JAPAN INTERNATIONAL COOPERATION AGENCY

MINISTRY OF URBAN DEVELOPMENT,

THE REPUBLIC OF ARMENIA

THE STUDY ON

LANDSLIDE DISASTER MANAGEMENT

IN THE REPUBLIC OF ARMENIA

FINAL REPORT

VOLUME-III

ENGLISH SUMMARY

February 2006

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Composition of the Final Report

VOLUME	REPORT	LANGUAGE	MEDIA
Volume I :	SUMMARY	JAPANESE	Heard copy, Compact disk
Volume II :	SUMMARY	ARMENIAN	Heard copy, Compact disk
Volume III :	SUMMARY	ENGLISH	Heard copy, Compact disk
Volume IV :	MAIN REPORT	ENGLISH	Heard copy, Compact disk
Volume V :	SECTORAL REPORT-1 PRESENT CONDITIONS	ENGLISH	Compact disk
Volume VI :	SECTORAL REPORT-2 PILOT PROJECTS	ENGLISH	Compact disk
Volume VII :	SECTORAL REPORT-3 TECHNICAL BULLETIN With Landslide Map, Inventory	ARMENIAN/ENGLISH	Compact disk

Currency Exchange Rates Adopted for the Study

USD 1.00	=	AMD 455
AMD 1.00	=	JPY 0.26

November 2005

PREFACE

In response to a request from the Government of Armenia, the Government of Japan decided to conduct the Study on Landslide Disaster Management in the Republic of Armenia and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected a study team headed by Mr. Satoru TSUKAMOTO of Kokusai Kogyo Co., Ltd. The study team was formed from Kokusai Kogyo Co., Ltd. and Nippon Koei. Co., Ltd. and was dispatched between March 2004 and December 2005.

In addition, JICA set up an advisory committee headed by Mr. Masayuki WATANABE. The advisory committee examined the study from technical points of view.

The team held discussions with the officials concerned of the Republic of Armenia and relevant personnel. The team members also conducted landslide inventory surveys of the whole territory and four pilot project sites. Upon returning to Japan, the team prepared this final report.

I hope that this report will contribute to the promotion of this master plan and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere application to the officials concerned of the Government of the Republic of Armenia for the close cooperation extended to the study.

February 2006

Ariyuki MATSUMOTO
Deputy Vice President
Japan International Cooperation Agency

Mr. Ariyuki MATSUMOTO

Deputy Vice President

Japan International Cooperation Agency (JICA)
Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir,

It is with great pleasure that we submit to you the Final Report of the "The study on Landslide Disaster Management in the Republic of Armenia".

Because of the low precipitation in the Republic of Armenia, landslides are ordinarily stable. But in case of inappropriate surface and drainage water control, landslides can become active and cause losses to the inhabitants and endangering life. This kind of landslide capable of being stabilized by appropriate drainage works.

The heads of communities have a duty to secure the lives of inhabitants and protect community developments. But around 80% of communities have no investment budget and are unable to fulfill their obligations to the inhabitants. This report describes the technical and financial public assistance that are necessary to correct this situation. Landslide management that can be undertaken with the current abilities of communities (Community Based Approach) is efficient and practical.

Priority programmes of Armenian mountainous areas are "road, water supply, irrigation". And the overall goals of the programmes are poverty reduction. The study conducted pilot projects for which the overall goal is community development. The project's outputs are community infrastructure development that contribute to landslide mitigation and project resource acquisition (income generation). This report also described the activities of the pilot projects.

We believe that "technical materials containing landslide location map" will contribute to the planning of priority programmes for poverty reduction.

We wish to express our deep appreciation and gratitude to the personal concerned of your Agency, JICA, the Embassy of Japan in Moscow, the Ministry of Urban Development and other related authorities of the Republic of Armenia, Municipalities and Communities, and NGOs for the courtesies and cooperation extended to us during our Study.

Very truly yours,

February 2006

Satoru TSUKAMOTO
Team Leader
The Study on Landslide Disaster
Management in the Republic of Armenia

LOCATION MAP OF THE STUDY AREA

The Study On
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Summary

Executive Summary

Executive Summary

I Basic Condition of Landslide Management

1. Objectives of the Study

The objectives of the study were:

- To prepare location maps and inventory of landslide-prone areas, and to formulate a Master Plan (M/P) for landslide management;
- To implement a Pilot Project (P/P) for the evaluation of landslide management practices and effect on the M/P; and
- To transfer skills and techniques on landslide management to counterpart staff, communities and relevant organizations during the course of the Study.

2. Present Conditions

2-1. Landslides in Armenia

The JICA Study Team identified 2,504 landslide-prone sites (those in which no damages had been reported or were too small to be interpreted using maps and aerial photography were excluded). In these identified landslide sites, 68 sites (about 3% of the 2,504 landslides) have progressive occurring damage, 77 sites (about 3%) have stopped from causing any damage, and 2,359 sites (about 94%) have not reported damages caused. Around 40% of Armenian communities are situated on these 2,504 landslides

Based on correlation analysis undertaken of the identified 2,504 landslide sites, the number of landslides of 1 ha or more is estimated at 53,000 and cover a gross area of 2,500 km^2 or 8% of the territory of the Republic of (RA).

Analysis of the distribution and movement of landslides shows that precipitation is the main cause of the landslide activities. This is significantly associated with snowmelt resulting in precipitation infiltrates underground intensively.

In previous perception in the RA, the earthquake was considered as the main cause of landslides, and landslides tend to occur more densely in areas with active faults caused by earthquakes. The Study showed that the area density of landslides in these areas is actually relatively small. The submerged areas along the active faults are generally sediment plains and lakes where there are no existing or potential landslides. On the other hand, relatively upheaval areas are new slopes where landslide is sparse. However, there is the possibility of new landslides to occur due to seismic activity etc. It should be noted when slopes around active faults are developed.

2-2. Economic Factors and Organizations Related to Landslides

Landslide management budget over the last three years was approximately AMD 90-150 million (USD 0.2-0.3 million), a very low proportion (0.02%-0.05%) of the total state budget.

The existing damage caused by landslides (cumulative loss as of August 2004) is about AMD 21.3 billion (USD 468 million). The potential damage if all areas at risk of landslides were completely lost approaches AMD 26.8 billion (USD 589 million). These correspond to respectively 5.3% and 6.7% of the 2005 state budget, and to respectively about 230 and 300 times of the 2005 landslide management budget of the Ministry of Urban Development (MoUD).

Current investment for landslide management is a low proportion of overall state budget allocated for landslide damage. In general, the benefits of a single purpose project for landslide management are small and lower than its cost. This may be the reason for the small investment in landslide management.

Government Decree No. 1074 in 2001 was drafted by MoUD and appoints MoUD as the organization with overall responsibility for the implementation of the “initial landslide management program”.

The Ministry of Territorial Administration (MoTA) has jurisdiction over community support and regional development. MoTA supervises the regional administration (Marzpetaran) and the Armenian Rescue Service (ARS). The Department of Urban Development under Marzpetaran, is in charge of landslide management and is instructed by MoUD. ARS is in-charge of crisis management of natural hazards, fires, etc., and has regional offices in Marzes, other from Marzpetaran.

In parts of the regions, community unions are formulated with the adjacent communities. The functions of these community unions include receipt of project capital from donors, selection of priority projects from among the community’s proposals, provision of transparency in the implementation of projects including accounting, and stakeholder adjustments such as the environmental problems between adjacent communities, human resource development (education and training) and so on.

II Master plan

3. Basic policies

The ideal landslide management is composed of the three basic policies as shown in follows, and is based on the financial capabilities etc. of the RA.

Policy-1: M/P deals mainly with landslides, which cause damage to communities. Each community plan and implement its landslide management project with financial and technical supports by the government, the overall goal of which is community development.

Landslides in RA are categorized into two types from the viewpoint of their affection:

- Community Landslide: Landslides that predominantly affect the daily lives and infrastructure of communities.
- Wide-area Infrastructure Landslide: Landslides that predominately affect inter-community/ inter-regional infrastructure.

