Japan International Cooperation Agency (JICA)
His Majesty's Government of Nepal

THE DEVELOPMENT STUDY ON INTEGRATED WATERSHED MANAGEMENT IN THE WESTERN HILLS OF NEPAL

FINAL REPORT

VOLUME II PLAN

JANUARY, 1998

JAPAN FOREST TECHNICAL ASSOCIATION (JAFTA)
KOKUSAI KOGYO CO., LTD.

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SUMMARY

1. Objectives

(1) Implementation of a socioeconomic baseline survey in five Model Areas established in the Study Area.

(2) Formulation of the Integrated Watershed Management Plan (Master Plan) based on the findings of the socioeconomic baseline survey and natural conditions survey in each Model Area.

(3) Preparation of guidelines for the formulation of an integrated watershed management plan for the Study Area.

2. Current Conditions of Watersheds

In the western hills of Nepal, i.e. the Study Area, until now farmlands have been expanded and forests have been felled to secure the food supply for the increasing population and firewood to sustain the lives of local people, putting tremendous pressure on the natural resources. Under severe natural conditions in terms of the climate, topography, geology and soil, soil erosion is widespread in the Study Area and there are many sites with a high erosion hazard. In terms of the lives of local people, all land which appears to be suitable for cultivation has been developed as farmland to supply food despite the steepness.

Nevertheless, the limited constant supply of water for agricultural purposes means that sites which can be used as Khet land (irrigated paddy land) as desired by local people are limited. Accordingly, sloping land from the hillside to the summit is used as Bari land (rainfed terraced land) for the cultivation of wheat, maize, millet, etc. The resulting insufficient income forces local people to seek employment away from home and has led to insufficient land management and even the abandonment of farmland. In turn, this has caused erosion in numerous places during the monsoon and other periods of heavy rainfall.

3. Identification of Problems

The Study Area is characterised by a number of fundamental causes of the insufficient implementation of soil conservation measures, which are common in Nepal, including poor accessibility, population increase, insufficient external support, shortage of farmland, insufficient cash income, daily over-work and priority of daily needs. The Study has identified

three crucial issues of watershed degradation, i.e. "decline of land productivity" originating from soil loss due to erosion, "forest degradation" originating from the presumably excessive use of resources and "the occurrence of disasters" which affect those people living in hazardous areas.

4. Principles of Integrated Watershed Management Plan Formulation

Upto the present, watershed management has been conducted as a national policy and it is important for the administration to formulate and implement the relevant plans covering wide areas. However, the continuation of large-scale projects appears difficult from both the financial and organizational point of view. The lives of people living in hilly areas are dependent on forests and other natural resources. In other words, natural resources are closely related to the daily lives of local people. It is believed that the implementation of various projects which will directly improve local life with the participation of local people will reduce the pressure on forest use and achieve sustainable watershed management in an effective manner. In the formulation of the Plan, the following overall targets have been set to solve the three crucial problems and various programmes have accordingly been formulated.

(1) Preservation of land productivity

(2) Conservation and utilisation of forest resources

(3) Hazard mitigation and reduction of disasters

At the same time, local development programmes to meet the needs of local people have been formulated to facilitate the participation of local people.

5. Proposed Integrated Watershed Management Plan Contents

(1) Land Use Improvement Programmes

In order to successfully achieve the three targets, appropriate land use methods have been examined for existing forests, grassland and farmland from the viewpoint of conservation (hazard) and production (land suitability classification) to prepare land use improvement programme which incorporates the need of local people.

① Forests are classified into forests for soil and water conservation (forest improvement programme 1) and forests for timber production and income generation for local people (forest improvement programme 2) to achieve the conservation and utilisation of forest resources.

② Grassland which requires the highest care from conservation viewpoint is classified into grassland for conversion to forests depending on the degree of hazard (grassland improvement programme 3), grassland subject to silvopasture (grassland improvement programme 2) and grassland for improvement (grassland improvement programme 1).

③ Farmland is classified into Bari land subject to terrace improvement (farmland improvement programme 1), Bari land subject to agroforestry (farmland improvement programme 2) to preserve and improve the land productivity and to Khet land subject to maintenance for soil and water conservation (farmland improvement programme 3).

④ It is also planned to establish nurseries to produce the seedlings which are required for the implementation of various programmes.

(2) Erosion Control Programme

The erosion control programme has been prepared to reduce the occurrence of disasters by deciding control measures and methods for subject sites depending on the scale and type of erosion and objects to be protected.

① In regard to landslides, the rehabilitation and control of small landslides are planned using simple structural and bioengineering measures. As far as large landslides are concerned, their prevention and rehabilitation will require major engineering undertakings such as construction of large structures, treatment of ground water, etc. the implementation of which will require special skills and large investments. Therefore, emphasis is placed on simple mitigation measures, such as surface run-off control and monitoring, applicable by people at the community level to prevent further enlargement of these landslides.

② Planting, diversion channels and check dams, in which local people find it easy to participate, are combined to control gully erosion. The materials used in gully control work are those readily available in the locality and are easy to handle and maintain by people.

③ The use of simple structural and bioengineering methods such as creation of riparian belt is planned to control bank erosion.

(3) Living Environment Improvement Programme

For the implementation of the programmes described above to ensure watershed conservation as well as environmental conservation, it is necessary to obtain the understanding and cooperation of local people while solving their day-to-day problems. Based on this understanding, the following living environment improvement programme has been formulated.

① The planned components of infrastructure development consist of trail improvement and road improvement, incorporating the viewpoint of erosion control. The feasibility of new road construction, which is high on the list of local people's needs, is examined. In regard to drinking water supply, the proposals include improvement of areas around permanent springs and the necessity to establish a piped water supply system.

② Further proposals include the construction of suspension bridges, the introduction of rice polishing mills and the rehabilitation of irrigation facilities, all of which are related to improvement of the living environment for local people.

③ The programme refers to the necessity to install toilet facilities in connection with public health and hygiene and to the promotion of literacy education and the proper maintenance of schools in connection with education.

④ The programme also proposes the introduction of improved furnaces and biogas in connection with the conservation of forest resources.

(4) Income Generation Programme

People in the area are extremely interested in improving their income as well as improving their living environment. This programme hopes to achieve increased interest in and understanding of projects aimed at improving the lives of women and occupational castes and alleviation of the daily workload of women through its implementation.

① For local people, cash income through farming is familiar and, therefore, the introduction of cash crops is easy to understand and to adapt to. The programme proposes the introduction of wheat, vegetables and fruit trees. Important things are the provision of market information as well as communication and coordination with related organizations on planting methods. In addition, the raising of goats should increase the level of income. Together with carefully considered measures to prevent

the possible adverse impacts of goat raising on the land, it will be possible to achieve income generation and forest conservation.

② The prospect of introducing small-scale processing industries is not particularly good at present as there are few resources which can be exploited for such purposes except such traditional crafts as bamboo crafts. The current prospect of growing fruit and vegetables is also not bright. The future of these activities will depend on the demand trend in consumption areas, particularly Pokhara.

③ The emergence of abandoned farmland due to men working away from home presents a problem not only from the viewpoint of agricultural production but also from the viewpoint of soil conservation, making the introduction of measures designed to return the workforce to the Model Areas particularly important. In the immediate future, projects can provide employment opportunities for cash income. In the long-term, however, it is hoped that the development of local processing industries will provide local jobs.

(5) Extension and Education Programme

As extension and education activities are meant to clarify the incentives for self-reliant watershed and forest conservation activities by local people, they should not constitute the one-way conveyance of environmental conservation methods to local people. This programme is particularly important to improve the knowledge and technical levels of those persons (local people, NGO staff members and field officers, etc.) related to plan formulation and implementation. It is also important in terms of shifting the responsibility for plan implementation from government agencies to local people.

6. Implementation Method

(1) Implementation System

For the implementation of the Plan, it is expected that such related government organizations as the Department of Soil Conservation will cooperate with local people and other related persons to establish a project team.

(2) Plan Implementation Process

Under the Plan, each Model Area is regarded as constituting a watershed which is then used as the planning unit. Plan implementation by each administrative unit within the planning unit is desirable in view of the efficient organization of local people, execution of

the budget and maintenance in the post-plan period. For the Plan, a VDC is regarded as the plan implementation unit in view of the appropriation of the national budget, plan implementation priority decision, liaisoning within the VDC and the smooth progress of follow-up activities in the post-plan period, etc. and the actual subjects of plan implementation are "Wards".

(3) Plan Implementation Period

The length of the plan implementation period depends on the size of the actual plan, organization system in place and degree of self-reliance on the part of local people. When taking the necessary preparations for plan implementation, the empowerment of local people and the required maintenance in the post-plan period into consideration, it is assumed that two years and 3 - 5 years will be necessary for preparation and plan implementation respectively. Accordingly, the project period for one VDC should be approximately five years.

The idea is to use the actual results in those VDCs where the Plan is implemented as model cases as lessons to be learned for the implementation of subsequent plans with a view to gradually shifting the responsibility for plan formulation and implementation to local people to encourage their self reliance.

(4) Use of the Plan at Field Level

① At the DDC level, the Plan (Master Plan) should be used to select the subject VDCs based on various data and information.

② At the VDC level, the subject Wards should be selected based on the requirements of the Plan and the VDC planning profile (VPP).

③ At the Ward level, the Ward Planning Profile (WPP) should be used as basic data and information for the preparation of an implementation plan.

Here, a case study is made for the following five wards using their respective WPPs.

a. Kaski North Model Area	:	Arba Vijaya VDC	- Ward No. 2
b. Kaski East Model Area	:	Siddha VDC	- Ward No. 7
c. Kaski West Model Area	:	Pumdi Bhumdi VDC	- Ward No. 5
d. Parbat North Model Area	:	Katuwa Chaupari VDC	- Ward No. 9
e. Parbat South Model Area	:	Tribeni VDC	- Ward No. 7

7. Environmental Care

(1) Initial Environmental Survey

The Plan follows the Forestry Sector Assessment Guidelines in Nepal for environmental care and uses the similar JICA guidelines regarding the survey method and survey items. The survey in question involved a fact-finding survey and the establishment of environmental factors and used the scoping technique to judge the existence of any environmental impact.

(2) Issues to be Considered for Plan Implementation

There are many issues to be considered in connection with plan implementation, including the restriction of stock raising, minimum volume of civil engineering work, adequate run-off control method and coordination with local people.

8. Monitoring and Evaluation

As the present Plan is a master plan indicating overall targets and aiming at implementation with the participation of local people, it does not specify the subject area(s). Here, the necessary monitoring and evaluation items and methods in the post-plan period are described.

9. Plan Justification

Achievement of the following benefits and effects are anticipated through the implementation of the programmes to be formulated under the Plan.

(1) Conservation of forest resources

(2) Alleviation of disasters (erosion)

(3) Increase of food production

(4) Improvement of the living conditions of communities

(5) Income generation for local people

(6) Maintenance of drinking water sources

(7) Improvement of the knowledge, technical expertise and ability to solve problems on the part of local people

(8) Improvement of the management and technical abilities of DSCO staff members

(9) Improved continuity, cost reduction and efficiency of projects by means of their implementation with the participation of local people

(10) The Plan intends to achieve the empowerment of women and the socially weak, all of which are closely related to forests, in order to facilitate the participation of local people in projects. The subsequent improvement of the standard of living of local people will promote understanding of and interest in forest conservation and watershed conservation to ensure the continuity of projects designed to achieve conservation targets.

10. Recommendations

The recommendations following the formulation of the Plan are restricted to those of a general nature to avoid any concrete infringement with the policies adopted by the Department of Soil Conservation which is the C/P organization.

(1) The basic approach adopted by the Plan, i.e. watershed management with people's participation, has its own limitations when dealing with erosion control in the Study Area. In the case of such mass movement as a large landslide, national measures, including the evacuation and relocation, etc. of local people, must be introduced.

(2) Along with the Plan, supporting programmes are proposed to create a situation in which local people can positively participate in watershed management. The implementation of these programmes will require consolidation of the coordination system of related organizations and also of the supporting system.

(3) The formulation of a watershed management plan and the effective implementation of such a plan demand accurate understanding of the prevailing conditions. In this regard, the accumulation of data is necessary which in turn demands the establishment of an efficient data gathering system.

