vicinity of the Reserve. All plantations, except a large one owned by Dwangwa Sugar Corporation, are small and owned by individuals. Since they are not distinguishable in aerial photographs, the gross volume of all man-made forests around the Reserve could not be calculated.

4. Necessity for Securing Fuelwood in the Vicinity of the Reserve

Farmers use fuelwood for households collected from customary forests as a fuel source. As already mentioned, these forest resources have deteriorated, and some of them can no longer provide fuelwood.

According to the LANDSAT data analysis, the forest area in the 10 km zone from the Reserve boundary decreased by 37% from about 120,000 ha in 1984 to 76,000 ha in 1993. This tendency becomes more distinct in outer zones. The area decreased by 50% from about 56,000 ha to 28,000 ha in the 5-10 km zone from the Reserve. Of course, the state of existing forests varies from area to area even in the same zone. If felling volume is more than growth (overcutting), forest resources will continue to deteriorate and no timber will be available. Calculated on the assumption that fuelwood is collected in the study area outside the Reserve and self-consumed (no sale to outside the study area is assumed), and other assumed conditions, felling volume will exceed growth in all the traditional (sub-traditional) authorities in the study area, especially on the east side of the Reserve. Resources may be depleted in a few years in the most excessively cut area.

In fact, people in some areas must go further and take more time to collect fuelwood. The chiefs of traditional (sub-traditional) authorities and group villages are aware of the

necessity for taking appropriate measures to supply fuelwood. However, many villagers do not think of planting trees as a necessary measures though they have some doubt about fuelwood supply. Since it takes at least a few years to supply any fuelwood, an appropriate measure should be taken as soon as possible.

Fuelwood supplied to people must be produced efficiently, at a low cost, as far as possible. In this case, people need to recognize that they must produce by themselves a required quantity of fuelwood. Unless people really understand that the management of customary forests or reforestation should be done for themselves, and voluntarily participate in relevant operations, any successful measure is impossible. It is necessary to develop forestry of the people's will, by their own power for themselves, namely social forestry.

To maintain the balance between fuelwood supply and demand in the study area, efforts should be made to not only increase the production but also its efficient use. Accordingly, in addition to reforestation and active management of customary forests to be done as part of the social forestry, a better furnace should be provided and extended to more people in order to improve the thermal efficiency. The active participation of women is essential in the process of securing fuelwood, including seedling production, fuelwood collection and the introduction and spread of a better furnace. Women are expected to actively take part in the planning stage of social forestry. For this purpose, the heads of villages as well as relevant administrative agencies need to play an active role.

2-3 Workshop

A workshop was held at the Kambiri Hotel in the Salima District on 23-24 January, 1996 with about 30 representatives from the DNPW, relevant administrative agencies, District Commissioners, the chiefs of traditional (sub-traditional) authorities, the JICA and the study team. The objectives of the workshop were to:

(1) Explain land cover changes in the study area

(2) Explain the current state of resources in the Reserve

(3) Explain the necessity for developing sustainable multiple-use and resource management plan, and

(4) Understand the intentions of relevant administrative agencies and the local people as to the preparation of a sustainable multiple-use and resource management plan.

1. Plenary Meeting

The workshop was declared open by Mr. Matemba, Director of the DNPW on the evening of 23 January . In the opening address, he offered words of welcome and stated that the purpose of the workshop was to provide an opportunity for expressing opinions to those who might be involved in the planning of sustainable resource management. Moreover, he explained that any plan for sustainable multiple-use and resource management would never be successful without the participation and support of the local people, and requested participants to cooperate with one another.

The leader of the study team expressed appreciation for the cooperation of the people

concerned in the study and requested further cooperation for the study. Then, he explained land cover changes in the study area and deforestation which would lead to a critical prospect for fuelwood supply. He also explained the current state of resources in the Reserve, especially the habitat of major animals and the state of the evergreen forest so that the people concerned could understand the present situation. Moreover, he explained that the development of sustainable resource management plan was indispensable for the conservation of precious resources in the Reserve based on the present situation. He concluded his remarks by requesting participants to make frank comments on this occasion for which this gathering was intended.

2. Subcommittee Meetings

Specific subjects were discussed at four subcommittee meetings. The results of discussion were reported at the final plenary meeting.

(1) Subcommittee Meeting I: Reserve Administration and Management

The agenda for the first section included the current administration and management of the Reserve, complementary measures, and a preferable method of administration and management. With many merits of the presence of the Reserve in mind, problems in the administration and management of the Reserve were pointed out. Among other things, problems related to the improvement of the national road M10, poaching, tree cutting and ecotourism were major points of issue. As for M10, the relation between traffic and animals, traffic regulation at night, speed limitation, and vegetational recovery were addressed. With regard to poaching, the necessity for increasing scouts, meat supply, and extension and education were discussed. In connection with tree cutting, furnace introduction, afforestation, and extension and education were discussed. As for ecotourism, local ecotourism was discussed.

(2) Subcommittee Meeting II: Animal Resources

The agenda for the second Meeting included various problems with animal resources in the Reserve, and the exploration of measures which local people can accept. Problems people facing are poverty, damage to farm crops, local people shut out from resources in the Reserve demand for meat, a deficiency of fish supply outside the Reserve and so on. As for animal resources, the low animal population and problems of Reserve management were pointed out and the countermeasures were discussed. With respect to fish resources, the problem of fishery management, improper fishing methods, and the reduced availability of fish outside the Reserve were addressed. To cope with these, the extension of a proper fishing methods, fishery control within the Reserve, fish culture and other measures were discussed. As problems for the local community, poverty, damage to farm crops, and meat demand were addressed and discussed.

(3) Subcommittee Meeting III: Forest Resource Utilisation and Social Forestry

The agenda for the third meeting included issues as to the necessity for the use of forest resources and social forestry. Major problems in reserve conservation are poaching, encroachment, and uncontrolled fire. It was concluded in this session that these problems were caused by poverty and people's ignorance of the significance of forest resources in the Reserve. On the other hand, improper management of natural forests, lack of efforts to develop forestation, and the slow growth of natural forests obstruct the conservation of resources outside the Reserve. These problems are related to low agricultural productivity and people's ignorance of the necessity for conserving resources. Measures for these were discussed.

(4) Subcommittee Meeting IV: Agriculture and Local Life

The agenda for the fourth meeting was the effects of agriculture on the local people in the vicinity of the Reserve. This was an immediate concern of the chiefs of traditional (sub-traditional) authorities, who took the lead of discussion. For example, a decline in agricultural production per unit area, a social infrastructure deficiency, a decrease in income due to prohibited fishing within the Reserve, improper beekeeping, rapid deforestation, and land allocation were addressed as immediate problems for the local people. Measures for these problems were actively discussed.

3. Summary

The results of discussion at these subcommittee meetings were reported, and a certain time period was given for questions and answers. Finally, they were summarised as follows.

It was unanimously agreed that people's participation in this project, building up the managerial capability of the DNPW, and implementing this project for conserving the Reserve were significant. It was also agreed that a request for respecting the conservation of the Reserve should be made to the Ministry of Works in connection with the improvement of M10. All the participants in the workshop agreed that they were required to serve as a consultant group in the administration and management of the Reserve. To conclude the workshop, the DNPW was requested to take action for procuring funds for implementing the project.

2-4 Field Verification for the Provisional Plan

In the field survey in the second half of Phase II, prior to drafting a master plan, the study team closely examined the basic matters and framework for a master plan by each item (hereinafter referred to as the "provisional plan") on the site together with the DNPW officials. This field verification was conducted on 1-2 July, 1996. Mr. Mphande, Deputy Director of the DNPW, Mr. Dzimbiri, Assistant Parks and Wildlife Officer for the Nkhotakota Wildlife Reserve, and some scouts and all the members of the study team who represented Japan took part in the verification and eagerly discussed relevant matters.

The main subjects of discussion were; (1) Policy for management and utilisation of the

Reserve, (2) Facilities and equipment for the Reserve, (3) Conservation of wildlife in the Reserve, (4)Access to the Reserve, and (5)Social forestry. Besides these, the reintroduction of black rhinoceroses was also discussed.