More than 80% of the sum of direct losses due to landslides is generated by Community Landslides, while less than 20% is generated by Wide-area Infrastructure Landslides. The M/P, therefore, mainly deals with Community Landslides.

The projects of single target for landslide damage reduction are generally not given a priority due to the lack of cost/benefit justification. Therefore, landslide management projects which contribute to community infrastructure development such as drainage construction for improving muddy road conditions to insure vehicle running should be planned and prioritized. Such projects generate higher benefits which assure the economic validity of the investment.

Each community plans and implements their “community development (income generation) project” with receiving financial and technical support from the Government. Communities should then invest their earnings to “projects for landslide management and community infrastructure development” and in subsequent “community development projects”. Communities can then gradually expand the scale of projects and their outcomes.

The purposes of Projects (effectiveness of projects upon completion) are as follows.

- Reduction of casualty and damage
- Development of community infrastructure for livelihood and industry
- Increase in the income of inhabitants and community budget

Policy-2: State (management authorities) has responsibility to support the financial and technical requirements for nation-wide landslide management of the various implementation bodies (community or management organization for wide area infrastructure).

The relationship between management authorities and the various implementation bodies are proposed as follows.

Risk Objects	Management Authorities (Responsible organizations for the technical and financial side of landslide management)	Implementation Body for Landslide Management （Communities or management organization for wide area infrastructure ）
Community infrastructure, private property	MoUD, MoTA, Urban Development Department of Marz	Communities
Wide area infrastructure		
Inter regional road	Ministry of Transportation and Communications (MoTC)	Transportation and Communication Department of Marzpetaran
Railway	MoTC	Private companies
Communication infrastructure	MoTC	Private companies
Energy supply infrastructure	Ministry of Energy（MoE）	Private companies
Water supply infrastructure	Water Committee of MoTC	Private companies
River	Ministry of Environmental Protection (MoEP)	Environmental Protection Department of Marzpetaran

MoUD has overall responsibility for community landslide management and integrated management of landslide-related information and techniques. MoUD gathers new information and techniques and disseminates to all organizations and personnel related to landslides.

Policy-3: Implementation body to manage landslide according to damage level through the support and assistance of management authorities

(a) Landslides for which there are no reports of damages to risk objects (numbering 2,359 in total)

The Government of the RA **manages information and knowledge** to minimize the risks of new landslides damage resulting from new development activities.

Implementation bodies for daily management of landslides (b) and (c) below are communities and management organization for wide-area infrastructure. Management authorities are responsible for landslide management and provision of financial and technical support to the implementation bodies.

(b) Landslide that have stopped from causing any damage (77 in total.)

Implementation bodies for landslide management investigate and assess the risks. They perform **disaster mitigation activities.** And above mentioned (a) should also be implemented.

(c) Landslides to which continuous damage has been received (68 in total.)
Implementation bodies conduct **safety management to avoid casualties,** and above mentioned (a) and (b) should also be implemented.

Twelve (12) Priority landslide sites are selected in the study by severity of risks from 68 presently active landslides. MoUD is to formulate the pilot project plans for these 12 landslide sites, including the conduct of geotechnical investigation, materials procurement for countermeasure works, dispatch of specialists and technical support for the planning and implementation of projects through the Urban Development Department (UDD) of Marzpetaran.

4. Community Landslide Management

Communities plan and implement "landslide management and community infrastructure development projects" and "community development (income-generating) projects" depend on abovementioned three policies of M/P.

Under conditions of limited finances, communities implement projects through the Community Based Approach (CBA: planning by communities, implemented through community participation) to sustain the projects. The bases of CBA are as follows:

- Local inhabitants have detailed phenomena and situations of the specific landslides, and the resources which can be used for landslide countermeasures and community development.
- Local inhabitants can check and maintain community infrastructure such as water supply and drainage facilities. They can undertake daily monitoring of landslides, if technical instruction from specialists is provided first. This undertaking by local residents is more efficient, and cost is lower.

MoUD and MoTA can gradually provide financial assistance as follows.

- Short Term: MoUD and MoTA plan the pilot projects (continuation of the study's projects and additional new projects) and provide resources to the communities on geotechnical investigation, specialists in field of civil engineering and income-generation.

- Medium Term**:** MoTA and MoUD examine and select communities' plans applying for "Community infrastructure development and landslide management" and provide

subsidies for the selected projects. The UDD of Marzpetaran supports the communities technically in project planning stage.

- Long Term：MoUD enhances the provision of non-conditional subsidies to communities. Communities formulate and implement community development plan including their landslide management.

5. Landslide Management for Wide Area Infrastructure

Implementation bodies responsible for wide area infrastructure maintenance (government organization or private company) formulate and implement landslide management plan. Management authorities support the planning and implementation activities financially and technically.

Regarding landslide management undertaken by various implementation bodies and management authorities, MoUD should coordinate these agencies to avoid overlap and to increase efficiency.

6. Crisis Management

(a) Community Landslide

Community public offices organize a landslide monitoring team for the early detection of any disaster signs. Community leaders warn and recommend evacuation of affected inhabitants depending on the “index value (threshold)” for landslide movement, including precipitation levels, signs, etc. When disaster occurs, the rescue of victims and recovery of damages are done by the head of the community’s order with support of the ARS, Marz, and local inhabitants.

(b) Wide Area Infrastructure Landslide Management

Management organizations formulate the crisis management plan（landslide monitoring and warning, facility use control such as road closures for safety of users, facility restore system, and providing system of alternative facilities） and implement landslide monitoring and regular patrol.

The representative of Marz for inter-regional road and the heads of the regional offices of private companies for other infrastructure managed by private companies, direct the management organization staff patrol during emergency situations, and limit the facilities use, and notify the ARS depending on the “index value (threshold)” for landslide movement, precipitations, and results of patrol. The patrol and the facilities use restrictions (install barricades on road, etc.) are conducted by the management organization of wide area infrastructure and ARS together.

In case of landslide disaster, the victim's protection and disaster recovery are lead by a head of Marz

with the support of ARS, Marz, management organization staff and local inhabitants.

(c) Technical support by MoUD and ARS

MoUD and ARS provide the technical support for the setting of the “index value (threshold)” of landslide movement, precipitation, and other signs of early warning for recommendation on site evacuation, and facility use restrictions.

7. Expansion of practical landslide-related technology

MoUD collects new information on landslide management, etc. in addition to technical materials including landslide location map, inventory and countermeasure examples provided by this study. MoUD then disseminates this information through publishing newsletter on landslide management and other technical bulletin, etc.

MoUD continually provides appropriate technique for landslide management to the communities through the Department of Urban Development of Marzpetaran.

Earthworks and water flow caused by wide area infrastructure development may cause new landslides. Planning and implementation organizations (government organizations and private companies) should use the landslide-related technical materials collected by MoUD for project planning, design and construction works.

Managing authorities have responsibility for the projects and should guide the planning and implementation organizations. MoUD, as the responsible authority on the technicalities of landslides, should review the infrastructure development plans and provide guidance to correct these plans.

8. Environmental Evaluation

The negative environmental impacts of landslide countermeasure projects may include noise and vibration, water, land use, utilization of local resources and local conflicts of interest.

Implementation bodies on landslide management (communities and management organization for wide-area infrastructure) should evaluate the environmental impacts and countermeasures for mitigating negative impact under the guidance of the Department of Environmental Protection of Marz.

In communities, the following methods are proposed for stakeholder information dissemination:

- Newsletters and bulletin boards (community facilities, Marzpetaran) are used for information dissemination, and

- General assembly (meeting of heads of families) is held as stakeholders meeting.

Marz calls for the regional stakeholder meeting to gather and consolidate opinions for revision of the implementation body's ideas on environmental assessment and proposed action on the negative environmental impacts.

Participants of the stakeholders meetings are the implementation bodies on landslide management (communities, management organizations for wide-area infrastructure), Marzpetaran, ARS in the region, heads of communities, and the community union in the region. MoEP and management authorities are called to participate when important environmental problems are considered.