(4) It is desirable that further qualitative improvement of all related people be made for the effective implementation of the Plan. It is, therefore, necessary to educate as well as train all related staff in regard to their knowledge and technical expertise.

VOLUME II

PLAN

1. BASIC PRINCIPLES OF INTEGRATED WATERSHED MANAGEMENT PLAN

1. BASIC PRINCIPLES OF INTEGRATED WATERSHED MANAGEMENT PLAN

1-1 Necessity for Integrated Watershed Management Planning Under the Study

The expansion of farmland and felling in forests have been steadily taking place in the western hills of Nepal, i.e. the subject area of the Study, to secure food and firewood to support the increasing population. Because of the geological, soil, topographical and climatic conditions, soil erosion is occurring in many places. In addition, there are also many other places with a high level of erosion hazard. This situation necessitates the urgent implementation of an effective watershed management to prevent the further deterioration of the watershed environment and to rehabilitate it by means of land conservation and forest resources preservation activities.

Upto the present, watershed management has been conducted as a national policy and the planning and implementation of wide-ranging measures by the administration will be essential in the coming years to ensure appropriate watershed conservation. However, it appears difficult for the Government of Nepal to continuously implement a number of large-scale projects, partly because of the financial implications of such a commitment. To implement a sustainable and effective watershed management, therefore, understanding of the necessity of watershed management by local people and their cooperation are essential. To achieve this, in addition to soil and watershed conservation, measures to improve the living condition of local inhabitations and to create income generation opportunities for them will have to be taken. And it is of crucial importance for local people to take the initiative in land conservation, integrated watershed management implementation and forest resources preservation efforts.

1-2 Preconditions of Integrated Watershed Management Plan

① It will be a master plan which aims at conservation of the natural environment as well as national land in a watershed (area).

② It will have the ultimate goal of conducting watershed management through local development.

③ The existing conditions will be precisely understood so that a plan can be formulated with accurate knowledge and understanding.

④ The formulated plan will reflect the relevant policies of the Government of Nepal, i.e. the relevant scheme of the Department of Soil Conservation.

⑤ There must be constant awareness that, while the immediate user of the plan is the existing JICA project, the end user is the Department of Soil Conservation which is the C/P organization.

⑥ Although the principal rule for the formulation of an implementation plan is that it is formulated by a user with the participation of local people, the plan will describe the required plan formulation process.

⑦ As people's participation in the plan is assumed, there should not be excessive dependence on external support.

⑧ Various types of information and data will be provided for the user so that the formulation and implementation of the implementation plan can be easily conducted.

⑨ The proposed programmes will be feasible in the subject watershed (area) in terms of size, cost and period, etc.

⑩ The plan achievements should prove useful for further extension and education.

It is desirable that the planning unit coincides with a watershed. However, the area division under the Plan does not necessarily coincide with the actual topographical division of the watershed but is based on the administrative unit for easy project implementation. Because of this, the Plan has a general character in some aspects while providing detailed descriptions in other aspects.

1-3 Establishment of Overall Targets

The natural conditions survey has clarified the current state of land use, soil distribution and geological condition in the Model Areas. The prediction of hazardous sites and land suitability classification have been conducted based on the survey findings. Meanwhile, the socioeconomic baseline survey has identified various problems applicable to all of the Model Areas. The principal objective of the integrated watershed management plan is to present the desirable state of the watershed in general by means of identifying common problems in the Model Areas and to propose general measures to deal with such problems and methods of implementing such measures.

To fulfill this objective, certain targets are established under the integrated watershed management plan as shown in Fig. 1-1. Measures to solve the identified problems through efforts to tackle the fundamental causes are proposed in order to achieve watershed conservation and forest conservation through realisation of the targets.

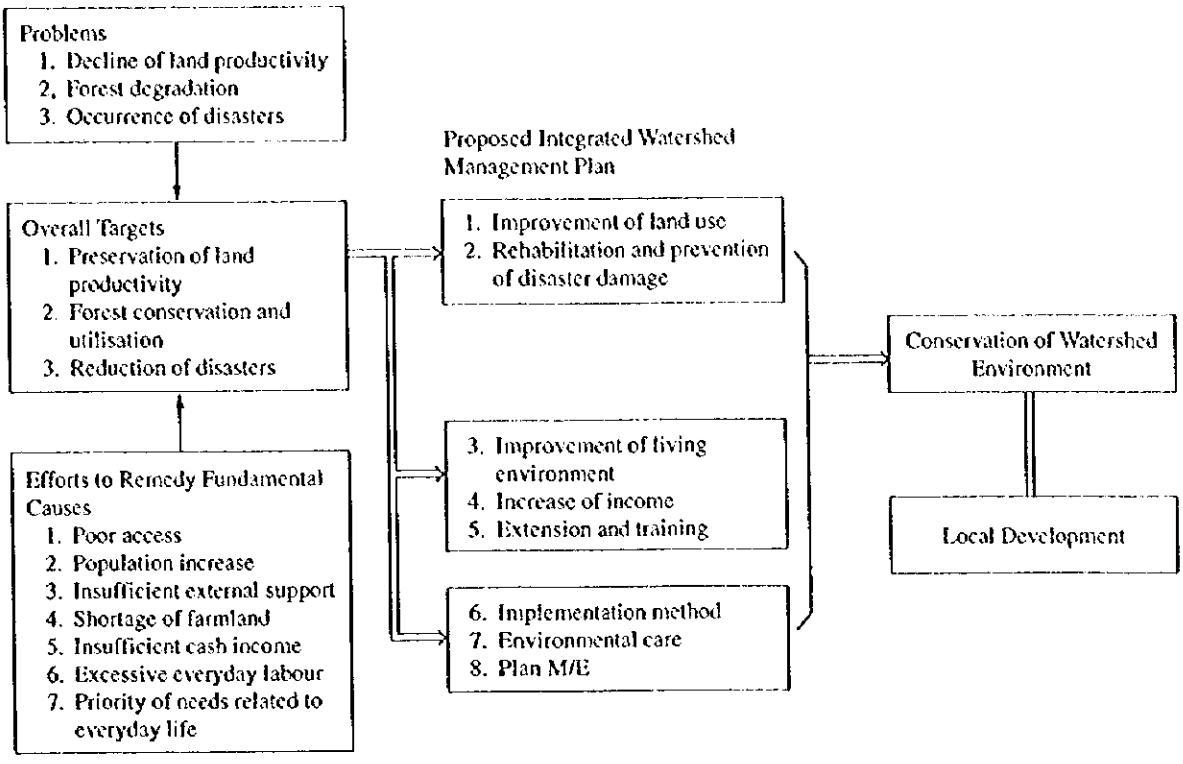

Fig. 1-1 Overall Targets and Proposed Integrated Watershed Management Plan

(1) Preservation of Land Productivity

The preservation of land productivity will be attempted by means of soil conservation and the introduction of an appropriate agricultural system while meeting the people's needs regarding forests and agricultural production by means of tackling the following causes of the declining land productivity through watershed conservation and management.

① Inappropriate use of farmland
② Insufficient supply of nutrients
③ Loss of soil nutrients

(2) Conservation and Utilisation of Forest Resources

The lives of local inhabitants benefit from forest resources in many ways and are highly dependent on a sound forest environment. Remedying of the following main causes of forest degradation will be attempted to properly conserve and utilise forest resources.

① Excessive utilisation of forest resources
② Insufficient forest conservation and management
③ Widespread erosion

(3) Reduction of Disasters

Solving of the following causes of soil erosion will be attempted for the purposes of protecting land from degradation due to soil loss, floods and landslides, preserving a balanced ecosystem and contributing to the stabilisation of local life.

① Forest degradation
② Insufficient implementation of disaster mitigation measures

1-4 Efforts to Remedy Fundamental Causes

In order to achieve the overall targets, efforts must be made to remedy the following fundamental causes so that appropriate watershed conservation and soil conservation is conducted with improvement of local life, increase of income and wide acceptance of the conservation measures by local inhabitants.

(1) Poor Access

The poor access greatly constrains the daily activities of local inhabitants, underlining the importance of adequate infrastructural development. National measures are required to solve this problem.

(2) Population Increase

Because of migration from the area to work outside the Model Areas, the nominal population growth rate in the Model Areas is lower than the national average. However, most of these moving out of the area are active young men and local production activities are affected by this migration. The development of local income sources is essential to eradicate the dependence on working outside the Model Areas.

(3) Insufficient External Support (Technical and Financial)

Even though the self-reliance of the local inhabitants is the ultimate target, external technical and financial support is required to achieve this. The precise selection of watershed management programmes with desirable effects and external support are important to give proper incentives to local inhabitants.

(4) Shortage of Farmland

While this problem relates to the question of land productivity, the farmland shortage must be dealt with by the appropriate selection of the crops to be cultivated together with measures to prevent a decline of soil fertility and to improve the soil fertility in those areas where it has declined.

(5) Insufficient Cash Income

As it is necessary to improve the living standard of those people with a minimum self-sufficiency level, the introduction of cash crops will be the key to achieving such improvement. Moreover, the income from forest products is expected to contribute to the improvement of income of local inhabitants in future. An income increase will not only reduce the farming and firewood collection burden but will also constitute an incentive for local inhabitants to tackle watershed degradation.

(6) Excessive Everyday Labour

The improvement of drinking water supply facilities, the introduction of efficient storage to reduce the burden of firewood collection and the increased income due to improved land productivity, etc. will be important to reduce the chronic, excessive labour of women.

(7) Priority of Needs Related to Everyday Life

Unless the needs related to everyday life are met, the attention of local inhabitants cannot be directed to watershed management featuring land conservation as well as forest conservation. It is accordingly necessary to deal with the needs related to everyday life with external support to start with. It is hoped that an improved standard of living with some leeway in everyday work will make it easier for the attention of local inhabitants to focus on watershed management for disaster prevention, land productivity improvement and forest resources management and conservation. However, it is important to determine how much the needs of local inhabitants related to everyday life are given priority over issues related to watershed management.

1-5 Measures to Achieve the Targets

1-5-1 Appropriate Land Use and Management

Inappropriate land use is leading to watershed degradation. Cultivable land in the Model Areas has already been turned into farmland as shown by the survey results and the remaining forests are distributed on steep, north-facing slopes. These forests contribute to local life by means of providing fuelwood, fodder, timber and by protecting water source areas, which is essential for local life, and preventing soil discharge to farmland and downstream areas. Forest degradation and the occurrence of widespread erosion in the Model Areas have, however, quickened watershed degradation with serious impacts on local life in terms of reducing the various benefits of forests and increasing the damage to farmland.

Meanwhile, the food shortage faced by local inhabitants is caused by the decline of farmland productivity, in turn caused by the excessive use of farmland and surface erosion, as well as by shortage of farmland, directly affecting local life. The resulting inadequate maintenance of farmland and inappropriate cultivation practices have caused watershed degradation. Consequently, the preservation of land productivity and an increase of the agricultural production are crucial tasks to ensure appropriate watershed conservation and stable local life.

In order to achieve ecological stabilisation and environmental conservation in the watershed while balancing the conservation and production needs, the maximum utilisation of the present land should be planned together with proposals for improved land use and effective land management measures and their implementation based on the natural and socioeconomic conditions of the Model Areas to achieve "the preservation of land productivity", "forest conservation and utilization" and "reduction of natural disasters" in the Model Areas.

1-5-2 Immediate Erosion Control Measures

Landslides of various sizes and other forms of erosion are taking place in the Model Areas, inflicting significant damage on farmland, roads and water channels. The causes of these natural disasters are complex, including a high rainfall level during the monsoon season, steep topography and fragile geology and inappropriate land use management.

The socioeconomic baseline survey discovered that many have experienced damage due to landslides and soil loss, etc., indicating the serious nature of erosion in the Model Areas. Local inhabitants show strong concern in regard to such natural disasters as landslides, etc. which have not only adverse impacts on local life but which also cause a number of problems in terms of the watershed environment.

By taking into consideration the possibilities of DOSC and VDCs, what is important in the present context is the proposal of measures which can be implemented by the local inhabitants themselves in the Model Areas. Further considerations are the empowerment of inhabitants in terms of participation and the introduction of incentives to ensure long-lasting effects of the planned programmes.

Given the serious implications of erosion, immediate rehabilitation and prevention measures are proposed from the view point of hazard mitigation and land conservation.