1. Policy for Management and Utilisation of the Reserve

In principle, the use of resources in the Reserve will not be permitted except where the use will not have a remarkable impact on the ecosystem of the Reserve. Poaching and tree cutting will be more strictly regulated. The use of dead trees will be permitted, if necessary.

Game viewing, ecotourism, canoe, sportfishing, and bird watching will be encouraged under specific rules based on the non-consumptive use of resources. It was examined whether some of the earnings from the control of harmful animals such as hippopotami could be allocated to the construction of facilities for villages around the Reserve.

2. Facilities and Equipment on the Reserve

Opinions were exchanged as to facilities in the Reserve, in terms of sites for building various visitors' center facilities, trails, work roads, scout camps, suspension bridges, details of these facilities, and their sizes.

In light of the importance of communication in reserve management, it was recognized that communication vehicles and radio transmission systems should be provided.

3. Conservation of Wildlife in the Reserve

As the density of mammals inhabiting the Reserve is low, it is important to increase their population through proper management. Therefore, efforts will be made to secure an optimal habitat for animals with emphasis on the prevention of poaching.

Both the evergreen broad-leaved and miombo forests constitute precious vegetation. To protect the former, entrance will be limited except for management, research and study. The use of fire will be strictly prohibited at the area inside the firebreak, except in facilities.

4. Access to the Reserve

The existing roads leading to the visitors' camps and scout camps need to be improved.

5. Securing Fuelwood

With regard to model project sites of securing fuelwood, it is important to explain reasons for establishing model sites and to confirm the opinions of the chiefs of relevant traditional authorities, and the heads of group villages and other villages on the implementation of the model social forestry plan.

6. Reintroduction of Black Rhinoceroses

Prior to the reintroduction of black rhinoceroses, it is necessary to examine the aptitude of habitat, procurement of the initial animals, and the running cost. Therefore, it was determined that these matters would again be discussed in Lilongwe.

7. Others

The study team explained the planned construction of gates at the Reserve boundaries on M10 after the completion of its improvement, the agriculture and markets in the vicinity, and the current state of the Kaombe River basin. It was confirmed that great care should be taken for safety when conducting ecotourism because three lions were observed in a bush beside of M10 road.

2-5 Subject Maps

1. Land Cover Change Detection Map

To understand land cover changes in the vicinity of the Reserve, LANDSAT data were analysed and a land cover change detection map was prepared (Procedure of LANDSAT data analysis is indicated in Appendix 21). Data were collected at an interval of nine years in September 1984 and September and October 1993. Criteria were determined based on these data as well as information available in Japan. The first land cover classification map was prepared according to this classification.

The first map was verified on site, and a land cover map was drawn and printed out for 1984 and 1993 on a scale of 1:200,000, based on a field verification.

Changes in land cover between 1984 and 1993 could be extracted by overlapping the prints for these years. Based on the comparison results, a final land cover change detection map was drawn on a scale of 1:200,000.

As the next step, the area of land cover was aggregated by class, and it was determined how each land cover class changed in each of the zones in the nine years (Refer to Appendix 22). The results of the aggregation can be summarized as follows. Deforestation is found in all zones. The further the area from the Reserve, the less remaining forest there is. Farmland, by contrast, has increased in all zones, and the increase is remarkable in the outer zones. This means that forest area has been increasingly converted into farmland.

2. Land Use Map

Aerial photographs taken in June and July 1990 were used in preparing a land use map. To fully grasp current land use in the vicinity of the Reserve, these photographs were analysed and a field survey was conducted. Subsequently, a land use map was prepared by adding the necessary things to a topographical map drawn by the Department of Surveys on a scale of 1:50,000 (Refer to Appendix 23).

The following land use features in the vicinity of the Reserve can be summarized from the land use map.

(1) Population is large, and farmland occupies a wide area.
(2) There is variance in main crops between the east and west of the Reserve. This reflects topographical and soil variations.
(3) The remaining forest areas are mountains and steep slopes which are not suitable for cultivation.
(4) A huge wetland extends around Lake Malawi.
(5) Many mango trees are scattered in the farmland.

3. Distribution Map of Major Mammals

The map produced by an aerial survey supplemented with information from a ground survey. The aerial survey was conducted in October, 1995, when most trees shed their leaves, with full cooperation by the Malawi Army Airwing. The flights were made systematically along the transects set over the whole Reserve (Appendix 3, 4, 5). Supplementary ground survey included automatic photography and reconnaissance to confirm additional species (Appendix 6). The results were analysed before December, 1996 and then previous sighting records were reviewed for comparison to produce a map on a scale of 1:50000. Additional maps on a scale of 1:100000 were also produced for easy use in the field.

4. Proposed Zoning Map

The proposed zoning map was prepared by referring the present zoning after the current situation of the Reserve was fully surveyed. The vegetation in the Reserve is covered with uniform Miombo forests except Chipata Mountain and notable difference cannot be distinguished to demarcate these Miombo forests. Although there is a trend that dense animal habitat is scattered in the southern part of the Reserve, animal distribution is also irregular and particularly precious habitat is not confirmed. Therefore, there is no reason to change the existing zoning remarkably.

The proposed zoning map was also prepared by taking the ecotourism programme into consideration. Utility areas were newly set up and the location of new scout camps and management of road side area were examined to determine the zoning. The map was drawn on a scale of 1:50,000, however, to make it convenient to use it in the field, the map was compiled to 1:100,000.

5. Forest Type Map

To fully grasp the present state of vegetation, forest types and growing stock in the Reserve, a forest type map was prepared through the same process as the preparation of the land use map using the same aerial photographs. The major forest type is miombo, representing about 95% of the entire Reserve. Besides this, grasslands have a notable share of about 4%.

Miombo forests were classified by height into three groups, namely 20 m or higher, 10 m to less than 20 m, and less than 10 m. Moreover, they were classified by crown density into another three groups, namely 70% or more, 30% to less than 70%, and less than 30%. As a result, a forest type map was prepared. The aggregation of miombo forest area by type showed that stands less than 10 m to 20 m in height accounted for about 46% of the total area, while stands more than 70% in crown density accounted for about 44% (Refer to Appendix 25).

III. Initial Environmental Survey

3-1 Conducting an Initial Environmental Survey

As a necessary step to the initial environmental survey, this project was outlined and the locational conditions were surveyed in Phase I. In respect to environmental items extracted from the results of field surveys, main plans and programs for sustainable multiple-use and resource management in the Reserve and its vicinity were screened, and also to some extent examined, by scoping in order to determine what effect each will exert on the natural and social environments.

The initial environmental survey of this project was made in accordance with the environmental assessment guidelines provided by the Japan International Cooperation Agency. As the general plan has taken shape, each of the main plans and programs was scoped in terms of environmental items. As for plans which were found to have negative impacts on the Reserve and its vicinity, appropriate measures for their improvement them will be proposed.

3-2 Scoping

Prior to determining the location of this project, it was examined whether environmental consideration should or should not be given. As a result, it was concluded that this project should give environmental consideration to the location. Therefore, this project was examined by scoping.

1. Criteria for Scoping

All main plans and programs for sustainable resource management were examined by scoping in respect to specific environmental items. The results of the scoping are summarised in Table 3-1. The legends used in assessment, as shown in the table, stand for the following criteria.