Marzpetaran reports the results of the regional stockholders meeting to the management authorities and MoEP. They review the report and provide appropriate guidance to implementation body for landslide management through Marzpetaran.

III Pilot Projects

9. Outputs of Pilot Projects and Issues

9-1. Outputs of Pilot Projects

The purpose of the pilot projects was to undertake a trial and confirmation of the effectiveness of the Community Based Approach (CBA). Pilot projects have become multipurpose projects, which contribute to community infrastructure development. The participation of inhabitants reduce construction costs, resulting in possible transforming the pilot projects into economically feasible projects for benefit to exceed cost.

The plan for 'The landslide management and community infrastructure development' and 'the community development concept plan for acquisition of project resources' were formulated by the working commissions organized in the communities. Parts of plans include community road drainage works, landslide monitoring and early warning system and were started through the participation of local inhabitants. Residents' awareness of the benefits of self-help and mutual assistance was remarkably improved along with the improvement of community infrastructure (muddy roads) and solution of landslide issues.

Stakeholders meetings (advisory committees) were chaired and held by the MoUD and technical support like for example environmental assessments was provided through these committees.

Plans for "landslide mitigation works which contribute to community infrastructure development"

formulated from the Pilot Projects in Gosh and Martuni Villages, were assessed as economically feasible. The Pilot Project in Kapan involving hazard recovery works (opening of 2-lanes of Harutyunyan Street) was evaluated as economically beneficial in keeping regional traffic safe, including the flow of bulky international cargo, which is the major mean of trade across the Iranian border. The project is highly recommended for implementation.

Landslide monitoring was undertaken by the Study Team together with communities in the area. Monitoring techniques were transferred to the communities, and these monitoring systems has been established and operated. Drilling and GIS equipment were provided as grants to MoUD to provide technical support to the public.

9-2. Issues Resolved by the Pilot Projects and Integrated into the M/P

One issue has been the insufficiency of public finance due to severe constraints in the state budget and the small benefits generated by existing projects that aim solely at landslide mitigation.

The pilot projects became economically feasible by expanding the benefit streams by transforming these into multipurpose projects, which contribute to community infrastructure development. These also include reduction in project costs through the participation of local inhabitants' in project implementation.

These positive experiences should be shared, new projects formulated and public finance allocated.

'Community Based Approach (CBA)' has been proven to be useful for effective project formulation. While the initial investment requirements and specialist in the communities are still scarce, public participation and inputs in the technical and financial aspects are needed to insure the sustainability of the pilot projects and implementation of new projects.

Therefore, the basic policies of the M/P include not only CBA, but also the responsibility of the State (managing authorities) to nation-wide landslide management and the provision of technical/ financial assistance to implementation bodies for landslide management (communities and management organization for wide-area infrastructure).

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Abbreviations

AMD	Armenian Drams
ARS	Armenian Rescue Service
CBA	Community Based Approach
CU	Community Union
CVM	Contingency Value Method
DCU	Dilijan Community Union
DfID	Department for International Development of United Britain
EMA	Emergency Management Administration under the Government of the Republic of Armenia.
GDP	Gross Domestic Product
GIS	Geographic Information System
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit, German International Technical Co-Operation Public Corporation
ICU	Inter Community Union
KCU	Kapan Community Union
MoA	Ministry of Agriculture of the Republic of Armenia
MoFE	Ministry of Finance and Economics of the Republic of Armenia
MoEP	Ministry of Environmental Protection of the Republic of Armenia
MoTA	Ministry of Territorial Administration
MoTC	Ministry of Transport and Communication of the Republic of Armenia
MoUD	Ministry of Urban Development of the Republic of Armenia
MTEF	Medium Term Expenditure Framework
NAS	Armenian National Academy of Science
NGO	Nongovernmental Organization
PRSP	Poverty Reduction Strategy Paper
RA	Republic of Armenia
WB	World Bank

Explanation of Terms

ARS/EMA Armenian Rescue Service/ Emergency Management Administration under the Government of the Republic of Armenia

The EMA became a sub-organization of the Ministry of Territorial Administration in June 2005. The EMA was renamed the ARS in December 2005.

CVM Contingency Value Method

Method of estimating “Willingness to Pay (WTP)” using a questionnaire

Community Union

Armenian Community Law describes that the adjoining community can formulate "Inter-Community Union : ICU" based on mutual agreement

The DfID assists in the ICU formation. GTZ assists in the formation of CU as a temporary organization until the ICU is formed based on law. GTZ supports the communities' projects through CU.

Marz

RA is subdivided into 11 regions（Yerevan Privilege City and 10 Marz）Marzes are regional administrations of the central government. The regional administrations do not have the assembly, and the function of regional law formulation.

Measurement Units

Area

cm^2 ＝ square-centimeter(s) (1.0 cm x 1.0 cm)
m^2 ＝ square-meter(s) (1.0 m x 1.0 m)
km^2 ＝ square-kilometer(s) (1.0 Km x 1.0 km)
ha ＝ hectare(s) (10,000 m^2)

Volume

cm^3 ＝ cubic-centimeter(s) (1.0 cm x 1.0 cm x 1.0 cm)
m^3 ＝ cubic-meter(s) (1.0 m x 1.0 m x 1.0 m)
L ＝ Liter (1,000 cm^3)

Length

mm ＝ millimeter(s)
cm ＝ centimeters (cm ＝ 10 mm)
m ＝ meters (m＝ 100 cm)
km ＝ kilometers (km ＝ 1,000 m)

Weight

g ＝ gram(s)
kg ＝ kilogram(s) (1,000 g)
t ＝ metric ton(s) (1,000 kg)

Currency

USD ＝ United State Dollars
JPY ＝ Japanese Yen
AMD＝ Armenian Drams

Time

s ＝ second(s)
min ＝ minute(s) (60 s)
hr ＝ Hour(s) (60 hr)

PART-I CONDITION OF LANDSLIDE MANAGEMENT

CHAPTER 1 OUTLINE OF THE STUDY

1.1 Background of the - Study

The Republic of Armenia (RA) has predominantly hilly terrain and is prone to landslides.
This study shows that the total number of individual landslides of one (1) hectare (ha) or larger extend over approximately 2,500 km^2, or about 8% of the total land area of RA (these do not include ones for which damages have not been reported or ones which are difficult to recognize from topographic maps/ aerophotograph). Also, approximate 40% of the populated areas in hilly or mountainous regions are located on areas displaced by landslides.

1.2 Objectives of the Study

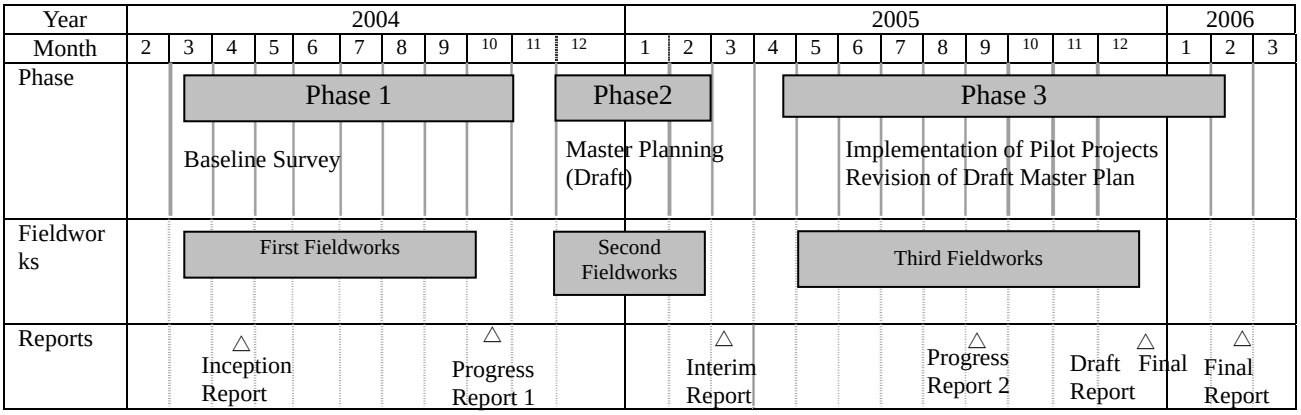
The objectives of the study are:

(1) To formulate a Master Plan (M/P) for landslide management based on landslide location maps and their inventory tables;
(2) To implement priority Pilot Projects (P/P) including the study of practical landslide countermeasures in RA, and to reflect the experience in the M/P; and
(3) To transfer skills and technologies on landslide management to counterpart staff, communities, and relevant organizations .