1-5-3 Improvement of Lives of Local Inhabitants

As the local needs survey clearly indicates, local inhabitants are greatly interested in such infrastructure as water supply and roads and their interest in forests is only secondary. Past experience shows that it is difficult to secure people's participation in a forest or environment conservation project by simply asking for their understanding of the importance of such a project.

In addition, deterioration of the watershed environment is the result of not only natural causes but also socioeconomic causes as described in the section dealing with problems in the Model Areas. In the case of the "decline of land productivity" for example, apart from such natural causes as soil, topography and climate, there are also socioeconomic causes, ranging from the excessive use of farmland to the insufficient supply of soil nutrients. Moreover, poor access, population increase, insufficient cash income and excessive everyday labour also form the socioeconomic background for the decline of soil fertility. It is, therefore, important to solve these problems with a view to facilitating understanding of and participation in programmes designed to achieve watershed conservation and environmental conservation by people.

As the lives of local people depend on forests, it should be possible to continuously obtain forest resources through forest conservation which in turn is assumed to lead to

improvement of the income of local people. Given the importance of remedying the underlying causes of key problems, measures aiming at improving local life will be incorporated in the integrated watershed management plan after the examination of possible programmes to improve the living environment and to increase income, etc.

1-5-4 Promotion of People's Participation

(1) People's Participation

Several soil conservation and watershed management projects have so far been implemented in Nepal, aiming at achieving watershed conservation and the stabilisation and improvement of local life. Some of these projects were implemented with the understanding of the project objectives, etc. on the part of local people but others were not. Consequently, the former achieved practicality and long-lasting results while the latter achieved only temporary results. Having reviewed such results, the Department of Soil Conservation reached the conclusion that watershed management involving the rehabilitation of degraded areas and the preservation of land productivity could not be successfully conducted without the understanding and cooperation of local people and issued guidelines for people's participation in soil conservation in 1993. Problems related to people's participation are as mentioned below.

① Problems of Organizing Local People

a. Because of the unclear definition of user groups, the roles of women are not properly understood, resulting in confusion.

b. While a soil conservation project demands a large labour input, it should not cause an unbearable burden on the daily lives of local people.

c. When there is no leader to promote the participation of local people, it is difficult to mobilise farmers who are passive to the idea of participation.

d. The educational level is inadequate to enable local people to properly understand the project objectives and the significance of their participation. This is particularly noticeable among women and poor farmers.

e. Some farmers have no idea how to participate due to their lack of experience of receiving external assistance in this regard.

f. Local people naturally have diverse needs and tend to direct their attention to projects dealing with the subject of strongest concern. Planting and soil conservation do not highly feature in their participation priority.

g. The project may not smooth proceed as newly formed user groups lack sufficient fund management and self-management capabilities.

h. As the plan formulation and implementation capabilities of user groups are not yet sufficient, their dependence on a donor may continue after project completion.

② Insufficient Understanding Among Local People

a. There has been a case in which a bank erosion control project was not smoothly implemented due to insufficient understanding of the importance of the project on the part of local people.

b. Planting at abandoned former farmland failed at the maintenance stage as invasion of the site by cattle, etc. led to the death of the planted trees. It was essential for local people to understand the processes and future outcome of the project.

c. Local people's participation is often understood to be the simple provision of labour by the planners. The same can be said for local people who should be fully aware of their contribution to watershed conservation through their work.

In connection with people's participation the following three stages as shown in Fig. 1-2 are conceivable in the process of facilitating people's participation in a watershed management programme.

(a) Most backward stage of inhabitants' participation (support stage)

(b) Stage where positive training and extension activities are required in the light of inadequate skills and knowledge despite understanding of the programme on the part of people (training and extension stage)

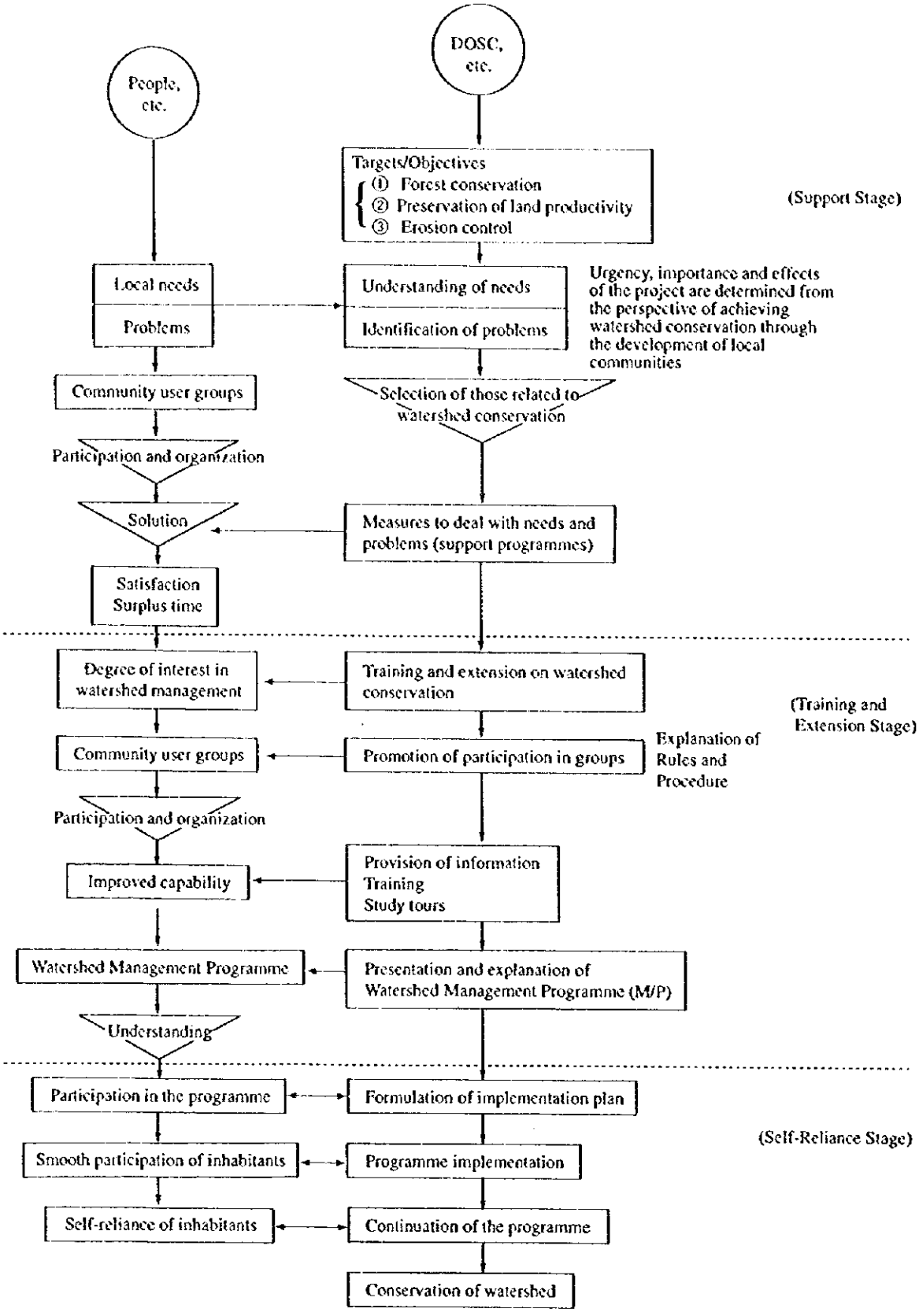

Fig. 1-2 Process of People's Participation in Watershed Management

(c) Stage of immediate implementation of the programme after the firm establishment of a participation system (self-reliance stage)

Following this process, the presence of a donor is gradually weakened to hand over the project from the project team to the HMG, leading to the final stage where watershed management can be conducted by the self-reliant efforts of local people.

Fig. 1-2 shows people's participation process described above. However, depending on the ward and VDC, there may exist various groups in different stages of operation, and the process of participation should be carried out depending on these groups.

(2) Implementation System and External Support

① DOSC Staff Members

The Model Areas are currently under the jurisdiction of the Kaski and Parbat Soil Conservation Offices. The staff members of these offices not only conduct daily soil conservation work but also coordinate the diverse needs of local inhabitants as well as organize user groups.

A project can only be completed after successfully completing various processes, including initial contact with local inhabitants, organization of a user group, plan formulation with local inhabitants, cost estimation and work management. When the implementation of many programmes with limited manpower is planned, the consultations with user groups and understanding of the local situation may be inadequate, making it difficult to smoothly implement the planned projects let alone preserve the project momentum after completion of the projects.

Access to the local work sites from the offices in Pokhara and Kusma is generally made on foot except for some places to which a road is available for access by vehicle. Not all VDCs have a local office and most of the staff members live in either Pokhara or Kusma and travel to the sites when the need arises. The reality is that the field work is inadequate because of problems related to the means of transportation and travelling cost.

In addition, the smooth progress of people's participation is hindered due to the slow diffusion of information among local people regarding how they can benefit from a soil conservation project or an income generation project and also regarding how much these projects can contribute to the development of

a local community. Furthermore, as the supporting side is busy with project implementation as planned, it lacks sufficient time or commitment to organize local people, resulting in failure to obtain a proper understanding on the part of local people. As a result, the project implementation process may come to a standstill. These problems are summarised below and are not confined to the Model Areas but are applicable throughout Nepal.

a. Small number of extension officers
b. Inadequate provision of means of extension
c. Insufficient technical level of extension workers
d. Insufficient model sites to demonstrate project effects
e. Insufficient linkage with other fields

While the Department of Soil Conservation has established the Extension Training Centre in Kathmandu to improve the technical level of extension officers, the achievements so far are not satisfactory. For this purpose, further qualitative improvement of the staff members of the Department of Soil Conservation and NGOs is essential, backed by the relevant education and training. NGOs in particular can play an important role as partners of the Department of Soil Conservation after the phasing-out of a donor from the scene.

② NGOs Activity

Aid provided by foreign governments and NGO activities comprise significant external assistance in Nepal for not only soil conservation projects but also for other types of projects. Foreign ODA for soil conservation projects is described in 2-3-4, Volume I Surveys and is achieving positive results using the Department of Soil Conservation as the counterpart. NGO activities can be direct activities, such as those of the BTRT and ACAP operating in areas next to the Model Areas, or indirect activities such as in the case of the JICA project in which NGOs are operating as part of the JICA team. Further details of such activities are described in 2-3-4, Volume I Surveys. NGOs play a crucial role in terms of empowerment to facilitate the participation of local people and in other fields. Given the importance of NGOs described above, their continued cooperation with DOSC should be sought for the smooth implementation of programmes in the Model Areas in addition to the overall improvement of the current situation. Needless to say, education and training on technical matters as well as technical support

related to extension activities should be provided for NGO staff as in the case of staff members of the Department of Soil Conservation.

(3) Empowerment of Women and Occupational Caste Households

Women in the Model Areas are constantly aware of the conditions of watershed management through their daily work of collecting firewood and tree fodder, fetching water and farming and are directly affected by watershed degradation in terms of the depletion of resources. Therefore, as the direct users of watershed resources, women are the most appropriate people to be involved in watershed management and conservation.

However, the absence of many young men in the Model Areas due to the fact that they work away from home forces women to be responsible for farming and waged labour in addition to childcare and housework. It is unrealistic to add to their work without alleviating their already excessive burden. While collective action by the whole community is required for effective watershed management, the reality is that women find it difficult to participate in communal activities due to their heavy workload, low level of education and various social customs. In order to facilitate the participation of women in watershed management, the relevant environment to encourage women's participation in group activities should be created together with the empowerment of women to enable their participation of such group activities at the decision-making stage.

Meanwhile, people belonging to occupational castes (Damai, Kami and Sarki) have been excluded from communal activities because of social customs. As they are poorer than other members of the community with restrictions imposed on their use of such watershed resources as land, forests and water, they should also be empowered in order to enable them to participate in watershed management activities to improve the present situation.

1-6 Use of Integrated Watershed Management Plan at Implementation Level

Successful watershed conservation through the implementation of the Plan requires consolidation of the implementation system, coordination between related organizations and the smooth exchange of opinions between supporting organizations and local people. It is also necessary to examine the systems to promote people's participation and to ensure smooth project implementation and also ways to proceed with the Plan.