P:	Prospects of positive impacts
A:	Much possibility of negative impacts; further field surveys are necessary for conducting the project, and reform measures should be taken as the occasion arises.
B:	Possibility of minimal negative impacts; further field surveys are necessary before conducting the development project, and based on the results, measures should be taken in the same way as in A.
C:	No noticeable negative impacts

Table 3-1 Results of Scoping

Environment Items	Consumptive Use of Resources (honey, mushrooms, medicinal plants, grass)	Non-consumptive Use of Resources (ecotourism)	Social Forestry
1. Social Life			
(1) Local Life			
Better lifestyle	P	P	P
Conflict among inhabitants			B
(2) Population Problems			
Population increase	C		C
Rapid demographic changes			
(3) Economic Activities of Inhabitants			
Expansion of economic activities	P	P	P
Increase of income	P	P	P
Widening of income gaps	C	C	C
(4) Systems and Customs			
Readjustment of forest concessions	C	C	B
Reform in existing systems and customs			B
2. Health and Hygiene			
More use of agricultural chemicals			C
Accumulation of residual toxicity			
Occurrence of endemic diseases			
Spread of epidemics			
Increase in waste and discharge		C	
3. Cultural Heritage and Scenic Beauty			
Damage to and destruction of historic			
Sites and cultural heritage			
Loss of valuable scenic beauty		B	
Effects on buried cultural assets			
4. Valuable Living Things and Ecosystems			
Change in vegetation	C	C	C
Harmful organisms's invasion and propagation			C
Effects on valuable species and indigenous animals	C	C	
Decline in biological diversity	C	C	

Environment Items	Consumptive Resources (honey, mushrooms, medicinal plants, grass)	Non-consumptive Use of Resources (ecotourism)	Social Forestry
Disappearance of wetlands and peat bogs			
Degradation of natural forests	C	C	C
5. Soil and Land			
(1) Soil			
Erosion	C	B	P
Decline in fertility	C	C	C
Contamination			
(2) Land			
Devastation	C	C	P
Occurrence of landslides		C	
Functional degradation in preventing damage by wind, sand or fire			P
Subsidence of ground			
6. Hydrology and Water Quality			
(1) Hydrology			
Changes in water level of water			P
Occurrence of droughts or floods			P
Decrease in flowing surface water			P
Sedimentation of earth and sand			P
Rise of riverbeds			P
(2) Water Quality			
Contamination		C	
Changes in water temperature			
7. Atmosphere			
Air Pollution			
Emission of CO2			
Microclimatic changes			P
Occurrence of noise			

3-3 Main Plans for Sustainable Resource Management in Environmental Consideration

The plan for sustainable multiple-use and resources management to be prepared based on the results of the survey is a proposal of concrete measures for sustainable resource use without causing environmental disruption in the Nkhotakota areas.

Therefore, the study team is preparing the following plans: direct protection measures such as wildlife protection and watershed management in the study area; the promotion of social forestry and improvement of inhabitants' living standard as the measures against the expected greater pressure on the Reserve by the inhabitants in the surrounding area; and consumptive and non-consumptive uses of the resources.

Of these measures and plans, consumptive and non-consumptive use of resources in the Reserve, and social forestry are activities which may affect the natural and social environments.

Of consumed resources, honey, mushrooms and thatch are reproducible and their collection will probably have few negative effects on the environment of the Reserve. However, in the case of medicinal plants (both herbs and trees), only certain species are collected. If they are recklessly collected, their population could rapidly decrease or totally disappear. Before giving permission, their collection should be fully examined.

As a means of non-consumptive use, the introduction of ecotourism is planned to impose less of a burden on nature. Since many tourists are not expected in this area, ecotourism should be friendly to nature without having to construct a new road for vehicles so that tourists will travel in the Reserve on foot rather than by vehicles. The construction or improvement of structures, including buildings, roads and bridges may affect landscapes and soil erosion. To match surrounding landscapes as far as possible, the arrangement, scale, shape and colour of each structure should be elaborated. To prevent soil erosion, the gradient of slopes should be gentile and grass and shrubs should be planted to cover the ground. These appropriate measures will help avoid the adverse effects of construction.

The social forestry would be adopted to give positive impacts on both natural and social environments. However, it is predictable that they may have some negative effects on the social environment of the areas involved. From this viewpoint, an implementation plan for social forestry should be developed to reflect the actual situation of the land ownership system and the intentions of local people.

IV. Backgrounds of the Master Plan for Sustainable Multiple-use and Resource Management

4-1 Structure of the Master Plan

The final goal of the master plan for sustainable multiple-use and resource management is to conserve the Reserve, and the plan comprises various methods and measures and common work for them. These items are interrelated as shown in Fig. 4-1. The four methods and measures as shown in the figure complement one another, being all equally placed without consideration for superiority. On the other hand, two items of common work are different in nature but common to these methods and measures in some respects.

Any of these measures and methods cannot be carried out without the cooperation of local people. Their cooperation is indispensable. As these measures and methods will bring benefits to local people, mutual cooperation should be established between the Reserve and local people.

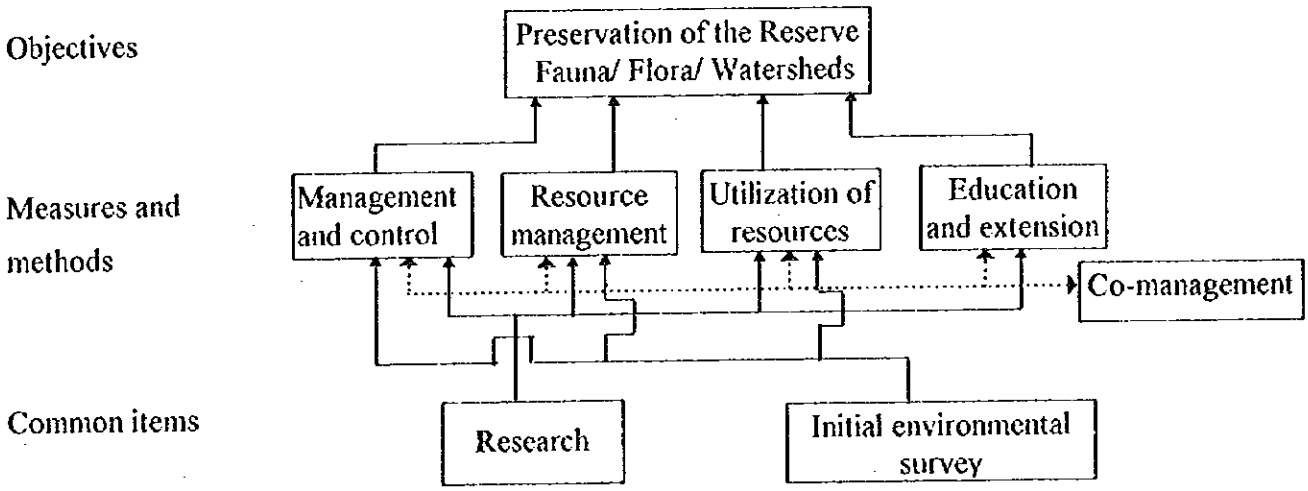

Fig. 4-1 The Structure of the Master Plan

1) Final Goal

The final goal of the master plan is to conserve the Reserve. Resources to be conserved include animals and plants. Major animals include such mammals as African elephants, zebras, warthogs, various species of antelopes, and African buffaloes. Plant resources mainly come from a large area of miombo forest and a small area of evergreen broad-leaved forest. Indigenous fish species in Lake Malawi outside the study area and African elephants in the Reserve represent the fauna of this area. Near the eastern edge of the large wet miombo forest land in Africa[1], the vegetation of this area is well conserved and highly valuable from a botanical and ecological point of view. The evergreen broad-leaved forest is a

[1] White P., 1983, "The Vegetation of Africa", Natural Resources Research XX" UNESCO.

small isolated stand near the summit of Mt. Chipata, consisting mainly of old trees such as *Chrysophyllum gorungosanum* and *Ficus natalensis*. This stand is also highly valuable from a botanical and ecological point of view.

In terms of river basin conservation, forests in the Reserve are well conserved, fully performing the function of water yield. Within the Reserve, the channels of the Dwangwa, Bua and Kaombe are stable. The purpose of watershed management is achieved by conserving forests in the Reserve.

2) Method/Measures

Methods or measures for conserving the above-mentioned resources include, (1) reserve management and operation (2) resource management in the Reserve, (3) resources use in and around the Reserve, and (4) education and extension activities to make local people aware of the necessity for conserving the Reserve. These methods or measures will serve the conservation of the Reserve as follows.

(1) Reserve Management and Operation

The zoning of the Reserve as a fundamental measure of reserve management should be maintained as it is except for some minor changes following the construction of new scout camps and other facilities.