1.3 Time Table of the Study

This study was undertaken in three phases from March 2004 to February 2006, as shown in Table 1.1.

Table 1.1 Time Table of the Study



CHAPTER 2 PRESENT CONDITIONS

2.1 Landslides in Armenia

The JICA study team identified 2,504 landslides as GIS database by referring existing landslide distribution maps, interpretation of topographic maps/aerophotographs, and reconnaissance of 162 damage reported sites (145 sites are landslides, remaining 17 sites are damage by other causes).

In correlation analysis of number and displaced mass area of 2504 landslides, when the landslides of less than 20 ha are excluded, a correlation equation of the highest correlation coefficient is obtained.

Some less than 20 ha landslides with no damage report not identified to GIS database.

The correlation equation obtained by exquluding less than 20 ha landslides show that the number of landslides covering an area of 1 hectare (ha) or more is estimated at 53,000, covering a gross area of 2,500 km^2 ,which is 8% of the total land area of the RA.

Numbers and area of landslides based on displaced mass area are shown in Table 2.1.

Table 2.1 Numbers and Area of Landslides Based on Displaced Mass Area

Displaced mass area	Numbers of landslides	Accumulated area of landslides	Area percentage of landslides to whole area of the RA
Identified numbers and area based on landslide inventory study			
Larger than 1000 ha	7	42,428 ha	1.4%
Larger than 100 ha	276	68,442 ha	2.3%
Larger than 50 ha	582	89,678 ha	3.0%
Larger than 20 ha	1,296	222,780 ha	3.8%
Estimated value according to correlation analysis based on the number and area of identified landslides (Non-identified landslides are those smaller than 20 ha for which damages have not been reported, because they are too small for map and aerophotographic interpretation).			
Larger than 10 ha	3,500	140,000 ha	4.8%
Larger than 5 ha	8,000	170,000 ha	5.8%
Larger than 2 ha	23,000	210,000 ha	7.1%
Larger than 1 ha	53,000	250,000 ha	8.2%

The relationship between identified landslides and social conditions is shown in Table 2.2.

Table 2.2 Outline of Landslide Sites and Social Conditions

Descriptions	Sum
Number of landslides sites in the RA	2,504 landslides
Number of populated places with landslides	965 places
Housing stock area in landslide areas	79.5ha
Roads located in landslide areas	238km
Railways located in landslide areas	4.05km
Agricultural land in landslide areas	10,819ha
Number of landslides covering historically important places	6 landslides

2.2 Damage Level and Risk Object Importance Level

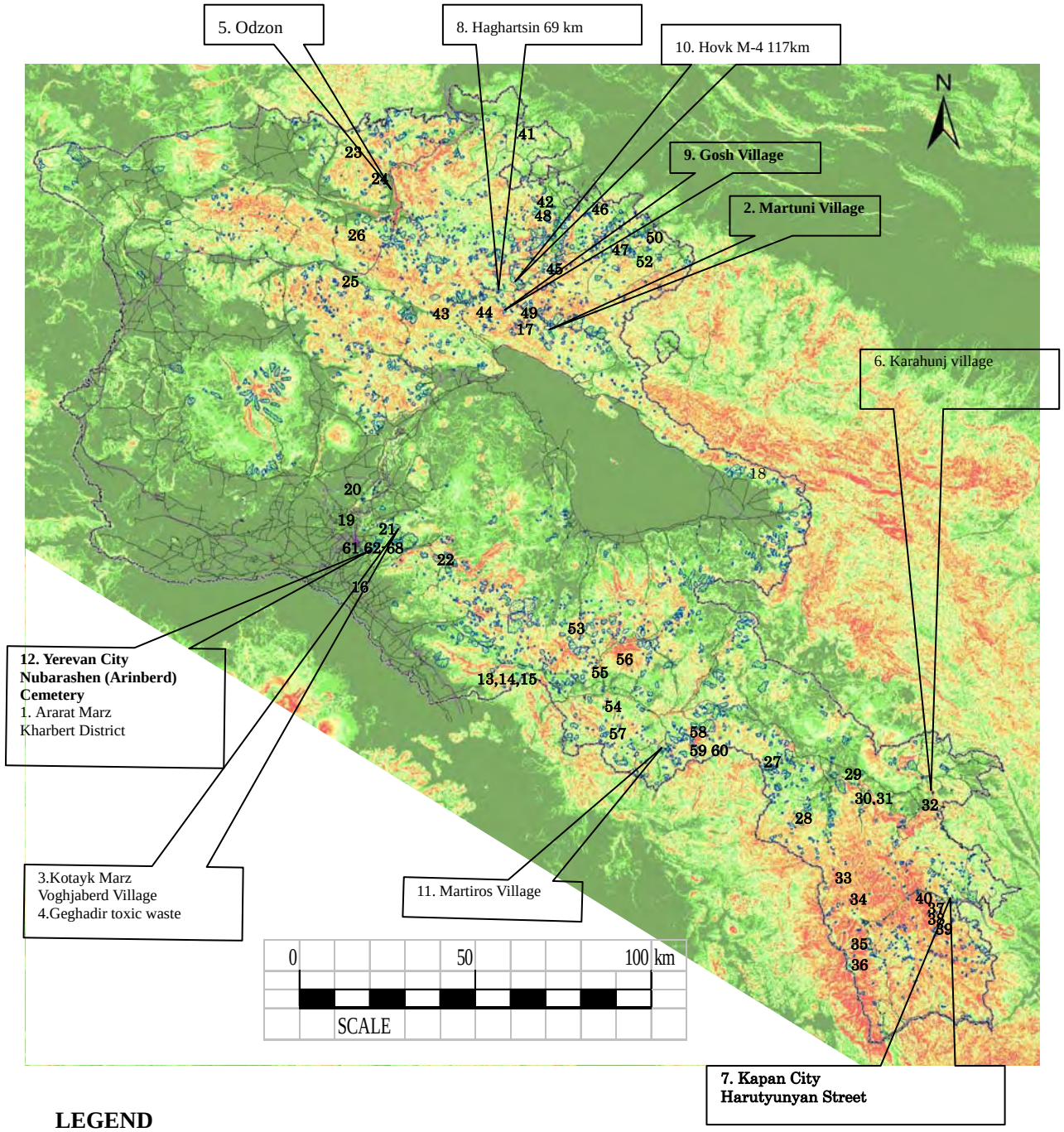
Damage progress level (progressing, dormant, no reported damage) and risk object importance level (high, medium, low) were confirmed for the 2,504 identified landslides. In addition, a priority evaluation for study was undertaken based on relating damage progress level and risk object importance level (see Table 2.3).

Twelve priority landslides were selected for further study, based on the highest rank in terms of both damage progress and risk levels (see Figure 2.1).

Table 2.3 Evaluation of Damage Progress Level and Risk Object Importance Level

		Damage progress Level Type			Total
		Type I: progressive damage	Type II: dormant damage	Type III: not reported	
Risk Object Importance Level	High: risk objects are numerous or important	12	45	0	57
	Middle: risk objects are few and not important	56	32	918	1,006
	Low: no risk objects and minimal influence on human lives	0	0	1,441	1,441
Total		68	77	2,359	2,504
Ratio to whole identified landslides of each damage progress level type		3%	3%	94%	100%

Figure 2.1 shows progressing 68 landslides



LEGEND

Landslide Area

Landslide No.:

1 to 12: Priority landslides for study (Bolded numbers are pilot project landslides)

1 to 68: Others with Type I damage progress level: progressing damage landslides

Figure 2.1 Location map of 68 Progressing Damage Landslides

2.3 Causes of Landslides

2.3.1 Natural Causes

(1) Precipitation and River Erosion

Analysis of landslide distribution and movement monitoring shows a relationship between precipitation and river erosion and landslide activity.