Although it is desirable for watershed management plans to be implemented by self-reliant local people in the future, the reality is believed to be that the implementation of such plans requires the assistance of the Department of Soil Conservation, donors and NGOs for the time being.

There are high expectations in regard to utilisation of the vigour of the private sector, particularly in view of the presence of local NGOs, in the implementation of the national development plan in Nepal. In the case of a participatory integrated watershed management plan, NGOs should play an important role in the provision of technologies and schemes which cannot be provided by the Department of Soil Conservation and in the assignment of staff on site for a long period of time. In short, NGOs are expected to act as good partners rather than subcontractors of the Department of Soil Conservation.

The programmes formulated under the Plan are to be implemented on the initiative of local people and, therefore, close contact with local people must be established to ensure sustainability as well as efficient implementation of the programmes.

As the results of socioeconomic baseline survey indicate, grasping the characteristics at VDC level only could lead to misunderstand the real needs at ward level. This necessity demands that implementation plans should be prepared at ward level (using a ward as implementation unit) and that contents of the plans should be flexible to permit their efficient implementation. In this context, as shown in Fig. 1-3 a smooth relationship should exist between the master plan (the plan) showing overall targets and field level implementation plan.

It is for this purpose that the ward planning profile, containing information on specific problems and measures to solve them in each ward, has been prepared in the plan in addition to a ward profile based on the findings of the socioeconomic baseline survey. Furthermore, the various thematic maps and socioeconomic conditions maps, which have been produced using the GIS, can be used to assist analysis or examination at local meetings as well as in the field.

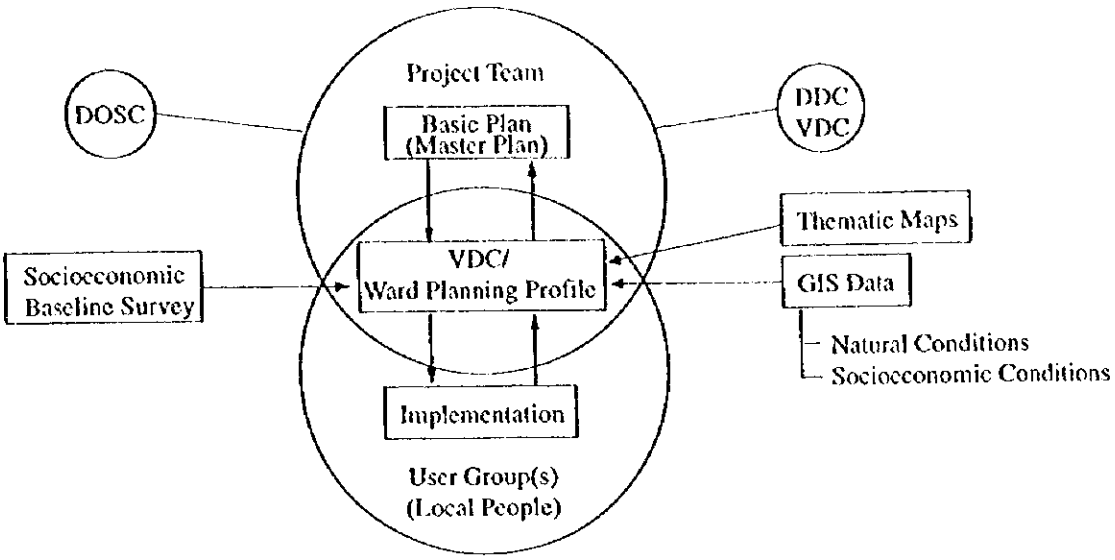

Fig. 1-3 The Relation Between Basic Plan (Master Plan) and Field Level Implementation

1-7 Components of Integrated Watershed Management Plan

Understanding of the needs of local inhabitants is essential for the formulation of an integrated watershed management plan together with the planning of measures to ensure appropriate land use and erosion control. To achieve such an understanding and erosion control, wide-ranging programmes must be planned and implemented, etc. Accordingly, the integrated watershed management plan will have the following components.

(1) Improved Land Use

The appropriate land use will be examined from the viewpoints of the needs of local inhabitants, hazard prediction (conservation aspect) and suitable land classification (production aspect) and the examination results will be used to formulate a land use improvement programme, proposing appropriate land use, management techniques and technical measures to improve the current land use.

(2) Control and Prevention of Erosion

Here, measures to deal with erosion will be proposed based on the objects to be protected and the scale of eroded sites. The types of erosion to deal with are surface erosion, gully erosion, landslides, bank erosion, etc., all of which have implications vis-a-vis the preservation of land productivity.

(3) Improvement of Living Environment

It is important to solve, based on their needs, the problems of local inhabitants to facilitate their understanding of and cooperation for watershed conservation. As local residents strongly hope for the improvement of such infrastructure as vehicle roads, footpaths and irrigation channels, infrastructure improvement is a subject which should be incorporated in any watershed management plan. In the present integrated watershed management plan, the prospects of infrastructure improvement (and rehabilitation) will also be described from the viewpoint of soil conservation. Moreover, proposals will be made to improve local health care and education.

(4) Income Generation

Among the various needs of people, cash income is highly ranked. Improvement of the income of people will have both direct and indirect positive effects on the degraded watershed environment. Programmes to generate income have been implemented under other projects, contributing to a better understanding of the importance of watershed conservation among local inhabitant. Accordingly, the integrated watershed management plan will propose various measures, including the introduction of cash crops and the encouragement of stock raising, to improve the standard of living in the Model Areas.

(5) Extension and Training for Watershed Conservation

To conduct watershed conservation activities smoothly, it is necessary to obtain the understanding and cooperation of local inhabitants through extension and training. Also the same could be said about NGO and DOSC staff members who have a supporting role vis-a-vis local people. In this plan, important points and processes of extension and training are proposed.

(6) Implementation Method

Consolidation of the implementation system, coordination with related organizations and the smooth exchange of opinions between the supporting organizations and local inhabitants will be essential for the implementation of the above-mentioned programmes to ensure watershed conservation. Therefore, the system to promote people's participation to ensure smooth programme implementation and the implementation schedule, etc. are described in the integrated watershed management plan. Also explanations are given on Ward Planning Profile which links the plan (Master Plan) and field level implementation plan.

(7) Environmental Care

As one of the objectives of the integrated watershed management plan is to ensure environmental conservation, it has positive implications vis-a-vis the environment. As the Nepalese environmental guidelines demand the implementation of an initial environmental impacts survey for the planning of a soil conservation project, it is necessary to consider the aspect of environmental care at the planning stage. As already stated, the present plan will examine the environmental implications of the above programmes, taking the natural and socioeconomic conditions of the Model Areas into consideration.

(8) Plan Monitoring and Evaluation

As the present Plan is a master plan indicating overall targets and aiming at implementation with the participation of local people, it does not specify the subject area(s). Here, the necessary monitoring and evaluation items and methods in the post-plan period are described.

2. PROPOSED INTEGRATED WATERSHED MANAGEMENT PLAN

2. PROPOSED INTEGRATED WATERSHED MANAGEMENT PLAN

2-1 Improvement of Land Use

The land use improvement programme, which is one of the plan's key programmes, aims at contributing to forest and environmental conservation in the watershed by means of establishing the suitable land use through people's participation in the programme.

2-1-1 Plan Principles

(1) Tasks for Land Use Improvement

The shortage of forest resources, soil erosion and decline of the land productivity have caused watershed degradation and have had significant impacts on local life in the Model Areas. These negative factors are the result of the lack of proper land use, including excessive forest use, insufficient maintenance of farmland due to working away from home as well as an excessive workload other than farming and the degradation of grassland due to excessive stock raising, and could lead to the degradation of the entire watershed if not improved. At the same time, the development of farmland in the Model Areas has already reaches areas with steep topography and the general picture is that forests are observed on steep slopes or around farmhouses. Given the farming scale of each household and the complaint of local inhabitants that the crop production volume is insufficient, a change of the present state of farmland to other types of land use appears difficult.

In the case of forests, even if some forests are deemed suitable for conversion to farmland, such conversion is difficult to pursue because of the present government policy. Because of these circumstances, it is necessary for the land use improvement plan to propose realistic measures while ensuring a balance between conservation and production.

(2) Viewpoint of the Plan

Firstly, the appropriate land use in the Model Areas is examined based on the erosion hazard and land suitability classifications to produce a land use improvement matrix. The needs of local inhabitants as well as regulations (restrictive factors) related to land use are then added to this matrix to formulate the land use improvement programme which proposes the best possible land use for each type of present land use. The flow of the programme formulation is shown in Fig. 2-1.

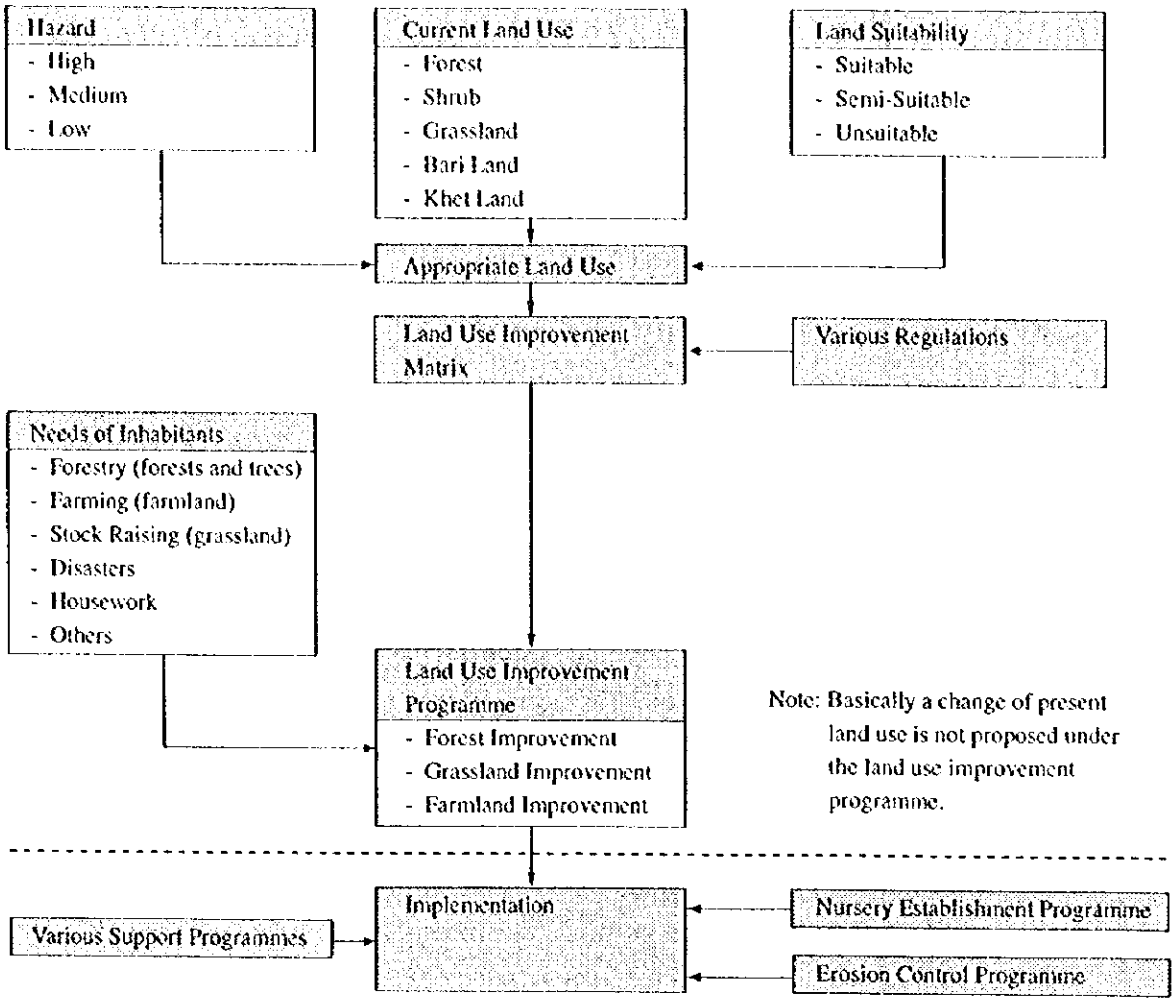

Fig. 2-1 Land Use Improvement Programme Flow

① Hazard (Conservation Aspect)

In the Model Areas, landslides as well as other types of mass movement and erosion have discharged a large volume of sediment to downstream areas, causing the destruction of farmland and houses, the loss of human lives and the inducement of floods. As such, the implication of various types of erosion vis-a-vis watershed degradation is very great. It is needless to say that the most favourable land use from the view point of hazard mitigation is forest which reduces the surface run-off and facilitates rainwater infiltration. However, judged from the present conditions of land use in the area, it is impossible to attempt afforestation in all cases, and it is important to improve the present conditions of land use from the view point of erosion control. Table 2-1 shows the appropriate land use to mitigate erosion hazard.