The prevention of poaching and the protection of habitats are important measures for increasing the population of wild animals. The prevention of uncontrolled burning and tree cutting is indispensable for conserving the forest ecosystem. For this purpose, it is planned to improve the quality of scouts and increase scouts, and increase and improve scouts camps.

(2) Resource Management in the Reserve

Since the density of animals inhabit the Reserve is low, protecting animals from poachers is the most effective way of maintaining and increasing animal resources. To prevent poaching, patrolling must be reinforced by providing scouts with necessary equipment and enhancing their morale. At the same time, efforts should be made to obtain cooperation from people living in the vicinity of the Reserve. It is effective to give concessions for fishing to fishery clubs, which organized by residents living along the rivers and depending on fishery, on specific conditions to obtain cooperation from local people.

As for forest resources, it is necessary to protect the evergreen broad-leaved forest against fires and prevent the reckless burning in miombo forests. Moreover, the felling of forests must be prohibited. In this respect, the reinforcement of patrolling and the cooperation of local people are an effective way of preventing it.

(3) Resource Use in and around the Reserve

The use of resources may be divided into inside or outside the Reserve, and consumption or non-consumption use. The consumption of resources within the Reserve is unfavorable for strict protection. Nevertheless, there are many people who cannot make a living if they

cannot use resources in the Reserve. Rather, permission for the sustainable use of them could make it easier to obtain active cooperation from local people for conserving the Reserve. Moreover, if efforts are made to improve the living standards of local people through the use of the existing various resources, the pressure on the Reserve could be reduced.

Of resources in the Reserve, for example, dead trees, medicinal plants, mushrooms, thatch, and honey can be collected for self-consumption. However, this type of use should be permitted not unlimitedly but to such an extent as not to disturb the ecosystem of the Reserve. If the situation of local communities is taken into consideration, hunting by local people and safari hunting by tourists are not feasible. The use of fishes is planned to be permitted in the context of protection. However, meat will become available from vertebrate pest control.

On the other hand, non-consumptive resource use includes ecotourism, camping and other recreational activities. Although tourism can be linked with resources outside the Reserve, securing tourist resources first is a problem.

The use of resources outside the Reserve is intended to improve the living standards of local people. Typical projects are to establish fuelwood provision system to compensate a shortage of household fuelwood and to take measures for raising the incomes of smallholders. Moreover, what should be considered for local people's living standards is to improve social infrastructure, including schools, clinics and roads essential for social life.

(4) Education and Extension

As previously stated, the Reserve should be conserved in cooperation with local communities. For this purpose, the necessity for conserving the Reserve must be fully explained to local people through education and extension activities. Visitors to the Reserve also need to be educated and enlightened in this respect.

3) Common Work

Various types of research conducted in the Reserve can provide a basis and material for many items discussed in Paragraph 2). Initial environmental survey is designed to identify the effects of the implementation of these items on the natural and social environments. These two activities can be said to be common work.

4-2 Considerations in Implementing the Plan

1. Administrative Responses

This master plan for sustainable multiple-use and resource management is not limited to planning the management of the Reserve but also concerns a wide range of measures, including the use of resources around the Reserve, the improvement of social infrastructure,

and the improvement of the living standards of local people. Accordingly, all plans and programs in the master plan cannot be completely carried out by the DNPW alone. The implementation of these plans and programs will require much funds, technology, manpower and know-how. They constitute a comprehensive plan which needs the active cooperation of many administrative agencies. In this sense, the master plan is characterized by regional development with the focus on the Reserve. Moreover, the plan is designed to take various measures for local people living in the vicinity of the Reserve and request them to cooperate in the sustainable resource management of the Reserve on the other hand. It is desirable that the DNPW needs to recognize this point and strive to obtain cooperation from both other relevant agencies and local people.

The participation in the master plan which will be requested to DNPW and other relevant agencies are follows:

(i) The DNPW has the jurisdiction over reserve management, resource management and use in the Reserve, as well as research, education and extension concerning the Reserve. The DNPW needs to positively carry out relevant plans and programmes, keep contact with relevant agencies for cooperation in carrying out other plans and grasp the progress of their implementation through monitoring. To establish a close link with relevant agencies, the DNPW should set up a committee for implementation and liaison in order to carry out plans.

(ii) It is planned to give a concession for fishing to club organized by local people in order to protect river fish resources in the Reserve. The implementation of this plan will require the total support of the Department of Fisheries. Their cooperation is also needed for supplying suitable species for fish breeding.

(iii) The implementation of social forestry will require the total cooperation of the Department of Forestry. Moreover, the DNPW needs to supply household fuelwood, expected to fall short of demand, from dead trees in the Reserve. Taking it in consideration that successful social forestry is essential for conserving forest resources in the Reserve, the DNPW needs to have a close link with the Department of Forestry. It will take a long time to succeed in social forestry, which also requires the active participation of women and grass-roots extension activities.

(iv) Measures to improve the living standard of local residents living around the Reserve should be carried out with the cooperation of the Ministry of Agriculture and Livestock Development. In addition, grass-roots extension activities are also needed for their implementation.

(v) For other plans, especially one to improve social infrastructure, cooperation should be given by the Ministries of Works, Education, and Health and Welfare.

(vi) Relevant District Commissioners and chiefs of traditional/sub-traditional authorities are requested to recognize that the master plan is not singly intended for the Reserve, and to actively cooperate with the people concerned and lead local people in this direction.

2. Technical Responses

Although the implementation of this master plan does not require any novel

technology, local people will be asked to perform new and unaccustomed technical work. In this respect, it is recommended to receive guidance from experts for the following points.

1) Reserve Management and Operation and Resources

To implement the master plan, techniques for operating the Reserve along with management are necessary. The management and operation of the Reserve and the management of resources must be responsive especially to increases in the number of visitors. Therefore, the people concerned should receive technical guidance from experts in this area. In addition, it is preferable that they will also receive general guidance in other areas, including the construction and use of various facilities and equipment, and education and extension.

It should be also noted that the survey and protection of animal and plant resources, especially invaluable species will require the guidance of zoological and botanical experts. Moreover, the technical support of the Department of Fisheries is needed for control over river fish resources in the Reserve.

2) Promoting Social Forestry

Social forestry involves the forestation, the upgrade of customary forest resources, the improvement of the furnace, and the extension of an improved one. Trees can be planted in the gardens and dry farm fields of farmers. The furnace is a daily necessity for individual farms. Accordingly, technical guidance should be individually given to them. Guidance in nursing and planting, which may substantially determine the result of forestation, should to be practically and specifically given. Therefore, it is necessary to establish a system whereby farmers can closely receive technical guidance from experienced experts.

3) Improving the Living Standard of Smallholders

Technical guidance is also needed for each of the proposed measures to improve the living standard of smallholders, such as conservation of soil fertility, small animal farming, irrigated agriculture, fish breeding, beekeeping, and fruit cultivation.

4) Measures to Promote People's Participation

Any plan in which local people participate should be carried out in the order of necessary steps. When a wide range of people are requested to participate in a project, it is necessary that many people will agree to the project and a long enough period of time will be set for publicity and explanation. To make the project thoroughly known to local people, the people concerned should listen to them to grasp what they really intend, promote people's participation at the project planning stage, and use NGOs in developing grass-roots activities.

There are various types of projects in which local people take part. Guidance to them is specifically given in different areas, but overlapped in some areas. In this point, instructors and experts must have close communications with one another for effective guidance.

5) Use of Private Capital

In terms of tourism, the use of private capital needs to be considered for advertising the Reserve and utilising tourist resources.

4-3 Reserve Management and Operation and Resource Management

4-3-1 Significance of Reserve Conservation

1. World Trends in Nature Conservation and Malawi's Responses

At the present time, one of the important trends in the world is global environmental problems. Environmental problems must be considered and coped with from a global perspective beyond individual countries. Countries all over the world, whether advanced or developing, commit themselves to or sign various treaties and conventions concerning the conservation of the global environment, in order to promote international cooperation and collaboration. For example, the Washington Convention, the Ramsar Convention, the Convention concerning the Protection of the World Cultural and Natural Heritage, and the Convention on Biological Diversity were signed by many countries in their efforts for nature conservation. Of these, the Convention on Biological Diversity is particularly important. This convention was signed by 157 countries at the UN Conference on Environment and Development, generally known as the Earth Summit in Rio de Janeiro, in May 1992 and came into effect in December 1993.