1) Analysis of GIS-Identified Landslides

- Landslides are concentrated in areas with annual precipitation exceeding 1000 mm and are rare in those areas with annual precipitation of 400 mm or less
- Almost 40% of landslides are located within 100 meter from large rivers, as defined on 1:20,000 mapping. About 60% of landslides for which damages have been reported are located closer to rivers. (Better to have a figure for closer, like the 100 meters above)

2) Landslide Monitoring Results

- Some landslides are activated during years of high annual precipitation. (better to have number of landslides, and quantification of high annual precipitation)
- The Gosh village landslide monitoring shows that the activation of landslides is significantly associated with snowmelt.

(2) Earthquakes and Active Faults

Formerly, there was a perception in the RA that landslides are concentrated around active faults, and the relationship between earthquakes and landslides was being emphasized.

During the Spitak Earthquake in 1988, one distinct landslide occurred, and small slope collapses occurred in the vicinity of the epicenter and the earthquake faults. In 735 and in 1139 some landslides were recorded in the south-east region of the RA. However, these are a small part of all landslide cases in the country.

The relationship between landslide distribution density and distance between landslides and active faults has been examined. It has been found that landslides are distributed more densely in zones far from active faults. Ground that subsides along the fault plain may be buried by water and sediment, and lakes and plains, such as Sevan Lake and Ararat Plain, respectively, are formed. In these plains and lakes no landslides are distributed.

On the other hand, ground that rises forms steep slopes. These new slopes are characterized by weak weathering and undeveloped river systems, thus, landslides do not occur, but they may occur in the

future.

When earthquakes and the movement of active faults cause landslides, new landslides and reactivation of old landslides may occur.

2.3.2 Human Occupation of Landslide-Prone Sites and Man-Induced Causes of Landslides

Almost 90% of the communities located in hilly-mountainous areas are on gentle slopes (less than 20 degrees), almost 40% of which are distributed on the 2,504 landslides identified in this study.

Landslides are predominately distributed in areas where water flows. Landslide movement destroys the ground and makes gentle slopes. As a result, land affected by landslides have better resources for agriculture such as water, fertile soils, etc., than the surrounding mountainous areas.

No ongoing damage has been reported in 97% of the 2504 identified landslides. There is, however, a possibility that human activities (leakage from water supply system, watering, embankment on landslide head, cutting at landslide foot, etc.) can cause activation of landslides. In particular, water supplies in landslide-affected land can represent a major negative impact due to the stable slope associated with low precipitation (200-1200mm/year).

Landslides activated by these water supplies can potentially be reduced by reducing the causes, such as decreasing water leakage from water supply systems, and by introducing minor measures such as drainage maintenance, etc. For example, in Ijevan City, the closing of factories and subsequent decrease in the water supply resulted in a settling of landslide activity.

There are also cases of inhabitants who relocate to avoid landslides, only to suffer from landslides again, such as in Martiros village. There is a possibility that in these cases the inhabitants' activities caused landslide activation.

2.3.3 Induced Causes of Wide-Area Infrastructure-Related Landslides

Many landslides affecting wide-area infrastructure are related to linear structures such as roads and railways.

Landslides on the Ijevan-Hrazdan railway at 69 km from Hrazdan (Tavush Marz, Haghartsin Village), the M-4 Highway at 117 km from Yerevan (Tavush Marz Hovk Village), and the M-6 Highway and Tbilisi-Vanadzor railway in Odzun Village (Lori Marz) are typical examples of wide-area infrastructure affected by landslides.

In general, when a linear structure passes over the landslide zone, the foot section of a large-scale landslide near a riverbed is often selected for the alignment. The cutting off of this foot section often reactivates the landslide.

2.3.4 Confusion of Landslide with Other Causes of Damage

A field inventory survey was undertaken covering 162 sites reported to be damaged. Of these sites, seventeen (17) were not landslide areas: two (2) were due to fall-type movement, one (1) was due to a rapid-flow type movement, and the other fourteen (14) were located on very flat areas, and may have occurred due to ground deformation either by settlement, or by frozen heaves, or by deterioration of constructed structures. Thus, there are cases where the cause is not thoroughly examined.

2.4 National Economy, Budget and Damages caused by Landslides

2.4.1 Outline of National Economy

The economy of the RA has grown by 6-13 % per annum for the last five years, as shown in Table 2.4.

Table 2.4 Indicators of Economic Annual Growth

Indicator of Economic Growth	2000	2001	2002	2003	2004
Economic Annual Growth Rate	6%	10%	13%	7%	10%
GDP billion AMD (billion USD)	1,031 (2.2)	1,176 (2.5)	1,363 (3.0)	1,623 (3.5)	1,893 (4.1)
GDP per/person thousand AMD (USD)	264 (569)	309 (666)	357 (769)	505 (1,088)	589 (1,270)

2.4.2 Outline of National Budget Related to Landslides

The budget allocated to landslide management has been expended from two fiscal resources, namely the regular budget and the reserve funds.

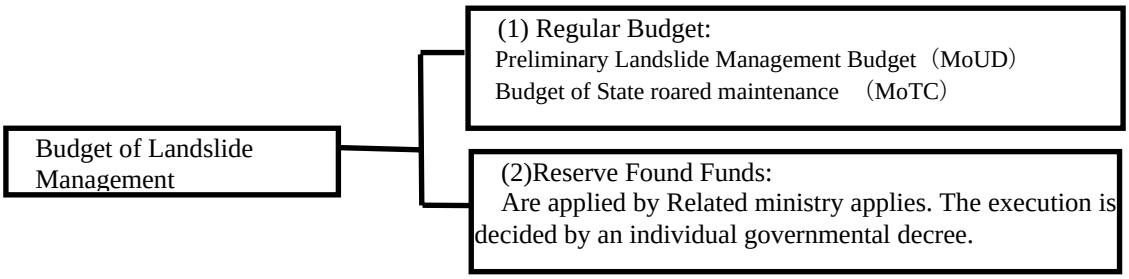


Figure 2.2 Budget of Landslide Management

(1) Regular Budget

Government Decree No. 1074 （27 November, 2001 “Program for preliminary landslide management” designated the MoUD as the overall management organization for landslide management in the RA. A budget for landslide is set in the Medium Term Expenditure Frame (: MTEF).

The budget was used for relocation, geotechnical investigation and construction. In 2005, however, the budget for landslide management was limited to geotechnical investigation only.

The MoTC uses part of the road maintenance budget for restoration works in areas damaged due to landslides.

(2) Reserve Funds

Related Ministries apply reserve funds for emergency countermeasure works or local requests to the Prime Minister. Government Decrees are issued to each project, with designated responsible organizations and budgets. The Ministry of Transport and Communication (MoTC), MoUD and Regional Governments (Marzes), Armenian Rescue Service (ARS), etc. are designated depending on the type of the risk objects.

Examples of the use of reserve funds for landslide management include the relocation of houses in 2002 under MoUD, and the inspection of the Geghadir toxic waste landslide in 2004 under the ARS.

(3) Budget for Landslide Management

Table 2.5 shows the allocated budget for landslide management by MoUD. Substantial amounts were allocated to Kapan City Harutyunyan street landslide as part of the recovery construction works in 1996-1999. However, the restoration construction work has not yet been completed.

The house relocation policy was undertaken in more recent years (2002-2004). However, because the budget was insufficient, only some sections of the relocation were completed. The fairness of the relocation policy is being questioned by residents.

In 2005, the house relocation policy was excluded from the landslide management budget and only investigation and study were executed, totaling AMD 92 million (USD 200 thousand). It is a ‘wide and shallow policy’, with a budget allocated to 22 landslides and an average input of AMD 4 million (USD 9 thousand).