Table 2-1 Appropriate Land Use in View of Hazard Category

Land Use	Hazard	Appropriate Land Use
Forest	High	Preservation as a forest with the aim of facilitating rainwater infiltration and slowing down of the speed of surface run-off
	Medium	As above
	Low	Use as an all-purpose forest for the production of timber, firewood and fodder, etc.
Shrub	High	Creation of a forest for soil and water conservation
	Medium	As above
	Low	Creation of a forest to produce firewood and fodder, etc.
Grassland	High	Conversion to a forest to facilitate rainwater infiltration and slowing down of the speed of surface run-off
	Medium	Creation of a grazing forest to allow continuous grazing and to conserve the soil
	Low	Maintenance of the present state for use as grassland
Bari Land	High	Conservation as farmland by means of the greening of slopes, planting of new trees and improvement of terraces as conversion to a forest is desirable but difficult
	Medium	Conservation as farmland by means of the greening of slopes and improvement of terraces
	Low	Conservation as farmland by means of preservation of the present condition

② Land Suitability Classification (Production Aspect)

Land productivity can be reduced by the excessive use of land, inadequate maintenance and insufficient supplementation of nutrients. The land suitability classification as mentioned in 3-1-5, Volume I means the determination of the suitability of land for agriculture, stock raising and/or forestry in terms of the relationship between soil and slope. Those sites suitable for agriculture, stock raising and forestry should generally be used as farmland while those which are unsuitable for agriculture should preferably be used for forestry. The appropriate type of land use vis-a-vis the present land use in the Model Areas based on the land suitability classification is shown in Table 2-2.

Table 2-2 Appropriate Land Use in View of Land Suitability Category

Land Use	Land Suitability	Appropriate Land Use
Forest	Suitable	While conversion to farmland is desirable, it is difficult to change the national policy of preserving national forests. Crops which can be planted without affecting the status of forest will be introduced to improve the income of local people.
	Medium	As above
	Unsuitable	Maintenance as a forest
Shrub	Suitable	It is possible to opt for either forest or farmland. Conversion of site suitable for farming to farmland is desirable.
	Medium	As above
	Unsuitable	Maintenance as shrub land
Grassland	Suitable	If necessary, conversion to farmland is possible but coordination with stock raising is required.
	Medium	Maintenance as grassland with the planting of trees if necessary
	Unsuitable	Improvement of the soil conditions through tree planting to increase the land productivity
Bari Land	Suitable	Maintenance of the present state to produce farming crops (terrace improvement if necessary)
	Medium	Maintenance of the present state or introduction of terrace improvement and tree planting to maintain the land productivity
	Unsuitable	Maintenance of the land productivity by means of terrace improvement and tree planting

2-1-2 Land Use Improvement Matrix

The land use improvement matrix indicates the appropriate land use vis-a-vis the present state of land use by applying the results of the hazard prediction and land suitability classification. It is desirable to maintain or create forests at high hazard land while cultivable land (i.e. suitable for agriculture, stock raising or forestry) should preferably be used as farmland. Fig. 2-2 shows the principles of the land use improvement discussed so far.

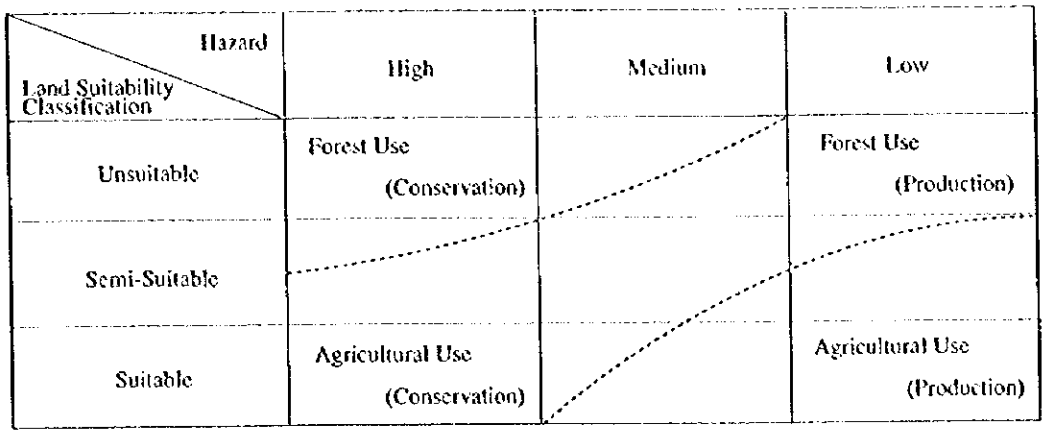

Fig. 2-2 Concept of Land Use Improvement

Incorporating the concept as mentioned in Table 2-2, and restrictive factors as given in Table 2-3, a land use improvement matrix as shown in Table 2-4 is prepared.

Table 2-3 Present Land Use and Restrictive Factors

Land Use	Land Ownership	Restrictive Factors
Forests	In principle, owned by the government although there is some privately owned forest land	It is difficult to convert forests to other types of land use. Private land can be converted at the owner's discretion
Shrub	As above	As above
Grassland	As above but some grassland is described as communal grassland	It is possible to convert grassland to forests. Private land as well as community land can be converted at the owner's discretion
Bari Land	Private land	There are no legal restrictions on the change of the type of land use
Khet Land	As above	As above

Table 2-4 Land Use Improvement Matrix

Hazard / Land Suitability / Present Land Use	High			Medium			Low		
	Suitable	Semi-Suitable	Unsuit-able	Suitable	Semi-Suitable	Unsuit-able	Suitable	Semi-Suitable	Unsuit-able
Forest	F1	F1	F1	F2	F1	F1	F2	F2	F1
Shrub	F1	F1	F1	F2	F1	F1	F2	F2	F1
Grassland	G3	G3	G3	G1	G2	G2	G1	G1	G2
Bari Land	A2	A2	A2	A1	A2	A2	A1	A1	A2
Khet Land	A3	A3	A3	A3	A3	A3	A3	A3	A3

Note: F = forest use; G = grassland use; A = agricultural use

The details of each land use symbol used in the matrix are given below.

Symbol	Detailed Description	Present Land Use
F1	The present land use is either forests or shrub. The subject sites are all types of land suitability categories with a high hazard, semi-suitable and unsuitable land with a medium hazard and unsuitable land with a low hazard. These sites will be maintained as conservation forests.	Forest (including Shrub)
F2	The present land use is either forests or shrub. The subject sites are cultivable land with a medium hazard and semi-suitable land and suitable land with a low hazard. These sites will be maintained as production forests.	
G1	The present land use is grassland. The subject sites are suitable land with a medium hazard and semi-suitable and suitable land with a low hazard. While it is desirable to use these sites for agriculture from the viewpoint of appropriate land use, these sites will be used as grassland because of land ownership and other reasons.	Grassland
G2	The present land use is grassland. The subject sites are semi-suitable and unsuitable land with a medium hazard and unsuitable land with a low hazard. From the viewpoint of hazard, it is desirable to use these sites as forests but trees will be introduced and soil conservation work will be conducted for present grassland to produce fodder in view of the importance of stock raising in local life.	
G3	The present land use is grassland. The subject sites are all suitable land with a high hazard. Because of the high hazard, it is intended to convert the present grassland to forests although the consent of local inhabitants is required.	
A1	The present land use is bari land. The subject sites are suitable land with a medium hazard and semi-suitable and suitable land with a low hazard. Agricultural production will be actively encouraged at present bari land.	Bari Land
A2	The present land use is bari land. The subject sites are all land suitability categories with a high hazard, semi-suitable and unsuitable land with a medium hazard and unsuitable land with a low hazard. From the viewpoint of hazard, it is desirable for present bari land to be converted to forests but agroforestry-type land use will be opted for in view of the food deficit which is important in local life.	
A3	The present land use is khet land. Regardless of the hazard and land suitability classification results, the water and soil conservation functions of khet land will be maintained through terrace repair and other measures.	Khet Land

2-1-3 Land Use Improvement Programme

The land use improvement programme as shown below describes the appropriate land use which reflects the local conditions and measures to improve the present land use based on the needs of local inhabitants.

(1) People's Needs

In regard to forestry (forests and trees), people have expressed a strong interest in and a need for a sufficient supply of firewood, fodder, timber and fallen leaves, etc., necessitated by over-use and insufficient management, making it necessary to implement forest management in accordance with the purposes of use. In addition, the prospect of introducing improved furnaces should be examined together with more active planting at feasible sites. Inappropriate land use management (water treatment) and the drying-up of water sources have created strong interest in water and soil-related issues. These people's needs can be addressed by making existing forests perform their respective functions.

In regard to farmland, strong interest is shown in the preservation of land productivity due to the increasing vulnerability of farmland, making the introduction of green manure, nitrogen fixing trees and/or grasses, the use of compost and the improvement of terraces necessary to prevent soil loss and to improve the soil fertility. Moreover, the improvement of productivity should be attempted by means of changing the types of crops to be cultivated.

Most of the grazing land and meadows (grassland) is located on steep slopes. Meadows are important feeding sources for livestock and are expected to supply a sufficient quantity of feed through grassland improvement and other means. There is also strong interest in livestock control, reflecting the growing vulnerability of grassland to soil loss. People's needs related to household work and others are dealt with by other programmes.

(2) Outline of Land Use Improvement Programme

From what presented above the outline of land use improvement programme is as shown in Table 2-5.

Table 2-5 Outline of Land Use Improvement Programme

Existing Land Use	Needs and Interests	Programme Type	Outline
Forest (including shrub)	- Sufficient supply of firewood, fodder and compost (fallen leaves) - Timber supply - Sale of firewood - Water supply - Improved furnaces - Landslides and erosion	FIP1 (F1)	- Preservation and improvement of soil and water conservation functions - Forest-oriented land use by means of conservation of present forests and forest improvement through enrichment, etc. - Production of firewood considered depending on local needs - Promotion of participation in community forest
		FIP2 (F2)	- Preservation and management of production forests - Forest-oriented land use by means of productive forest use and management of present forests to produce firewood, fodder and timber, etc. and introduction of fodder trees and firewood trees through enrichment - Introduction of cash crops to land classified as cultivable land to improve local life - Participation in community forestry - Introduction of improved furnaces in areas where the supply of firewood is insufficient
Grassland	- Sufficient supply of fodder - Alleviation of labour - Shed management - Grazing control - Landslides and erosion	GIP1 (G1)	- Grassland improvement, Introduction of high yield varieties - Managed grazing, organizing user's groups
		GIP2 (G2)	- Introduction of silvipasture - Managed grazing, organizing user's groups
		GIP3 (G3)	- Conversion to forests to preserve/improve soil and water conservation functions - Phased planting required, taking necessary grazing control and scale of planting into consideration - Introduction of fodder trees and possible employment of stall feeding
Bari land	- Cash income - Terrace improvement - Introduction of irrigation - Alleviation of ploughing work - Alleviation of compost transportation work - Landslides and erosion	AIP1 (A1)	- Improvement of bari land - Increase of yield - Introduction of cash crops - Appropriate water control - Terrace maintenance
		AIP2 (A2)	- Introduction of agroforestry techniques to bari land - Introduction of fodder trees - Introduction of cash crops - Appropriate run-off control - Terrace maintenance
Khet land		AIP3 (A3)	- Maintenance of present khet land - Terrace improvement - Maintenance of irrigation channels

Note: Symbols in ( ) are those shown in matrix.

Also, the land use improvement programme for each Model Area in terms of the subject area is given in Table 2-6, calculated on the basis of the land use improvement matrix.