In this convention, biological diversity is defined as "diversity at the three levels of intraspecies (genetic level), species and ecosystem," and a fundamental requirement for conserving biological diversity is defined as "conservation of ecosystems and habitats and maintenance of wild population." The objectives of the convention are to (a)conserve biological diversity, (b)use components of diversity in a sustainable way, and (c)distribute benefits of genetic resources in a fair and equal way[1].

The convention was originally designed in consideration for the significance of objective (a). In the course of discussion about the contents of the convention, objectives (b) and (c) were also stressed by developing countries. It was fundamentally agreed that both advanced and developing countries should enjoy the benefits of nature stemming from biological diversity.

The fundamental principle of biological diversity is that "diverse wildlife coexists in interrelationships and supports the circulation and stabilization of ecosystems and mankind." Although some things in the biological world are useful or useless for human beings, nothing is useless as a member of the whole biological world. Nothing should be annihilated by human beings for human interests. There is such a possibility that many undiscovered things may be very useful for mankind. Tropical rain forests are one of the symbols of biological diversity.

The Government of Malawi has paid attention to the diversity of wildlife across the

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[1] Moriyasu J., "Significance of National Strategies for Biologicl Diversity" Minutes of Natural Conservation and Improvement Forum, NCF Report No.6, May, 1996.

country since long ago, and therefore earnestly promoted its protective policies in response to such world trends. The country deserves respect and high appreciation in that it has conserved natural areas occupying 12% of the national land in the form of national parks and reserves.

2. Significance of Reserve Conservation

The Nkhotakota Wildlife Reserve is the oldest of the existing reserves, and was designated for animal protection in 1938. After the second half of the 1800s, excellent landscapes and a variety of biota in Malawi were designated for protection, or their designations were withdrawn or reorganized. Although they have gone through historical changes in this way, it seems that the policies of Malawi are based on the belief that their diverse fauna and flora are significant assets with environmental, scientific and educational values to mankind and the Malawian people. On such a principle, the Government of Malawi enacted the National Parks and Wildlife Act in 1992 unifying the four conventional laws, including the Natinal Parks Act and the Aniamal Protection Act. The objectives of the Act are:

(1) The conservation of selected examples of wildlife communities in Malawi;

(2) The protection of rare, endangered and endemic species of wild plants and animals;

(3) The conservation of wildlife throughout Malawi so that the abundance and diversity of their species are maintained at optimum levels commensurate with other forms of land use, in order to support sustainable utilisation of wildlife for the benefit of the people of Malawi;

Whereas objectives (1) and (2) are intended for invaluable organisms and their habitats, objective (3) is intended for diverse wildlife, namely all animals and plants and their sustainable use and therefore consistent with the very purpose of the Convention on Biological Diversity.

The Reserve is highly valuable in that a large area of wet miombo forest has remained in the far east of Southern Africa. It is not that a specially precious animal or plants exists there. Despite being commonplace, the existence of relatively diverse animals and plants is significant in itself. Unless such a variety of natural things are damaged, the sustainable use of them is possible and can directly benefit people in a sustainable way.

In contrast with many other reserves located near northern, southern and western boundaries of Malawi, the location of the Nkhotakota Wildlife Reserve is geographically favorable, being at the centre of Malawi. It has a high possibility of being used by the Malawian people for outdoor education and recreation as well as foreign tourists.

In addition, the Reserve also brings direct and indirect benefits to local people, including water yield, watershed conservation, disaster prevention, air purification, climatic mitigation, and scenic beauty.

4-3-2 Current Reserve Management

At first glance, it seems that the management system of the Reserve has been established to some extent and effectively operated. Nature appears to be well protected in

the Reserve. However, going into the Reserve to look at it close up, condition will not be necessarily good.

In fact, local people illegally catch animals, collect plants, cut trees or burn grass. The Reserve is exposed to a risk of invasion of farm land because the boundary is not well maintained or enforced. The density of animals is lower than expected, judging from the condition of the Reserve. There is such an apprehension that some animal species will disappear from the Reserve unless some action is taken.

In such a severe environment, the Reserve has been somehow maintained in the present condition by the efforts of scouts' acting as the field staff of management. Although scouts had senses of justice and mission, their morale has recently lowered because they desperately make a living to support their own families.

4-3-3 Wildlife Conservation

The distribution of wild animals in Malawi is limited to national parks and wildlife reserves, which have a major role in maintaining the fauna of Malawi in the long perspective. Therefore, it is predictable that many of animal species in Malawi will be annihilated before their use unless the fauna of national parks and wildlife reserves are protected. The protection of these fauna means the conservation of the natural environment represented by wild animals.

These animals are not many but effective in attracting many tourists. The Reserve does not have as many visitors as other national parks due to less accessibility and lack of visitors facilities.

To protect the fauna of the Reserve, efforts should be made to increase the number of animals while preventing their decrease as part of conservation of animal resources in the Reserve. However, the current management system is not sufficient compared with those of other national parks and should be reinforced. Current problems in the management of the Reserve are poaching and damage by animals to crops in most cases, which concern local communities. In this sense, local communities cannot be ignored in order to attain the goal of reserve management, and their active cooperation should be gained.

It is appreciated that the present natural environment has been maintained in spite of poaching and the pressure for converting forest into farmland following the increase of population in the vicinity of the Reserve. In the future, reinforcing measures against poaching through the unification of local people is a way of protecting the fauna of the Reserve and the quickest way to animal consumption in the near future.

4-3-4 Forest Conservation

1. Conserving Habitats

1) Relationships between Forests and Wild Animals

Wild animals in Africa mainly inhabit savannas covered with grass. The climate of Malawi also falls under the savanna zone in a broad sense.

In such areas, the existence of forests is no absolute condition for a habitat

despite providing a place for wild animals to take rest in the shade or drink water.

According to Haltenorth T. and Diller H., major herbivorous animals in savannas are classified as follows[1] :

i) Grazers: Buffaloes, sables, waterbucks, reedbucks and zebras

ii) Browsers: Bushbucks, kudus and grysboks

iii) Mixed feeders: Elephants, elands, bushpigs and warthogs.

However, the Reserve is a forest area clearly featuring the life-type formation of deciduous broad-leaved trees (miombo forests) and Gramineae species and belongs to an incomparable special type of habitat for a savanna.

Although research into wild animals in savannas has so far often been conducted and many measures for them have been conventionally taken, the protection and management of forest habitats like the Reserve have been left behind in conducting research and establishing specific protective measures. In this respect, the relationships between forests and wild animals in the Reserve are extremely important in view of not only animal habitats but also forest ecology.

2) Relationships between Forests and Herbal Species

In savannas, the absolute amount of grass as fodder is a critical factor. Particularly, in forest habitats like the Reserve, the relation between the distribution of grass and that distribution of forests may have some effect on increases in the number of species and the population of wild animals.

In this study, too, relationships between forests and herbal species were surveyed from such a point of view. The results of the survey are as follows:

i) Whereas the number of herbal species grazed on by animals is five on average in forest areas, it is three in grasslands. Thus, the number of utilised species is more in forest areas.

ii) Whereas the ratio of grazed grass to ungrazed grass is 4 to 1 in forest areas, it is 3 to 1 in grasslands. Thus, animals graze on a higher percentage of grass in forest areas.

iii) The absolute amount of grass grazed by animals is 1 for grasslands and 1.5 for forest areas. Thus, animals graze more grass in forest areas.

These results show that there are a large amount of various herbs as fodder in the life-type formation of deciduous broad-leaved trees (miombo forests) and Gramineae species compared with the case of grasslands. In relation to this

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[1] Haltenorth T. and Diller H , "A Field guide to the mammals of Africa including Madagascar" 1980

point, the significance of forests in the Reserve was recognized again.