Table 2.5 Transition of Landslide Execution Budget under MoUD

Landslide Budget AMD million										
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
State budget *				**242,585**	**222,886**	**244,381**	**263,912**	**312,698**	**364,700**	**397,700**
Landslide Budget Total	**247**	**63**	**206**	**181**	**0**	**21**	**163**	**148**	**152**	**92**
Ratio of landslide budget to state budget				**0.07%**	**0.00%**	**0.01%**	**0.06%**	**0.05%**	**0.04%**	**0.02%**
Breakdown of Landslide Budget										
Countermeasure works	247	63	192	181	0	0	19	8	0	0
Investigation, design and information	0	0	14	0	0	21	0	0	6	92
House relocation	0	0	0	0	0	0	144	140	146	0

*State Budget 1991- 2003 Statistical Yearbook of 2004

The landslide management budget of MoUD over the last three years was approximately AMD 90-150 million (USD 0.2-0.3 million), which is a very low proportion (0.02%-0.05%) of the total state budget of AMD 313 -398 billion (USD 688 – 875 million) (ref; budget for controlling erosion and flood in Japan is approximate 2% of national budget of Japan).

The MTEF (2003-2005) targets poverty reduction as one of its basic aims. Its strategic priority fields are education, health, social safety and water supply, with a focus on military expenses even though they have a social safety aspect. A territory disaster management fee is not listed as an item of expense.

In the MTEF the 2005-2007 landslide management budget was planned as shown in Table 2.6. This budget was executed in 2005, however, it was not adopted for 2006 and no results were achieved by the end of 2005.

Table 2.6 Landslide Management Budget MTEF (2005-2007)

AMD million			
	2005	2006	2007
Total	92	112	112
Investigation budget	92	112	105
Countermeasure Works	0	0	7

2.4.3 Situation with International Assistance

Most of the countries and organizations currently represented in the communities are donors and include the following:

1. Armenian Social Investment Fund (WB) – community infrastructure rehabilitation and development programs

2. Community Self-help Fund (US Embassy)

The Department for International Development of United Britain DfID assists to formulate the 'Marz Development Program'. This is a guideline to 3 Marzes–（Tavush, Gegharkunik, Syunik）–and includes international assistance and indirect assistance to the communities.

2.4.4 Landslide Damage Assessment

Table 2.7 shows the landslide damage in the RA as calculated in this Study. The amount of damage is divided into 'direct damage', and 'indirect damage'.

Direct damage is an asset value of the damaged objects.

Indirect damage is the losses related to economic activities while the damaged objects recover (the indirect damage is only the amount related to those items that can be calculated).

In Table 2.7, human loss is not included as it is difficult to calculate in monetary terms and the occurrence of it is extremely rare. Unaccountable damages such as losses due to anxiety, distrust, pessimism, and economic damage, etc, are also not calculated.

The existing damage (total existing damage of the risk objects as of August 2004) is AMD 21,300 million (USD 47 million). Moreover, the potential damage (amount of damage when all risk objects in landslide areas are completely lost) approaches AMD 26,800 (USD 59 million). This corresponds to 5.3% and 6.7%, respectively, of the 2005 state budget of AMD 397billion (USD 884 million) and around 230 times and 300 times of the MoUD landslide management budget of AMD 92 million (USD 0.2 million) in 2005. In general, the benefit resulting from measures for landslide mitigation alone is small and does not exceed the costs. This can be the reason why investments for landslide management are not justified.

Deaths due to landslides totaled three people (Kapan City Harutyunyan street landslide and Chiva village landslide) in the 14 years since the independence of the RA in 1991. Casualties are avoided by relocation or evacuation before the collapse of houses.

Depending on management subjects the landslide damages are subdivided into those 'under community management or private', those 'under private companies' management' and those 'under government organizations' management'. The damage related to 'under community management or private' landslides accounts 80% or more of the overall damage as shown in Table 2.7.

Table 2.7 Damages Caused by Landslides

Existing Damage as at August 2004 (AMD million)												
Sector	Under community management/ private			Under private companies' management			Under government organizations' management			**Total**		
	Direct	Indirect	**Total**	Direct	Indirect	**Total**	Direct	Indirect	**Total**	Direct	Indirect	**Total**
Buildings	3,640	500	**4,140**	0	0	**0**	0	0	**0**	**3,640**	**500**	**4,140**
Transport	6,870	450	**7,320**	0	0	**0**	1,590	630	**2,220**	**8,460**	**1,090**	**9,550**
Water, energy, and communications	0	0	**0**	1,000	40	**1,040**	950	40	**1,000**	**1,950**	**90**	**2,040**
Agriculture	5,550	0	**5,550**	0	0	**0**	0	0	**0**	**5,550**	**0**	**5,550**
Total	**16,060**	**950**	**17,010**	**1,000**	**40**	**1,040**	**2,540**	**680**	**3,230**	**19,610**	**1,680**	**21,290**

Potential Damage (AMD million)												
Sector	Under community management/ private			Under private companies' management			Under government organizations' management			**Total**		
	Direct	Indirect	**Total**	Direct	Indirect	**Total**	Direct	Indirect	**Total**	Direct	Indirect	**Total**
Buildings	14,050	1,090	**15,150**	0	0	**0**	0	0	**0**	**14,050**	**1,090**	**15,150**
Transport	6,090	590	**6,680**	0	0	**0**	2,590	720	**3,320**	**8,690**	**1,310**	**10,010**
Water, energy, and communications	0	0	**0**	500	0	**500**	680	40	**720**	**1,180**	**40**	**1,220**
Agriculture	450	0	**450**	0	0	**0**	0	0	**0**	**450**	**0**	**450**
Total	**20,610**	**1,680**	**22,290**	**500**	**0**	**500**	**3,270**	**770**	**4,040**	**24,380**	**2,450**	**26,840**

Note： The management division is judged in the outline according to its sector for management and scale.

2.5 Legal System and Institutions Related to Landslides

2.5.1 State Organizations

The RA has 15 Ministries and the Prime Ministerial Office under the Presidential Office.

The territory of the RA is subdivided into 11 local administration regions, namely Yerevan Capital City and 10 regions referred to as Marzes. Independent assemblies do not exist in these local administrations.

The President has the following characteristics and powers:

- The president is elected by a national election.

- The president nominates and dismisses the Prime Minister. Moreover, other government members are nominated and dismissed according to the Prime Minister's recommendation.
- The president nominates and dismisses the head of a local administration (heads of the Yerevan Capital City (which is an elected body since November, 2005) and of 10 Marzes).
- The heads of the communities (Yerevan Capital city is subdivided into 12 communities) are elected by the communities.

Therefore, presidential intentions are greatly reflected in the management and the actual power of the ministry and the impact of the assembly is minimal. Political decisions take the form of governmental decrees by presidential or prime ministerial signature.

2.5.2 Legal System

The actual practices and issues of the legal system related to landslides are summarized in Table 2.8.

Table 2.8 Actual Practices and Issue of Legal System related to Landslides

Legal System related to Landslide	Actual practices and issue
State responsibility to preserve the environment Constitution: Article 10 State responsibility to preserve the environment Water Code: Article 91 State responsibility to prevent or minimize damage caused by disasters (floods, mudflows, landslides and others).	MoUD makes the investigation plan and house relocation plan for landslide management. This is issued as a governmental decree. Because the budget is insufficient or not executed, practical measures are not executed.
Trust of land management to heads of community Community Code: Article 45 Head of community is entrusted by state for protection of lands from landslide, flood, and pollution by chemicals.	Heads of communities cannot execute their responsibility because of lack of budget, specialists, and support from the Government.
Formulating and execution of land use plan Community Code: Article 37 Head of community compiles community development plan, land zoning and use schemes, and upon agreement with the respective authorized state body through the regional governor, submits to the community council for approval. Head of community can issue permits for construction. Land Code: Article 42 Head of regional administration implements control over community plans for land zoning and use and implementation of main plans of residents.	Generally, inhabitants' and specialists' opinions are not reflected in land use plans formulated by community heads. Inputs by specialists are not available. In general, there are no engineers who can judge the danger of earth and sand disasters for the issuance of construction permits in small-scale communities.