Table 2-6 Land Use Improvement Programme by Model Area

(Unit: ha)

Model Area	FIP1	FIP2	GIP1	GIP2	GIP3	AIP1	AIP2	AIP3	Total
Kaski North	4,055	3,852	105	299	405	447	1,616	3,252	14,031
Kaski East	1,096	1,928	1	8	17	288	1,162	944	5,444
Kaski West	5,142	249	54	274	73	128	2,176	1,743	9,839
Parbat North	1,444	1,069	28	243	90	631	3,039	1,534	8,078
Parbat South	430	218	17	448	221	291	1,848	342	3,815
Total	12,167	7,316	205	1,272	806	1,785	9,841	7,815	41,207

The expected changes (in land area) of the present land use of these areas due to the implementation of the land use improvement programme are shown in Table 2-7.

Table 2-7 Change of Land Area by Land Use Improvement

(Unit: ha)

Current Land Use	Land Use by Improvement Plan				
	Forest (including Shrub)	Grassland	Bari Land	Khet Land	Total
Forest	F1: 19,483 F2: 7,316				19,483
Grassland	G3: 806	G1: 205 G2: 1,272			2,283
Bari Land			A1: 1,785 A2: 9,841		11,626
Khet Land				A3: 7,815	7,815
Total	20,289	1,477	11,626	7,815	41,207

(3) Forest Improvement Programme 1 (F1): Forest conservation

① Plan by subject site and land area

The subject sites of this programme are present forests and shrub with a high hazard and which are unsuitable for agricultural use. The subject area of this programme accounts for some 30% of the entire planned areas. The subject area by Model Area is given below.

Subject Area of Forest Improvement Programme 1 by Model Area

(Unit: ha)

Kaski North	Kaski East	Kaski West	Parbat North	Parbat South	Total
4,055	1,096	5,142	1,444	430	12,167

② Improvement Principle

a. To enhance the conservation function of forests, such as the water source conservation and control of soil loss and landslides, etc. Use of forests will be attempted by taking into consideration the supply condition of firewood and fodder.

b. As forests are, in principle, owned by the government, it will be necessary to promote the participation of local inhabitants in community forestry activities through the organization of user groups. See the guidelines of the Department of Forests for the organization and operation of forest user groups.

③ Improvement Method

a. From Technical View Point

(a) Forests located on steep slopes or in remote areas will, in principle, be preserved.

(b) Supplementary planting will be conducted at forests sites with a low crown density to improve the prospect of soil conservation.

(c) Forests located on former landslide or current landslide sites will be conserved.

(d) Forests near spring sites will be conserved (for detail see the section on Water Source Protection Plan).

(e) Regeneration by sprouting will, in principle, be adopted to prevent the expansion of the bare land and to reflect the characteristics of the species comprising forests.

(f) The regeneration method will be determined based on the site location and purpose. This programme is, in principle, appropriate for the high forest system or coppices with standards.

(g) The different types of forestry operations and their objectives are described in the following table.

Type	Objectives	Regeneration Methods	Felling	Subject Sites	Remarks
Simple Coppice System	- Production of firewood, fodder and small diameter logs	- Coppicing (use of seedlings if coppicing capacity declines)	- Felling period of four years - Clear felling at 15 cm above the ground	- Near communities - Less than 1 ha - Slope inclination of 45°	- Felling timing should be carefully considered
Phased Coppice System	- Production of large diameter logs, firewood and fodder - Erosion control	- Coppicing	- First year: 50% - Second year: 50%	- Less than 3 ha - Establishment of felling area	- Little exposure of top soil
Coppice with Standards	- Production of large diameter logs and timber	- Coppicing - Artificial regeneration	- High forest system for upper-storey trees - Simple coppice system for lower-storey trees		
High Forest System	- Production of timber - Collection of firewood and fodder possible	- Coppicing - Natural generation	- Selective felling		- Suitable for conservation of remote headwater areas and soil conservation

(h) The species to be planted will be decided depending on the purposes of planting. The candidate species are as mentioned in 2-1-5.

b. From the View Point of Management

(a) As the survey on the needs of local inhabitants clearly shows, local inhabitants show strong interest in the soil and water conservation functions of forests. Local inhabitants will, therefore, be encouraged to enhance these functions through extension activities.

(b) Forest conservation by local inhabitants can be facilitated through the provision of incentives, such as introducing a water supply system to provide drinking water for local inhabitants.

(c) Taking people's participation into consideration, it is necessary to supply firewood by means of the operation as mentioned in (e) of ③ a.

(d) As indicated by the rules for forest user groups, grazing in forests will, in principle, be prohibited in order to maintain the undergrowth.

(e) In principle, until community forests are handed over to people, forest management will be conducted by the Department of Forests. The active assistance of the Project Team and the Department of Soil Conservation will be required to promote watershed conservation through people's participation.

(4) Forest Improvement Programme 2 (F2): Timber Production and Introduction of Crops

① Plan by Subject Site and Land Area

The subject sites of this programme are present forests and shrub with a medium or low hazard and which are suitable for agriculture. This programme covers some 20% of the total area and some 40% of the present forest area.

Subject Area of Forest Improvement Programme 2 by Model Area

(Unit: ha)

Kaski North	Kaski East	Kaski West	Parbat North	Parbat South	Total
3,852	1,928	249	1,069	218	7,316

② Improvement Principle

a. This programme aims at the forest supply of firewood, fodder and timber while cultivating cash crops inside forests for income generation.

b. As in the case of forest improvement programme 1, the participation of local inhabitants in community forestry activities will be promoted.

c. To meet the local need, forests will be maintained in the following manner to supply firewood, fodder and timber.

Firewood : the introduction of biogas and improved furnaces will be considered if the local need cannot be fully met

Fodder : fodder will be produced around bari land and homes while considering the number of fodder trees

Timber : production will follow the procedure governing community forests, taking the need of not only the local community but also of neighbouring communities into consideration

③ Improvement Method

a. From Technical View Point

(a) Forests on steep slopes will, in principle, be preserved.

(b) The following tree and plants will be planted at those forest sites with a low crown density to increase income.

Tree : coffee

Plants : broom grass, ginger, turmeric, cardamon, bananas, pineapples, medicinal herbs, etc.

(c) The regeneration method will follow that of forest improvement programme 1. The simple coppice system will be suitable for the production of firewood and fodder, while coppices with standards and the high forest system will be suitable for the production of timber.

(d) Adjustment of the crown density will be required depending on the types of crops to be introduced. Those techniques to be described later for farmland improvement will be employed for crop cultivation.

b. From Management View Point

(a) In the case of user groups presenting problems in terms of the participation procedure, etc., the project side will actively provide advice to identify the technical and financial problems involved with a view to providing appropriate assistance.

(b) The firewood, fodder and timber that will be produced, considering the existence of demand in such large consumption areas as Pokhara, could become a significant source of income generation for local inhabitants in the future.

(c) The introduction of crops in forests will be decided depending on the needs of local inhabitants and the district forestry office will be consulted in advance via user groups.

(d) Possible incentives to involve local inhabitants in forest management include the supply of seedlings and seeds. The provision of marketing and other useful information for local inhabitants by the project team is also desirable. Also profit sharing among the members of user's group will be clarified.

(e) The question of crop marketing will be discussed in the income generation programme.

(f) The use of fallen leaves can contribute to continuous crop production. Careful attention should be paid to the control of grazing in forests and to the prevention of forest fires.

(5) Grassland Improvement Programme 1 (G1): Grassland improvement and sustainable production of grass

① Plan by Subject Site and Land Area

The subject sites of this programme are grassland with a medium or low hazard and which are suitable for agriculture. The programme covers some 0.5% of the total area and some 9% of grassland area.

Grassland Improvement Programme 1 by Model Area

(Unit: ha)

Kaski North	Kaski East	Kaski West	Parbat North	Parbat South	Total
105	1	54	28	17	205

② Improvement Principle

This programme aims at achieving fodder supply and the control of soil loss and landslides by means of improving present grassland.

③ Improvement Method

a. From Technical View Point

(a) The types of grass to be introduced and their planting methods are shown in the table below.

(b) Grazing will be prohibited at sites with conspicuous erosion. Grazing areas will be established depending on the conditions and size of grassland to protect grass and soil from erosion.

(c) Soil retaining structures for erosion control will be constructed when necessary. The construction work will be carried out through people's participation, using locally available material.

(d) The fences for grazing areas should preferably be made of stone although bamboo or timber may be used in places.

Type	Elevation	Seeding Volume/ha	Principal Planting Method	Planting Season
Marvel Grass	910 m or higher	10 - 15 kg	strip seeding at 1 m intervals; strip depth of 60 cm	May to July
Paspalum	1,000 - 2,000 m	15 - 20 kg	spot weeding	May to June
Para Grass	1,000 m or lower	10 - 15 kg		May to July
Teasinte		20 - 30 kg	direct seeding	beginning of rainy season
Napier grass	1,400 m or higher	125,000 seedlings	planting of 45 - 60 cm long cuttings at 15 cm intervals	May to July
Sitari	1,500 m	8 - 10 kg	seeding with sand four times in quantity of same	May to June
Lucerne (Alfalfa)	4,000 m or lower	20 - 25 kg	seeding at 30 cm intervals	October to May

b. From Management View Point

(a) The establishment of user groups will be necessary for communal land in accordance with the relevant guidelines set by the Department of Soil Conservation. In the case of privately owned land, the decision will be taken by the owner.

(b) Grazing on improved grassland must be controlled through the placing of a watchman and other measures.

(c) The size of the grazing area will be determined depending on the grassland size and number of domestic animals to be raised.

(d) As incentives for local inhabitants, grass seeds will be supplied and the harvested fodder, etc. will be distributed to local inhabitants. As some types of grass can be marketed, the provision of the relevant information for local inhabitants will be required.

(e) Coordination with the district animal husbandry office will be necessary regarding the grass management method.

(6) Grassland Improvement Programme 2 (G2): Stock raising and erosion control through the introduction of silvopasture

① Plan by Subject Site and Land Area

The subject sites of this programme are grassland with a medium or low hazard and which are unsuitable for agriculture. The programme covers some 3% of the Model Areas and approximately half of the total grassland area.

Grassland Improvement Programme 2 by Model Area

(Unit: ha)

Kaski North	Kaski East	Kaski West	Parbat North	Parbat South	Total
299	8	274	243	448	1,272

② Improvement Principle

The programme aims at achieving the co-existence of stock raising and trees. While producing fodder, firewood and timber, the programme also intends the control of soil loss and landslides.

③ Improvement Method

a. From Technical View Point

(a) The planting will be conducted along contour lines. A wide planting distance will be adopted to allow the growth of grass.

(b) The tree species used for grazing forests will be those used for grassland improvement programme 3 while the plants will be those listed for grassland improvement programme 1. The introduction of shade tolerance grasses may be required in some places.

(c) Utilization methods and regeneration methods will the same as mentioned in Forest Improvement Programmes.

(d) Particular attention must be paid to protecting the seedlings after planting. Fences will be erected around the planted trees.

(e) Grazing will be restricted to prevent excessive grazing in order to protect the forest floor after planting.

b. From Management View Point

(a) Same as in Grassland Improvement Programme 1, organization of user's groups will be necessary.

(b) In regard to privately owned grassland, its operation will be left to the owner's judgement. Operation in public land will be conducted by DOSC.

(c) Grazing areas will be established if necessary in accordance with the method described in grassland improvement programme 1.

(d) As incentives for farmers, seedlings will be supplied and such harvest as fodder will be distributed.

(e) Watchmen will be placed to protect the planting trees from domestic animals grazing on the grassland.

(f) Introduction of marketable grass species will be necessary for people's participation.

(g) The planted trees will be used to produce fodder in the immediate future and will then also be used to produce firewood and timber in the more distant future.

(7) Grassland Improvement Programme 3 (G3): Conversion to forest of existing grassland for conservation purposes

① Plan by Subject Site and Land Area

The subject sites are present grassland with a high hazard and which cover a relatively small 2% of the Model Areas (33% of the total grassland area).

Grassland Improvement Programme 3 by Model Area

(Unit: ha)

Kaski North	Kaski East	Kaski West	Parbat North	Parbat South	Total
405	17	73	90	221	806

② Improvement Principle

This programme, through afforestation aims at achieving land conservation (such as the control of soil loss and landslides) and the use of resources (fodder, etc.) to serve people's needs.