2. Protecting Precious (Rare) Plants and Vegetation

The Reserve is a unique natural environmment in which forests, herbs and wild animals are unified. Accordingly, protecting forests can play a major role in conserving not only vegetation but also wild animals.

The characteristic features of the vegetation of the Reserve are as follows:

1) Evergreen Broad-leaved Forest

There is a very rare mountain evergreen broad-leaved forest occupying an area of 54 ha around the summit of Mt. Chipata, which is said to account for less than 1 % of all vegetation of Malawi[1].

The upper story of the crown consists of *Chrysophyllum gorungosanum* and *Ficus natalensis*, and the mid story consists of *Craibia brevicaudata*, *Teclea nobilis*, and *Bersama abyssinica*. As a shrub, *Macrorungia pubineria* is common. *Rauvolfia caffra* and *Schrebera capensis* appear at the edge of forest stand. This stand includes *Chamaeta cristata*, *Albizia adianthifolia*, and *Bequaertiodendron magalismontanum*, all of which have brent roots featuring evergreen broad-leaved forests, and large standing trees of *Ficus natalensis*. Moss forests with *Usneaceae* as an epiphyte exist at a slightly lower altitude. *Anthospermum sp.*, *Sissotis sp.*, *Heteromorpha trifoliata*, *Tecomaria capensis*, and *Euphorbia sp.* appear at the summit.

2) Semi-evergreen Broad-leaved Forests

This is a small vegetation area distributed on the east side of the evergreen broad-leaved forest. The ratio of evergreen species to deciduous ones is 2 to 1 (about 5 to 2 in the number of trees). The forest consists of two layers: the tree layer comprises a variety of species, such as *Albizia adianthifolia*, *Syzygium cordatum*, and *Rauvolfia caffra*, while the shrub layer is almost occupied by *Dracaena laxissima*. This vegetaion area is relatively wet by the influence of springs coming from the foot of mountain, and moss is seen on the floor due to the closed canopy.

3) Miombo Forest

Miombo forests exist on a large scale in the Reserve. Among other areas, this area is a precious community typical of Malawi[2]. Main species include *Julbernardia globiflora*, *J. paniculata*, *Brachystegia boehmii*, *B. spiciformis*, *B. manga*, and *Uapaca kirkiana*. Besides these, *Pterocarpus angolensis*, *Bauhinia thomingii*, *Ochna schweinfurthiana*, *Protea angolensis*, *P. welwitschii*, *Faurea speciosa*, *Combretum spp.*, and *Terminalia sericea* are sporadically seen. *Brachystegia longifolia* and *Uapaca nitida* also appear.

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[1] Wildlife Society of Malawi, 1989, An Introduction of the Common Trees of Malawi

[2] Ditto

4) Other Forest

Such evergreen species as *Breonadia microcephala*, *Syzygium guineense*, *Bersama abyssinica*, and *Raphia farinifera* not found in miomobo forests are seen on the Bua, Dwangwa and Kaombe Rivers and their tributaries. A special community of *Terminalia spp.* and *Combretum spp.* is seen. Judging from such a variety of species, these forests constitute a very precious vegetation of the Reserve.

4-4 Use of Tourism Resources in the Reserve

4-4-1 Current Use in the Reserve

Most visitors to the Nkhotakota Wildlife Reserve are concentrated on the Bua and Chipata Visitors' Camps and their vicinities where facilities are now available.

The access route to the Bua Visitors' Camp is the national road M5 (paved) 10 km north of Nkhotakota, from which the unpaved westerly road leads to the Reserve within about 11 km. The unpaved road is maintained and administered by local people and the DNPW and is passable to even sedans in the dry season but only to four-wheel-drive vehicles in the rainy season. The camp is near the Bua River, 4 km from the entrance to the Reserve.

On the other hand, the access route to the Chipata Visitors' Camp is the unpaved road S54 branching from the national road M10 (unpaved) at Mbobo, from which the gateway to the camp is about 4 km toward Kasungu. The location of the Chipata Visitors' Camp is 5 km northerly from the gateway. This road (unpaved) is maintained and administered by the DNPW and is passable to even sedans in the dry season but only to four-wheel-drive vehicles in the rainy season.

The purposes of visitors are sportfishing, game viewing (including crocodiles), bird watching, outdoor education and so on. The Chipata Camp is also visited by people for camping, climbing Mt. Chipata, game viewing, bird watching and outdoor education. Judging from the current use of these camps, it is not too much to say that every visitor to the Reserve is interested in ecotourism and outdoor education. Most ecotourists are foreigners. The ratio of residents to tourists is 1 to 0.6. On the other hand, the majority of participants in outdoor education are Malawian, including secondary school students and some wildlife clubs.

4-4-2 Possibility of Introducing Ecotourism

National parks and wildlife reserves in Malawi are probably less attractive to tourists from advanced countries in that the density of animal habitat is low compared with those of many other Eastern and Southern African countries, and the majority of these tourists wish to watch wild animals. However, it should not be ignored that Malawi has nature not less excellent than its neighboring countries. The terrain of Malawi ranges from lowlands around 150 m above the sea to as high mountains as more than 3,000 m. In addition, lakes, forests and highlands feature diverse nature.

It is said that there are five major spectacular scenery of Malawi[1] : i.e., (1) lakes and swamps represented by Lake Malawi, (2) wetlands such as the Elephant Marsh through which the Shire River flows, (3) fold mountains on the African Great Rift Valley such as the Nkhotakota Wildlife Reserve, (4) African Central Hights such as the Kasungu National Park, and (5) mountains and hights such as the Nyika National Park and Mt. Muranje. Many of these spectacular sights are protected with much care in the form of national parks and wildlife reserves.

In addition to abundant nature, friendly people feature Malawi. Although Malawi comprises multiple tribes, the people are gentle and peace loving. They are kind and friendly to others. This gives a double good impression to visitors.

There are not a few nature-oriented people who wish to touch real nature free from human influence and different from commonplace tourism or who wish to experience a natural life separate from modern civilization. This trend is expected to spread further. It seems to be a fair wind for efforts to invite people to Malawi in the future.

Malawi does not need to invite tourists in the same way as its neighbors. Instead, it would be wiser for Malawi to consider different measures from theirs.

Although the density of animal is low, the Reserve can be highly evaluated in that nature ubiquitous in the southeastern part of Africa still remains in a large area. This area is attractive to the above-mentioned nature-oriented people or ecotourists, having suitable conditions for introducing ecotourism, such as walking, viewing, camping and sportfishing.

The access to the Reserve is as mentioned early. In addition, the road from Kasungu to Nkhotakota has been gradually improved from the side of Kasungu. When the work is completed, the accessibility of the Reserve will be remarkably improved. It will be possible to build a network of roads from Lilongwe to the Kasungu National Park, the Nkhotakota Wildlife Reserve, Lake Malawi (Nkhotakota and Salima) and Lilongwe.

Accordingly, the Reserve has good conditions and enough potentialities for ecotourism.

4-4-3 Significance of Introducing Ecotourism

1. Educational and Enlightening Effects on Local People

That is why the Reserve must be continuously protected and conserved in the future. Moreover, it is essential that Malawian people, especially local people will understand the significance of the Reserve in an effort for conserving it. To encourage local people to understand the significance, it is a realistic way that the government will change its policy from complete devotion to protection to partial permission for using resources to such an extent as not to damage nature. This will encourage local people to participate in protective activities and use in parallel with the extension of thought for protection and the enlightenment of local people.

The introduction of ecotourism is one of the ways of using resources based on the protection of nature. It should aim to provide local students as well as ecotourists with an opportunity for environmental education. This effect will probably extend to local people.

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[1] DNPW Tourism Master Plan for National Parks and Reserve in Malawi

The visit of ecotourists from distant places will induce local people to recognise the value of the Reserve.

2. Economic Contribution to Local Communities

As discussed later, the introduction of ecotourism will require a certain workforce, including workers for facilities, and guides and porters for hikers. Therefore, some people must be locally employed, and local communities will be given employment opportunities.

In addition, farm crops as foodstuffs will be demanded by the users of visitors' camps, and wood-carved goods and other handicrafts and honey will be also demanded by tourists as souvenirs.