2.5.3 Organizations Related to Landslide Management

Table 2.9 outlines the roles of organizations related to landslide management

Table 2.9 Organizations and Roles

Organizations	Main Activities
Ministry of Territorial Administration : MoTA **Sub organizations** **Armenian security service** **Water Committee** **Regional administrations (Yerevan Capital City and 12 Marzes)**	-Support for community -ARS reacts on emergencies: wars, accidents, hazards. It sometimes investigates inhabitant-security related landslides (e.g. Geghadir toxic waste landslide), corrects landslide-related materials, and produces the GIS database. The umbrella organization Crisis Management Institute (CMI) is in charge of disaster education. -Water committee administers water supply programs (Responsibility for river hazards is not clear among MoEP)
Ministry of Urban Development: MoUD	- Government decree No. 1074 appoints MoUD for overall organization and implementation of a "preliminary landslide management program".
Ministry of Transport and Communication: MoTC	- Management of landslides related to state roads and railways
Ministry of Environmental Protection: MoEP	- Management of rivers (Responsibility for river hazards is not clear among Water Committee under MoTA)
National Science Academy	-Geo-technological research（(MoUD department of science and technical policy cooperates with this Academy)
Communities (Cities excluding Yerevan Capital City, Villages, Communities in Yerevan Capital City)	-Natural hazard management in communities -Land use planning and implementation -Issuance of construction permits -Adjustment among neighboring communities on conflicts by projects (stake holder meeting or environmental assessment)
Inter Community Unions, Community Unions CU/ICU	-Securing of transparent accounts of the projects, organizing specialists, education, experience sharing among neighboring communities -Executive organization（receiver of funds from donors）

2.5.4 Execution System of Landslide Program

Government Decree No. 1074 in 2001 was drafted by MoUD and appoints MoUD as the organization with overall responsibility for the implementation of the 'initial landslide management program'.

The supervising organization is the Department of Science and Technical Policy of the MoUD. It is responsible for the engineering survey, protection of territory and facilities (four engineers).

Departments of urban development, under regional administrations/Marzes, are in charge of landslide management, and are instructed by or incorporated with the MoUD.

The budget for landslide management is executed by tenders for consigning of investigation and construction works by MoUD or Marzes (transferred from MoUD).
Tender documents, including specifications, are produced by MoUD with the affected regions, outlining the purposes and the amounts involved. The bid organizations produce detailed specifications and the estimate is based on the tender documents.

The Ministry of Territorial Administration (MoTC) has jurisdiction for community support and regional development. MoTC supervises the regional administration (Marzpetaran) and the Armenian Rescue Service (ARS). The Department of Urban Development under Marzpetaran is in charge of landslide management and is instructed by MoUD. ARS is in-charge of crisis management of natural hazards, fires, etc., and has regional offices in Marzes, other from Marzpetaran.

2.5.5 Community's Situation

The Community Code provides the following:

- Head of community must execute the means of ensuring the lawful rights of inhabitants and the community's economic property.
- Head of community must prevent and remove man-made/natural disasters to receive the trust of government.
- Head of community must compile a community development plan (master plan).

There are 1,006 communities in the RA, about 60 percent have a population under 1000 people. Annual budgets of these communities average AMD 7.5 million (USD 17 thousand), with income from community property, income tax, land ownership tax and subsidies. Subsidies from government account for 40-50% of the revenue. Around 80% of the communities do not have invested expenditure, and in some communities the entire budget is limited to personnel's labor costs.

Because of lack of budget and shortage of specialists, heads of communities cannot execute their responsibilities of natural hazard prevention.

Community improvement activities by mutual-aid are hardly widespread. Event such as festivals are also scarce. In those social circumstances, substantial land preservation management has not been conducted by communities.

In general, a small community with a population below 1000 is managed by a staff of 5 to 10 people (including the head of community) as shown in Figure 2.3.

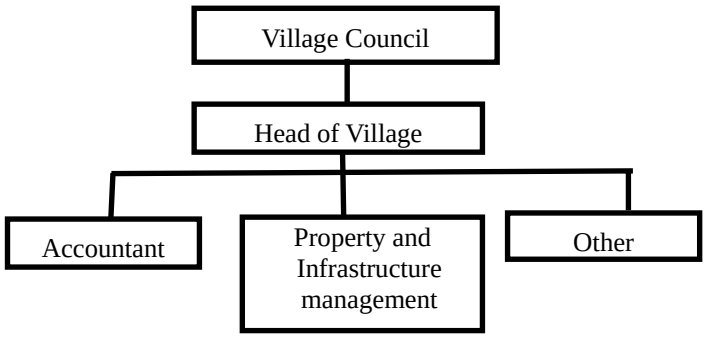


Figure 2.3 Organization of Small-Range Communities

2.5.6 Community Unions

Community law states that a community may form inter-community unions (ICU) based on mutual agreement between communities. DfID supports ICU establishment but no ICU had been established as of December 2005. The Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) supports the establishment and project execution of Community Unions (CU) which conduct provisional activities until establishment of ICU based on the law. CUs have been established in Syunik and Tavush Marzes and in the hub cities surrounding other Marzes.

The functions of these community unions include selection of priority projects from the communities' proposals, provision of transparency in the implementation of projects including accounting, stakeholder adjustments such as the environmental problems between adjacent communities, human resource development (education and training), and receiving of project capital from donors etc.

2.6 Technologies Related to Landslides

2.6.1 History of Landslide-related Technologies

In the Soviet Era from 1950-1980, investments were undertaken for agricultural development and infrastructure development. In projects, landslide problems were encountered and many landslide

investigations were done. World-leading technological research was done at that time with integrated study and formulation of master plans of sediment disaster management conducted in the 1980s. However, no systematic management guidelines were developed and as a result technology diffusion was not achieved.

Examples of countermeasure works are very rare; the drainage tunnel at Dilijan City is one example of a large-scale measures. To date, the main method of landslide management is the relocation of families whose houses were damaged.

Systematic management of landslides has not been practiced due to the political and economic confusion since the independence of RA in 1991. During this time, large-scale landslides such as the Odzun Landslide（Lori Marz；1993）, Ijevan-Hrazdan Landslide at railway 69km（Tavush Marz；1993）, and Harutyunyan street Landslide（Syunik Marz；1994）have occurred. Different organizations have responded but without a systematic approach resulting in ineffective countermeasures.

2.6.2 Current Situation of Landslide Technologies

To improve the above-mentioned situation, in 2001 the “program on Landslide Primary Countermeasure in the Territory of the RA” was formulated and issued as a Government Decision. The purpose of this program is systematic landslide investigation and effective landslide management. Actual investigations started in 2004 and data on topographic analysis and monitoring are now being accumulated. Planning and execution of landslide management has not, however, been implemented.

2.6.3 Issues on Technology Accumulation

Public engineering-related departments are now privatized in the RA. Engineers are, however, few in the ministry.

Therefore relevant engineering knowledge and skills are not being accumulated in the public sector and are not transferred between generations, and project management including engineering and financial justification is not properly undertaken by a responsible ministry.

PART-II MASTER PLAN

CHAPTER 3 BASIC POLICIES

3.1 Outline of the Master Plan

The ideal landslide management program is composed of three basic policies as shown below, and is based on the financial and other capabilities of the RA:

- Community development as an overall target
- The state responsibility
- Appropriate management according to damage level

3.2 Policy 1: Community Development as an Overall Target

The M/P deals mainly with landslides which cause damage to communities. Each community plans and implements its landslide management project with financial and technical public support, and with the ultimate goal of community development.

Landslides in the RA are categorized into two types according to the objects affected by them:

- Community Landslides: Landslides that predominantly and directly affect the daily lives of communities situated on them.
- Wide-area Infrastructure Landslides: Landslides that predominately affect inter-community/ inter-regional infrastructure.