③ Improvement Method

a. From Technical View Point

(a) Basically fodder trees will be planted, but trees to assist soil conservation will be planted on particularly steep slopes and soil retaining structures will be introduced when necessary.

(b) Artificial regeneration will be employed. The following points will be considered in the selection of the species for planting.

- Ecological suitability (in terms of survival, growth and adaptation to local conditions)
- Satisfaction of local needs
- Easy collection of seeds and easy breeding
- Positive contribution to soil and water source conservation

(c) The planting of such fast-growing species as pine and alder in the Model Areas is desirable. In addition, species suitable for the production of fodder, firewood and timber will be planted depending on the specific land conditions. The candidate plant species list is given in 2-1-5.

(d) The envisaged planting method is described below.

- Digging of 30 cm deep planting holes without land preparation
- In principle, contour planting with a planting distance of 2 m by 2 m
- Covering of the ground surface with leaves after planting to prevent soil loss
- Level trampling for land with a gentle inclination and tilted trampling towards the top of slopes for land with a steep inclination

(e) The planting schedule is described below.

- Selection of planting sites: September to October
- Production of seedlings: six months prior to planting for an elevation of not higher than 1,600 m; one year prior to planting for sites above an elevation of 1,600 m
- Planting holes: April to May
- Planting: June to August
- Weeding: twice a year (November to December)

(f) In the case of grazing land, fences should be erected to prevent the invasion of animals to the planted sites to protect the seedlings.

b. From Management View Point

(a) User groups will be established and their participation in community forest will be facilitated.

(b) The consent of local inhabitants must be obtained to convert present grassland to forests as grasses obtained from grasslands have been traditionally used as a source of roofing materials. Coordination with VDC and related organizations will be conducted.

(c) A clear understanding must be established within user groups of not only the distribution of the seedlings to be planted but also of the distribution of the harvest from forests.

(d) Conversion from grassland to forests will necessitate measures to deal with imminent changes of the stock raising methods (for example, the introduction of sheds). Guidance on new stock raising techniques must be provided in cooperation with the animal husbandry office.

(e) As an incentive to conversion to forest, such assistance as provision of fodder trees, grasses, compost and animal shed will be considered.

(8) Farmland Improvement Programme 1 (A1): Control of surface erosion coupled with increased crop production

① Plan by Subject Site and Land Area

The subject sites of this programme are farmland with a medium or low hazard and which are suitable for agriculture. This relatively small programme covers 4% of the total area and 15% of the total bari land area.

Farmland Improvement Programme 1 by Model Area

(Unit: ha)

Kaski North	Kaski East	Kaski West	Parbat North	Parbat South	Total
447	288	128	631	291	1,785

② Improvement Principle

Maintaining the productivity and continuity of agricultural production through such farmland improvement activities as terrace improvement.

③ Improvement Method

a. From Technical View Point

(a) To increase productivity compost as well as green manure will be used.

(b) Farmland will be covered by vegetation to a certain extent to soften the impacts of raindrops during the heavy rain period to alleviate surface erosion.

(c) As much eroded soil as possible will be deposited on terraces to prevent a decline of the soil depth and to maintain soil fertility.

(d) Drainage from terraces to prevent surface erosion will be safely arranged. This will further prevent gully erosion and reduce the landslide hazard.

(e) The following methods appear feasible to improve farmland in the Model Areas. The subject sites for improvement will be selected in response to the concrete needs of local inhabitants.

Method	Characteristics	Description
Bench Terraces	- Common method used in the Model Areas	- Riser repair required - Planting of leguminous plants in ridges
Contour Cultivation	- Prevention of loss of top soil and nutrients	- Planting of crops along the contour lines
Cover Crop	- Increase of soil fertility - Suppression of weed growth - Increase of organic matters in the soil	- Planting during the off-season - Supply of green compost
Crop Rotation	- Preservation of soil fertility by rotation	- Introduction of leguminous plants
Hedgerow	- Planting of trees and plants on slopes or ridges	- Similar to agroforestry
Minimum Tillage	- Easy cultivation	- Limited cultivation in the rainy season

(f) In addition to those listed in the above table, surface mulching, tree hedging and grass hedging can be used to improve farmland.

(g) The planted trees will be fast growing trees, soil improvement trees and/or those suitable for soil conservation. The candidate species for the Model Areas are as mentioned in 2-1-5.

(h) Run-off will be fully managed.

b. From Management View Point

(a) As the farmers with small land holdings form the majority, user's groups will be formed and distribution of seeds and harvested crops will be promoted.

(b) Inhabitants intentions on crop selection will be reflected and introduction of cash crops will be promoted and information on market will be provided.

(c) For confirmation of the effects of the programme, devoted farmers will be trained.

(d) Production techniques of manure will be propagated and recognition of the importance of forest will be promoted.

(e) Provision of guidance on appropriate technologies for terrace improvement by the soil conservation office

(f) Cooperation with agricultural extension agents

(9) Farmland Improvement Programme 2 (A2): Provision of fodder and fuelwood, and conservation and improvement of soil to increase production through the introduction of multi-purpose trees

① Plan by Subject Site and Land Area

The subject sites of this programme are farmland with a high hazard and which are unsuitable for agriculture. The programme covers some 24% of the total area and accounts for as much as 85% of the total bari land area.

Farmland Improvement Programme 2 by Model Area

(Unit: ha)

Kaski North	Kaski East	Kaski West	Parbat North	Parbat South	Total
1,616	1,162	2,176	3,039	1,848	9,841

② Improvement Principle

Supplying fodder, firewood and timber while maintaining the productivity and sustainability of crop production by means of establishing the co-existence of agriculture and trees.

③ Improvement Method

a. From Technical View Point

(a) The types of agroforestry which can be introduced in the Model Areas are described below and will be selected based on people's needs and the specific site conditions.

Type (Method)	Description	Place	Characteristics
Home Gardens	- Introduction of trees and crops constituting different storeys - Ginger, etc. is planted in the Model Areas below bananas which in turn are topped by fodder and fruit trees	- Near communities	- Ecologically as well as economically excellent but with the problem of proper management
Inter-cropping	- Planting of trees between crops - This method is used in the Model Areas at cultivation sites of pulses, rape seed and maize	- Places where cultivation sites are established	- Aims at fertiliser effects by soil improving trees and the facilitation of tree growth by crop residuals
Alley Cropping	- Planting at terrace ridges	- Feasible for steep slopes	- Common method - Small trees will be planted to avoid shading

(b) The planted trees will be fast growing trees, soil improvement trees and those suitable for soil conservation. The candidate species for the Model Areas are mentioned in 2-1-5.

(c) Introduction of trees and planting methods which will not shade crops

(d) Introduction of grass, etc. at sites where terrace improvement is necessary.

(e) Method of utilization of planted trees is as shown in forest improvement programme.

b. From Management View Point

(a) Same as in Farmland Improvement Programme 1, user's groups will be formed for a smooth implementation of the programme.

(b) Reflection of inhabitants intentions on tree selection

(c) Production and supply of seedlings will be conducted by the user's groups.

(d) Cooperation with agricultural extension agents to provide advice on the planting method and other issues

(e) Collection of information will be needed on growth condition, harvest condition and development of technology for the future.

(f) On the introduction of fruit trees, etc. which provide direct income, explanations will be provided in the section on income generation.

(10) Farmland Improvement Programme 3 (A3): Sustainable management of khet land

① Plan by Subject Site and Land Area

The subject sites of this programme are khet land which covers some 20% of the Model Areas. Given the excellent functions of khet land in terms of water conservation and crop production, khet land will be preserved. The repair and maintenance of terraces will, however, be continuously required.

Farmland Improvement Programme 3 by Model Area

(Unit: ha)

Kaski North	Kaski East	Kaski West	Parbat North	Parbat South	Total
3,252	944	1,743	1,534	342	7,815

② Improvement Principle

This programme aims at conserving present khet land to ensure its water conservation and soil erosion control functions while maintaining its productivity and sustainability.

③ Improvement Method

a. From Technical View Point

(a) Terrace improvement will be conducted where ever terraces are not properly constructed.

(b) The conventional methods used by local inhabitants as well as terrace improvement method as mentioned in Farmland Improvement Programme 1 will be employed.

b. From Management View Point

(a) Improvement measures will be introduced according to the instruction of soil conservation and agriculture offices.

(b) To solve the problem of lack of man-power as well as to conduct a proper management of khet lands, organizing user's groups will be necessary.

(c) To be used in an uninterrupted way, irrigation canals will be always maintained and continuously managed.

(11) Planned Surface Run-off Management

The following management methods will be used to control run-off and surface erosion in farmland.

① Improvement of trails and construction of ponds

Trails used as drainage ways for disposing of surface run-off from farmlands during the monsoon season will be improved by providing drainage facilities, by constructing stone-paved steps, which will decrease flow velocity and erodibility of run-off, and the trails will be maintained regularly (see the section on trail improvement). Existing ponds will be excavated, improved and connected to the trails. Where ponds do not exist new ones will be constructed.

The followings are proposed as guides when chosing sites for construction of new ponds and pond dimension.

a. Avoid the site on a slope where tension cracks, subsidence, deformities, old or new landslides and active gullies exist;

b. Avoid the site on a slope containing unconsolidated soils and highly weathered rocks;

c. Sites where there is a break in slope and the land is relatively flat and contain clayey soil are preferred for constructing a new pond;

d. For rectangle shaped pond:

Depth : 1.0-1.5m

Width : 5.0-10.0m

Length : 15.0-20.0m

e. For circular shaped ponds:

Depth : 1.0-1.5m

Radius : 3.0-6.0m

f. The ponds will be constructed using wet masonry (stones and cement) and their bottoms will not be sealed off to facilitate gradual infiltration. However, since infiltrating water may increase pore water, which in turn increases slope failure hazard, careful attention should be paid when selecting the site.

g. As a number of ponds built by local inhabitants or related organizations already exist in Model Areas and these will be used for storing run-off, under this plan construction of approximately 1 new pond per ward is proposed.

② Improvement of natural streams or channels

Natural streams or channels, carrying the surface run-off disposed of from Bari land terraces located in the upper slopes, will be improved and used because improved natural channels having already adapted to the rainfall and run-off of an area drains more efficiently than artificially excavated ones. Moreover, the construction expenses are less than building artificial channels. To slow down the flow of water in order to prevent scouring of a channel bed and sides, steep sections of the channel will be protected by means of stone paving or grass planting and drop structures will be built with stones every 15-20m.

③ Construction of small weirs

In the lower portions of the improved natural channels or streams small weirs could be constructed across the stream for storing run-off water which could be carried to the nearby farmlands or home gardens by diversion canals for use as short supplementary irrigation water during part of the dry season. If the amount of water stored behind a weir was found to be too small to be utilized for irrigation, diversion canal will not be built.

Small weirs could be built using gabions. The wings and bottoms of the weirs have to be well grouted to prevent scouring around the outer wing walls and the foundation. Gabion mattresses should be installed on the down stream side of the weirs to prevent scouring. The following is an example (FAO Soils Bulletin 44 p.128) that could serve as a guideline only.

(a) Area to be irrigated 5 ha (assumed);

(b) Height of weirs 1.0-1.5m, length approximately 5m (including anchorage in stream banks);

(c) If diversion canals have to be built it will be 200-300m/ha with a discharge of 5 litres per second;

(d) Drop structures will be constructed with stones every 20-30m of canal to reduce slope of the canal bed.

2-1-4 Seedling Production Programme

The seedling production and management methods are described below. In preparing the nursery plan, it is important to select seeds of the species requested by local inhabitants, to fully consult with local inhabitants on the nursery sites and nursing schedule and to improve the awareness of local inhabitants of their responsibility for nursery management.

(1) Nursery Practice

Forest tree seedlings, fruit tree seedlings and grasses, etc. required for land use improvement plan and the living improvement plan will be raised. The method of seedling raising to be adopted varies with the species of trees, and here the essential points of raising forest tree seedlings will be described. Seedlings will be raised in polyethylene bags, as a rule.

① Selection of seeds: Seeds of good quality will be selected. The method of selection varies with he species of trees.

② Sowing: Selected seeds will be sowed in the germination bed. The method of sowing varies with the species of trees.

③ Preparation of polyethylene bags: 10 cm × 17.8 cm bags will be used, as a standard.