Moreover, some visitors probably wish to stay in villages near the Reserve for one or two nights after a sight-seeing excursion of the Reserve. They will be more pleased to stay at a traditional house and have a traditional meal. In addition, they will enjoy listening to traditional folk music and songs and seeing villagers dancing. They will probably be satisfied with such entertainment even at a somewhat high cost.

When roads are improved for ecotourism, they will be also convenient for local people.

3. Contribution to Nation

First of all, the introduction of ecotourism will contribute to the national finance by substantially increasing revenue from tourists, including entrance fees and rental fees for facilities.

Second, the Reserve will be used by not only ecotourists but also Malawian studens as a site for outdoor education. In this respect, ecotourism will contribute to the culture of intelligence and aesthetic sentiments of students who will build the future of Malawi and have a very great educational effect on local people for nature conservation.

Third, the introduction of ecotourism will effectively prevent poaching and other illegal acts. This can be done by scouts accompanying tourists to serve as guides. Ecotourists themselves are supposed to deeply understand nature and take a severe attitude toward illegal acts.

4-5 Watershed Management Plan

1. In the Reserve

Large rivers which flow from outside to inside the Reserve and into Lake Malawi are the Dwangwa, Bua and Kaombe in the order of northerly location. The basins of these rivers are extremely large and need to be managed under an integrated system.

These three rivers have their respective networks of tributaries in the Reserve, the basins of which are stable and have no large landslide, providing wild animals with drinking water and fishes with a spawning ground. They also function as sources of water for agricultural areas on the way to Lake Malawi and control the water flow. Among other rivers, these three have great functions and provide drinking pools for wild animals in fast

streams called rapids. Therefore, efforts should be made to protect them to enhance the positive effect of riverside vegetation on the fixation of their riverbeds and banks. As the water flow intensely fluctuates between the rainy and dry seasons, the water yield of forests must be improved in the headwaters in order to prevent drinking water for wild animals from drying up in the dry season. As for mountain and riverside forests, their function of conserving water sources can be maintained only by conserving them in good condition with a special care taken to prevent forest fires. No other measure is specially needed for them.

2. Outside the Reserve

The basins of the three major rivers, extending above the Reserve, are mostly cultivated. Therefore, the conservation of farmland up the streams is an important measure in the management of these river basins.

They are individually outlined in the following.

(1) The Dwangwa River

The lower reaches of the Dwanga River are a large swamp used for large-scale production of sugar canes. Water is taken for irrigation from a gate constructed about 10 km from the mouth of the river in the dry season. In terms of utilising water resources, the river is effectively used and raises no problem. However, the gate completely blocks the flow of the river in the dry season, during which lake salmons and other fishes cannot easily return to Lake Malawi. In this respect, some measure should be taken to conserve fish resources.

(2) The Bua River

The Bua River below the bridge crossing the national road M5 and adjacent to the Reserve has formed a large alluvial plain. A delta has developed down the river. A first terrace as a natural embankment 80 to 100 m wide extends on one side of the river in this area, and a second terrace extends behind it. People live and cultivate land inside the second terrace.

Water will flow over the first terrace in the rainy season, however, flood will be prevented from reaching inside the second terrace where the residential area and farmland exist. Even inside the first terrace, farmers cultivate crops in the dry season.

Thus, the lower reaches of the Bua River have already been well managed by using natural power, and any artificial structure does not need to be newly constructed.

(3) The Kaombe River

In the rainy season, this river creates the greatest problem of the three.

Just after the river leaves the Reserve, a large wetland extends and the lakes of Chilingali and Chikukutu exist as a result of daming up the river. Farmers produce crops on the plateau around the wetland. There is little damage to

crops in the rainy season but some damage in some years.

Whereas a hill is formed on the right bank of the river near the mouth, a large flood plain extends on the left bank and is totally covered with reeds. In the rainy season, the reed-covered plain will be entirely submerged and provide an important habitat for hippopotami and waterfowls. The plain should be conserved as it is.

As far as these three rivers are concerned, it is proper to promote current agricultural activities using nature rather than to manage the basins by constructing artificial structures.

(4) Other Rivers

Besides the above-mentioned rivers, there are small rivers flowing from inside the Reserve into Lake Malawi. These rivers have no adverse effect on inhabitants or agricultural production even in the rainy season. There is no need for special management of their basins.

4-6 Improvement of Social Infrastructure around the Reserve

To improve the living standards of local people around the Reserve, the undeveloped social infrastructure is considered to be improved first. This undeveloped infrastructure is the serious restriction factor not only for the living standards but for agricultural aspects.

1) Current Social Environment

The social infrastructure in the vicinity of the Reserve is poor and substantially deficient compared with that of urban areas. Currently, the local people can not enjoy a good living environment. Therefore, they experience difficulties in everyday life, and industry and agricultural activities are limited.

However, improvement of their social infrastructure is inhibited by the natural environment around the Reserve that consists of complicated hills and steep mountains. It is also an unfavorable condition that farms are not gather collectively in a certain area but are typically scattered here and there, with at most only a few farms adjacent.

The infrastructure is deficient in all respects but especially with the roads, water supply, medical care and schools, which are closely related to their lives. These need urgent improvement so that the people can live normal and safe lives.

(1) Roads

There are two paved roads traversing Malawi, one in the north-south direction on the east and west sides of the Reserve, and the other an unpaved national road (M10) traversing the Reserve in the east-west direction. These are the mains roads in the vicinity of the Reserve. In addition, there are also roads leading to different districts and villages, which however, are unpaved and incomplete.

Many roads become impassable during the rainy season and currently obstruct people's daily life and agricultural activities. They do not appear to be properly maintained.

(2) Water

Water is essential for everyday life. The water referred to here is not water resources for industry and agriculture but water just for life.

Except in urban areas, there are few water facilities in the local communities. Accordingly, in most cases people use water from rivers and wells. There are several pumping wells 20 to 30 meters deep in villages, which, however, are used only by some villagers despite being available throughout the year. This is because farms are scattered in a wide range instead of gathering in one area.

Most people dig a hole 2 or 3 meters deep in the nearby dambo and use the water that gathers at the bottom. The quality of water is very bad. There are many old holes left in the dambo near the farms.

In the vicinity of the Reserve, where the dry season is long, rivers and wells dry up in a few months after the end of the rainy season. It is hard to secure drinking water during the dry season. In Malawi, securing water is customarily "the task of women". Women have to carry heavy water filled containers a long distance everyday, and this heavy labour for the women.

(3) Medical Care

In the vicinity of the Reserve, it is a reality that in every district only one facility literally called a hospital for hospitalization exists or not at all. There are only some clinics or small medical offices at the administrative level lower than district. Physicians or nurses seldom reside in the rural areas, to which the physicians go to at fixed dates and times for medical examinations and treatments.

Villagers usually purchase drugs at a grocery store, where only simple drugs are available. On the other hand, most of them have used natural medicinal plants since the early days. They know well which plants are effective against simple diseases and usually use them.

Gradual improvement is now seen with infants under 5 years old under a regular medical examination system. In Malawi, where the mortality rate of infants is high, the government strives to replenish this system in an effort to reduce their deaths. However, such a system is not available for adults.

Living in nature they are exposed to various diseases, which claim many lives in the absence of neighborhood medical facilities which provide medicine .

As shown by the social survey of the local people, more than half suffer chronic headaches, and most of them suffer from some types of disease.

The chronic headaches are an aftereffect of malaria in many of the cases. However, they take it as act of nature because they live with nature. As they cannot consume nutritionally balanced food, all the villagers are faced with a problem of chronic malnutrition. The mortality rate of infants due to malnutrition is high.

Thus, the local people have only poor knowledge as to diseases and nutrition, and yet the health agency has made no progress in enlightening them.

(4) Schools

At the present time, in every village or every two villages one school exists.

As the area of one village is very large, the distance between the houses and the school is very far. That is why a considerable number of children cannot go to school. According to the results of the social survey, families which have school-age children who do not attend school account for about 47% (Refer to Appendix 17, Table 15) The reason given by half was that the school is "too distant" from their houses. It may be stated that the distance is a barrier to attendance.

On the other hand, parents who do not have their children go to school because they have "no interest in education" or suffer from "poverty" hold almost the same share as those who replied "too distant". The attitudes of parents toward school also create problems.

Children who dropped out before the fifth grade are more than those who graduated from primary school. According to a nationwide survey on poverty in 1987, illiterate adults account for 60%, and illiterate women account for 71%. A policy for reducing illiteracy is urgently needed[1].

2) Problems and Countermeasures

As previously stated, people in the vicinity of the Reserve live in a poor social environment. There is a vicious circle such that their poverty deprives them of surplus (means) for improving the social environment and forces them to endure the status quo. To break the vicious circle, people must become aware of the current status as their own problem and make efforts to improve their living conditions by themselves. Accordingly, it is necessary to consider measures for improving their living conditions and social environment by means of their participation.

People have conventionally depended on others, thinking that what they lack will be given by the administrative agencies. In the future, however, they should not depend on the administrative agencies for everything they want or wish to be improved, but do it by themselves and positively think: "What shall we do about this problem?", "Is there anything we can do by ourselves?", or "We shall do

[1] Government of Malawi, 1995, Policy Framework for Poverty Alleviation Programme

what we can by ourselves." A mental reform of the people is necessary and important toward "solution by participation".

(1) Roads

[National Road]

The construction and maintenance of roads are the most important infrastructure not only for smooth industrial and agricultural activities but also for normal daily life.

In view of industry, apart from two national roads traversing Malawi in the north-south direction, only "M10" traversing the Reserve through east and west sides of the Reserve, between Nkhotakota and Kasungu can be called an industrial road. This road is unpaved, broken by large vehicles in many spots and tends to be impassable during the rainy season. From the perspective of development of industry and local society, this road is very important for the flow of goods and must be repaired, maintained and improved at all times for smooth transportation. The proper maintenance of this road will facilitate the smooth flow of goods and contribute to the development of industry and agriculture.

Crops produced by farmers living in Kasungu and Ntchisi, in the vicinity of the Reserve, are almost always transported to markets and towns via "M10". Therefore, "M10" needs to be well maintained in order to smoothly transport these crops. Since a new paved section of "M10" is now under construction from Kasungu to the Reserve, no problem should occur in the future.

[Road Networks Other Than National Roads]

Most of the village roads leading to "M10" are in bad condition, far from what is needed for the smooth transportation of farm crops. Even unpaved roads need a regular maintenance system for smooth year-round transportation.

Like national roads, village roads are not sufficiently maintained. The insufficiency and impassability of roads substantially inhibit and disturb agricultural activities.

Even if the improvement and maintenance of national roads is the responsibility of the central and local governments, it is practical to establish a road maintenance system in cooperation with the administration in every village, because village roads are used by villagers throughout the year. As part of a system, something like "Committee for Village Road Maintenance" should be set up so that villagers will maintain and repair their roads on a regular basis. Only when they cannot maintain or repair the roads by themselves will they request an appropriate agency to do so.

(2) Water

In every village, drinking water, as a minimum necessity for life, is severely lacking in the dry season. Pumping wells, available throughout the year,

are inadequate in number and most of them are only a few meters deep.

At this moment, it is impossible for the authorities to install an adequate number of wells for all villagers to use.

In an area where a certain number of houses cluster but have no pumping well available, the village as a whole must request the authorities to install such a well. In any other area, a deeper well should be constructed so that villagers can share the water throughout the year. Advice on a specific style and construction of a well should be given by the local health or relevant agencies. The authorities should consider providing some assistance for such collaboration.

Sanitary condition of well water is the worst. In terms of safety before the use, river or well water is not examined by health inspectors. Also, it is not chemically treated for safe drinking. In most cases, water is used as it is with no care.

Apart from the quality of river water, wells are dug only 2 or 3 meters deep and not embanked to prevent contaminants from slipping into them. They are always muddy. It is extremely difficult to keep the quality of well water safe.

These shallow wells seem to provide a favorable condition for the propagation of disease-causing bacteria. It is not too much to say that they are a source of disease for the local people. The quality of water is especially worst for less-resistant infants.

To control water quality, the inside of wells should be reinforced with bricks and the outside should be protected from contamination. Moreover, water should be chemically treated to meet requirements for drinking. Individual farms should be encouraged to install "a simple filter" which will enable them to purify water. It is important for the health agency to give advice on safe water quality. As for water treatment chemicals, a continuous chemical supply system needs to be established in cooperation between villages and administrative agencies.

If water is secured throughout the year in this way, it will relieve people from the concern on long-distant water transportation during the dry season and also reduce the labour of women.

(3) Medical Care

A current major problem for the local people is the absence of a full-time physician in their village. Medicines are not easily available.

In its very nature, there are still many tsetse flies, malaria mosquitoes and poisonous snakes in the vicinity of the Reserve, and people are always exposed to these dangers. Serums and medicines to combat any bite are currently unavailable in the villages.

Clinics are being constructed at the village level, but are still inadequate in number for covering all villages. Physicians do not always reside in the villages, but just travel from village to village once a month. Accordingly,

serums and medicines are not always available. When people suffer from a serious illness or suddenly fall ill, they must go to a hospital. However, hospitals are too distant for villagers who have no means of transportation, so they often miss the opportunity.

As for medicines, only medicinal plants or simple drugs sold at a grocery store are available. In case of a simple disease or injury, people use medicinal plants which grow naturally in the neighborhood. However, these plants have not yet been scientifically analysed to prove their effects. Relevant agencies need to study and analyse the medicinal plants from a scientific point of view and distribute pamphlets describing their effects to the villagers.

As previously mentioned, the majority of villagers experience chronic headaches, which is suspected to be a symptom of malaria. Many people replied that they contract epidemics several times a year. They do not have much knowledge on diseases and cannot properly judge or treat any symptom. In this respect, pamphlets which describe measures to prevent and treat diseases should be prepared and distributed to the villagers.

As a provisional measure, until the construction of clinics in the neighborhood, it is practical for relevant agencies to establish a medical control system for those who live in remote areas from clinics. In such a system, "hygienists" will be selected to make sure medicines are always available, and administer them even though physicians are absent. To treat with any medicine, hygienists need to be systematically trained in expertise to comply with national laws. It is also important for the staff of medical institutions to regularly travel from village to village several times a year in order to supplement any provided medicine, check the health of villagers, and take necessary steps for any problem. This is a system currently operated in mountainous areas in Vietnam, where the hygienists are all women.

For villagers to go to hospitals, it is possible to regularly carry patients to hospitals by vehicle made available at all times in every village or area, or to regularly dispatch vehicles from hospitals to pick up patients in every area.

The authorities must make efforts to construct more clinics and medical offices so that the local people can live healthy lives. If clinics with full-time physicians are available, they will be able to immediately take proper steps, give advice and make medicines available at all times. People should eventually be able to live healthier lives. At clinics, women will be able to receive guidance and advice on diet, nutrition and health.

(4) Schools

The absolute number of schools is small in this area. Many families are remote from schools and children have no means of transportation. Many children who live in remote area do not usually go to school until they grow physically strong enough to attend school for the distance. The authorities should make efforts to dispatch school buses to convenient

points to pick up these children or consider the construction of branch schools for fourth graders or lower.

On the other hand, parents have the pre-modern conception of education that "education is needless for agriculture" or "we have no interest in education" or "we are poor". They need to be enlightened. It is impossible to construct schools for children to attend, unless parents change their present conception of education. In the course of enlightenment, such an approach may be developed that if there is an inadequate number of close schools, parents should request relevant agencies to construct new schools.

In fact, there are some villages where villagers collaborate and cooperate in constructing schools as exemplified by Ching'amba in the Ntchisi District. To curtail construction costs, villagers collaboratively make bricks for building material. For the future of their own children, villagers cannot only depend on the authorities, but must take action by themselves. This active attitude of parents toward solving problems is important.

On the part of the government, more efforts are desirable to be made to replenish teaching materials and distribute textbooks for each child, though the construction of schools is most essential. The number of teachers must be also increased.