④ Preparation of the soil: The soil to be put in the polyethylene bags will be prepared. Varying with the species of trees, usually a mixture of soil, sand and compost will be used.

⑤ Transplanting of young seedlings: Young seedlings will be transplanted in soil-filled polyethylene bags.

In addition, shading, watering, weeding, root cutting, insect killing and prevention, hardening and other operations are necessary.

(2) Number of Required Seedlings

The number of required seedlings to be used in this Plan will be calculated on the following basis.

Land use improvement program	Calculating basis
Forest Improvement Programmes 1 and 2	10% of planned area for enrichment planting and planting distance of 2m × 2m
Grassland Improvement Programme 3	100% of planned area and planting distance of 2m × 2m
Grassland Improvement Programme 2	100% of planned area and planting distance of 10m × 10m
Farmland Improvement Programme 2	30% of planned area and planting distance of 5m × 4m

In addition, seedlings will be raised also for bank erosion control and other erosion control works and for cash crops which may lead to increased income. On the above calculation basis, the number of required seedlings for each Model Area will be calculated as shown in Table 2-8.

Table 2-8 Number of Required Seedlings

(Unit: 1,000)

Programme	Kaski North	Kaski East	Kaski West	Parbat North	Parbat South
F1 and F2	2,468	943	1,684	784	200
G3	1,265	53	228	281	690
G2	37	1	34	30	56
A2	303	217	408	569	346
Total	4,073	1,691	2,354	1,664	1,292

Note: The seedling survival ratio is assumed as 80%.

Forest trees and grasses are proposed in Table 2-8. However, according to the local inhabitants needs fruit trees and cash crops, etc. may also become necessary.

(3) Nursery

In establishing the nursery the following points will be considered.

① Water availability, topography, accessibility, etc.

② The nursery of a large scale need not be considered, and the nursery of a small scale in the vicinity of the farmhouse is favorable.

③ For obtainment of the site, the best suited one will be selected through discussion with the inhabitants.

④ The nursery will be designed to meet at least the following conditions.

a. Fences: To prevent ingress of animals.
b. Working paths: Used for transportation of seeds and seedlings, watering, weeding and other management and maintenance operations.
c. Water tank: For water make-up in the dry season. Simple one is desirable.
d. Seedbed: 1m × 10m, as a standard, to be adjusted as necessary.

⑤ In addition, soil storage yard, working yard, etc. are also required.

⑥ Moreover, seedbeds, etc. will be well drained, and care will be taken to avoid root rotting, etc. In this Plan, the nursery will be installed at two or more places in each VDC, and as necessary, additional installation will be considered.

2-1-5 Proposed Plant Species List

A list of the species of trees and grasses to be used in the land use improvement plan and erosion control plan, is prepared based on the available information and interviews conducted in the field.

Table 2-9 Proposed Plant Species List (1/8)

A. Grasses and small legumes

Local name	Botanical name	Altitude (m)	Propagation method	Main use
Amliso	Thysanolaena maxima	up to 2,000	cuttings	E (good in moist sites)
Babiyo	Eulaliopsis binata	up to 1,500	cuttings/seeds	E (also for rope & paper making)
Banso ghans	Bragrostis tenella	500-- 1,800	cuttings/seeds	E
Clover (legume, exotic)	Trifolium sp.	up to 2,000	cuttings/seeds	Fo, S, B
Dangre khar	Cymbopogon pendulus	up to 1,200	seeds	E
Desmodium (legume, exotic)	Desmodium distortum	up to 1,800	cuttings	Fo, S, B
Dhonde	Neyraudia reynaudiana	up to 1,500	cuttings/seeds	E
Kans	Saccharum spontaneum	up to 2,000	cuttings	E (good for dry & severe sites)
Katara khar	Themeda sp.	up to 2,000	cuttings	E
khar	Cymbopogon microtheca	up to 2,000	cuttings/seeds	E (also for roofing)
khus	Vetiver zizanioides	up to 1,500	cuttings	E

Note : ① Sources : -Agroforestry Systems and Practice in Nepal, Forest Research & Survey Centre.
-Bio-engineering Information (Lists of Species), Dept. of Roads, HMG Government, 1996.
-Interview with DOSC staff and local inhabitants.
-Lists of "Recommended Species for Vegetative Measures in Soil Conservation" provided by CDFWCP.
② Main Use : (E;Erosian control)(Fu;Fuelwood)(Fo;Fodder)(S;Soil improvement)(T;Timber)

Table 2-9 Proposed Plant Species List (2/8)

Grasses and small legumes

Local name	Botanical name	Altitude (m)	Propagation method	Main use
Kudzu (legume, exotic)	Pueraria lobata	500–1,500	cuttings	Fo, S
Molasses (exotic)	Melini minutiflora	up to 1,800	cuttings/seeds	Fo
Musekharuki	Pogonatherum sp.	up to 2,500	cuttings	E
Napier (exotic)	Pennisetum purpureum	up to 1,750	cuttings	E, Fo
Narkat	Arundo clonax	up to 1,500	cuttings	Fencing
Padang bans (small size bamboo)	Himalayacalamus hookerianus	1,500–2,500	cuttings	E (also for making baskets & roofing)
Phurke	Arunduella nepalensis	700–2,000	cuttings/seeds	E
Rato Kans	Prianthus rufipilus	900–2,200	cuttings/seeds	E
Salimo Khar	Chrysopogon gryllus	800–2,000	cuttings/seeds	E
Setaria (exotic)	Setaria anceps	500–2,500	cuttings/seeds	Fo, E
Sito	Neyraudia arundinacea	up to 1,500	cuttings/seeds	E
Stylo (legume, exotic)	Stylosanthes guianensis	500–1,500	cuttings	Fo
Tite nigalo bans (small size bamboo)	Drepanostachyum intermedium	1,000–2,500	cuttings	E (also for making baskets, etc)

Table 2-9 Proposed Plant Species List (3/8)

B. Shrubs and small trees

Local name	Botanical name	Altitude (m)	Propagation method	Main use
Ainselu (thorny)	Rubus ellipticus	1,000--2,500	seeds/cuttings	E
Alainchi	Blettaria cardomomum	1,000--2,000	seeds	cash crop
Amala	Phyllanthus emblica	up to 1,500	seeds	E (also fruits are edible)
Amba/ambak	Psidium guyava	up to 2,000	seeds	Fruit producing
Areri (thorny tree up to 5m high)	Acacia pennata	500--1,500	seeds	E
Assuro	Adhatoda vasica	up to 1,000	cuttings	E (leaves good for compost making)
Bainsh	Salix tetrasperma	up to 2,700	cuttings	E (specially good in wet sites)
Ban chutro (thorny shrub up to 5m high)	Berberis aristata	1,500--3,000	seeds	E
Bhui katahar (Pineapple)	Ananas comosus	up to 1,600	cuttings	E (especially for planting along terraces)
Bhujetro	Butea minor	500--1,500	Direct seeding	E
Dhanyero	Woodfordia fruticosa	up to 1,500	seeds	E
Dhusun	Colebrookea oppositifolia	up to 1,000	seeds	E
Ghangaru	Pyracantha crenulata	1,500--2,500	cuttings	E
Kera (Banana)	Musa paradisiaca	up to 1,300	Root suckers	Fruit producing, (specially good for planting in gullies), E

Table 2-9 Proposed Plant Species List (4/8)

Shrubs and small trees

Kettuke (large cactus)	Agava americana	up to 2,000	Root suckers	E (widely used for fencing)
Keraukose	Indigofera atroturpurea	up to 2,000	seeds	E, S
Kimbu	Morus alba	up to 2,000	cuttings/seeds	F o
Kunyelo	Trema orientalis	up to 1,500	cuttings/seeds	E (good on stony & dry sites)
Mesquite (thorny, exotic)	Prosopis juliflora	up to 1,000	seeds	E (good on calcar-eous soils)
NilKanda	Duranta plumier	up to 1,500	cuttings/seeds	E (used for making hedges)
Rahar (fast growing legume)	Cajanus cajan	up to 1,500	seeds	S
Saruwa/bihaya	Ipomoea fistulosa	up to 1,500	cuttings	E (Fill slopes only)
Simali	Vitex negundo	up to 1,750	cuttings	E, F u
Tilka	Wendlandia puberula	up to 1,500	seeds	E, F u

Table 2-9 Proposed Plant Species List (5/8)

C. Bamboos

Local name	Botanical name	Altitude (m)	Propagation method	Main use
Choya/tama bans(heavy branching)	Dendrocalamus hamiltonii	300–2,000	clum cuttings	E, construction, basket making, etc.
Dhanu bans (heavy branching)	Bambusa balcooa	up to 1,600	〃	〃
Kalo bans (heavy branching)	Dendrocalamus hookeri	1,200–2,500	〃	〃
Mal bans	Bambusa nutans	up to 1,500	〃	〃
Nibha/ghopi/lyas bans	Ampelocalamus patellaris	1,200–2,000	〃	〃
Tharu bans	Bambusa nutans	up to 1,500	〃	〃

Table 2-9 Proposed Plant Species List (6/8)

D. Large trees

Local name	Botanical name	Altitude (m)	Propagation method	Main use
Acacia (exotic)	Acacia auriculiformis	up to 1,000	seeds	E, F o, S (grows well in severe sites)
Amp/aap (Mango)	Mangifera indica	up to 1,200	seeds	Fruits, F u
Ashare phul	Lagerstroemia parviflora	up to 1,200	seeds	E
Bakeno	Melia azedarach	up to 1,800	seeds	E (grows fast in deep soils)
Bange kath	Populus ciliata	2,000-- 3,000	cuttings	T, F u
Champ	Michelia champaca	500- 1,500	seeds	T, E
Chilaune	Schima wallichii	900- 2,000	seeds	T, E
Dabdabe	Garuga pinnata	up to 1,300	seeds/cuttings	F o
Dhale Katus	Castanopsis indica	900- 2,900	seeds	E (also seeds are edible)
Dudhilo	Ficus neriifolia	900-- 2,200	seeds	F o
Ipil ipil(prone to pest attack. Mixed planting prefered)	Leucaena leucocephala	up to 1,500	seeds	F o, E
Jamun	Syzygium cumini	up to 1,600	seeds	T, F u
Kadam	Anthocephalus cadamba	up to 1,000	seeds	T, F u

Table 2-9 Proposed Plant Species List (7/8)

Large trees

Kagati	Citrus aurantifolia	500–1,500	cuttings	Fruit
Kalo seris	Albizia lebbeck	up to 1,200	seeds	T, Fu
Kaura	Ficus lacor	up to 1,600	cuttings	Fo, T
Khanyu (khosro)	Ficus cunia	up to 2,000	seeds	Fo
Khari	Celtis australis	700–2,400	seeds	T, Fo
Khashru	Quercus semecarpifolia	1,700–3,800	seeds	T, Fu
Koiralo	Bauhinia variegata	up to 1,900	seeds	Fo
Kutmero	litsea monopetala	up to 1,600	seeds	Fo
Lankuri	Fraxinus floribunda	1,200–2,700	seeds	T, Fu, E
Musure Katus	Castanopsis tribuloides	500–2,300	seeds	T, Fu
Nebharo	Ficus roxburghii	up to 2,000	seeds/cuttings	Fo
Okhar (walnut)	Juglans regia	1,200–2,800	seeds/grafting	fruit
Paiyu	Prunus cerasoides	500–2,400	seeds	ornamental, E
Patle katus	Castanopsis hystrix	1,000–2,500	seeds	Fo

Table 2-9 Proposed Plant Species List (8/8)

Large trees

Phalant	Quercus lamellosa	1,600–2,800	seeds	T, Fu
Phaledo	Erythrina sp.	900–3,000	seeds/cuttings	Fo
Rani(khotay) Salla	Pinus roxburgii	500–1,950	seeds	T, Fu
Rato siris	Albizia julibrissin	800–3,000	seeds	T, Fu
Sal	Shorea robusta	up to 1,000	seeds	T
Sissau	Dalbergia sissoo	up to 1,400	seeds/cuttings	T, Fu
Suntala	Citrus chyracarpa	500–1,500	cuttings	Fruit
Tanki	Bauhinia purpuria	up to 1,600	seeds	Fo
Tooni	Toona ciliata	up to 1,700	seeds	T, Fu
Utish	Alnus nepalensis	900–2,700	seeds	E, Fu