More than 80% of the total direct losses caused by landslides relate to Community Landslides, while less than 20% are generated by Wide-area Infrastructure Landslides. Approximately 40% of mountainous area communities are located on sites of landslide areas. The Master Plan mainly deals with community landslides, because it is necessary to deal with the landslide issue as a common problem of mountainous area of the RA.

Projects with the sole target of landslide damage reduction are generally not given a priority due to the lack of cost/benefit justification. Therefore, landslide management projects which contribute to community infrastructure development, such as drainage construction for improving muddy road conditions to insure passableness by vehicles, should be planned and prioritized. Such projects generate higher benefits, which assure economic validity of the investments.

Each community plans and implements its ‘community development (income generation) project’ by

receiving financial and technical support from the Government. Communities should then invest their earnings to 'projects for landslide management and community infrastructure development' and in subsequent 'community development projects'. Communities can then gradually expand the scale of projects and their outcomes.

The purposes of the Projects (effectiveness of projects upon completion) are given below:

- Reduction of casualty and damage
- Development of community infrastructure for livelihood and industry
- Increase of the inhabitants' income and community budget

3.3 Policy 2: The State Responsibility for Landslide Management

The State (management authorities) has the responsibility to support the financial and technical requirements for nationwide landslide management by the various implementing bodies (communities or management organizations for wide area infrastructure landslides).

3.3.1 Necessity of State Responsibility for Management of the Community Landslides

The Community Code of the RA provides that the head of community must prevent and remove man-made/natural disasters to receive the trust of the government. But around 80% of the communities do not have invested expenditure. And heads of communities cannot fulfill the obligation. Thus, technical and financial support should be the role of the state.

3.3.2 Significance of Landslide Management as an Issue of Importance for the State

(1) Significance of Community Landslides

The Landslide management budget has been a very low ratio of the State budget. When the ultimate goal of landslide management is community development, and it is done by multipurpose projects which contribute to poverty reduction (most important issue of the RA), consensus of state investments can be formulated.

The degradation of the water system and drainage facilities have resulted in water leakage and activation of landslides. Landslides damage not only houses but also community roads and water, energy, and communication infrastructure. Deterioration of life and industry is an obstacle for working efficiently and for attracting industry. The poverty and landslide activities form a vicious cycle.

After the collapse of the USSR, communities in Armenia converted from the group or governmental

agricultural method to the individual farming method. The afflux and accumulation of capital ceased, and poverty worsened. Communities and their/ inhabitants did not have disposable income for development of dwelling houses and community infrastructure, resulting in the degradation of various facilities.

To break such a vicious cycle and commence the afflux and accumulation of working capital, it is efficient to start from landslide countermeasures which contribute to community infrastructure management such as the mitigation of leakage from water supply systems, and the provision of drainage, and in particular road drainage, which improves passableness.

(2) Significance of Wide Area Infrastructure Landslides

In Poverty Reduction Strategy Paper（PRSP 2003）the following 3 items are given priority to:

1) Inter-regional roads
2) Drinking water supply
3) Irrigation

The RA currently appears to be at the basic infrastructure development stage. Social infrastructure development may cause new landslide activities. These projects should be studied from the landslide point of view as a state responsibility.

3.3.3 Relationship between Implementation Bodies and Management Authorities

The proposed relationship between management authorities and implementation bodies of landslide management are as follows:

Table 3.1 Relationship between Managing Authorities and Implementation Bodies for Landslide Management

Risk Objects	Management Authorities (Responsible organizations for the technical and financial side of landslide management)	Implementation Body for Landslide Management (Communities or management organization for wide area infrastructure)
Community infrastructure, private property	MoUD, MoTC, Urban Development Department of Marz	Communities
Wide area infrastructure		
Inter regional road	Ministry of Transportation and Communications (MoTC)	Transportation and Communication Department of Marzpetaran
Railway	MoTC	Private companies
Communication infrastructure	MoTC	Private companies
Energy supply infrastructure	Ministry of Energy（MoE）	Private companies
Water supply infrastructure	Water Committee of MoTC	Private companies
River	Ministry of Environmental Protection (MoEP)	Environmental Protection Department of Marzpetaran

The MoUD has the overall responsibility for community landslide management and integrated management of landslide-related information and technologies. It gathers new information and technologies and disseminates these to all organizations and personnel related to landslides.

3.4 Policy 3: Appropriate Management According to Damage Level

The Implementing bodies manage landslides according to damage progress level.

Landslide risk management policy based on damage progress level is as follows, and as shown in Table 3.2.

(a.) Landslides for which there are no reports of damages (2,359 in total)

The Government of RA **manages information and knowledge** to minimize the risks of new landslide damage which can result from new development activities.

Management authorities are responsible for landslide management and for the provision of financial and technical support to the Implementing Bodies. The implementing body for landslide management is charged with the management and organization of daily activities (communities and management organizations for wide-area infrastructure) for (b.) and (c.).

(b.) Landslides with damages which are dormant (77 in total.)

Implementation bodies for landslide management investigate and assess risks and perform

pre-disaster mitigation and preparedness as necessary. The actions for (a) should be also implemented.

(c.) Landslides with damages which are progressing (68 in total.)
Implementation bodies **manage the risks to avoid casualties and damage.** Actions for above-mentioned (a.) and (b.) should be also implemented.

Twelve (12) Priority landslides have been selected for study based on severity of risks, from 68 active landslides. MoUD should formulate the pilot project plans for these 12 landslides, including geotechnical investigations, procurement of materials for countermeasure infrastructure, and the dispatch of specialists and technical support for the planning and implementation of projects through the Urban Development Department of Marzpetaran**.**

Table 3.2 Landslide Management Policies based on Damage Progress Level

Damage Progress Level of Landslides	**Landslide Risk Management[1] Policies**
Level-(1): Progressive Damage **(68 landslides)**	**1.【For Level-(1) landslides】** **Purpose:** Avoidance of casualties **Activities:** **Security management**: Formulation and implementation of early warning and evacuation system based on landslide monitoring, etc. (by management bodies with public technical and financial support) Risk Management listed in items 2 and 3 shown below should also be executed.
Level-(2): Dormant Damage **(77 landslides)**	**2.【For Level-(1) and Level-(2) landslides】** **Purpose**: Risk reduction for buildings and infrastructure, etc. **Activities**: **Pre-disaster mitigation and preparedness** - Risk assessment for landslide mechanism, activity, hazard area, risk objects, damage amount → - Selecting of mitigation and preparation method → - Planning and designing → - Implementation Risk Management listed in items 3 shown below should also be executed.
Level-(3): No Reported Damage **(2,359 landslides)**	**3.【For Level-(1), -(2) and –(3) All landslides】** **Purpose:** Risk avoidance of new landslide damage caused by new development activities **Activities**: **Information, Knowledge Management** - Disseminating knowledge on landslides by MoUD (newsletter, technical bulletin) - Appropriate Planning and designing by development bodies.

[1] Risk Management: It is defined as a method of examination and execution of effective actions towards potential risk (damage scale and probability of generation).

CHAPTER 4 COMMUNITY LANDSLIDE MANAGEMENT

4.1 Purposes

Landslide countermeasures improve security and safety of life. Unfortunately, these countermeasures sometimes cause negative effects such as decrease in spring water by drainage boring. It is necessary for countermeasures to have positive effective outcomes.

It is incorrect that if landslides are mitigated, poverty is not alleviated and people leave the land. The gentle slope and abundant water in Landslide lands attract inhabitants. Co-existence with landslides and methods of poverty reduction should be examined.

“Landslide countermeasures which contribute to community infrastructure development”, such as road drainage works, indirectly affect income generation and expand beneficiaries/investors.

The purpose of landslide management is set from the above-mentioned viewpoints.

Table 4.1 Purpose and Outputs of Community Landslide Management

Ultimate Goal	**Community development（income generation, poverty reduction）**
Project proposes	- Disaster prevention （avoidance of casualty, damage reduction） - Development of community infrastructure for life and industry
Project outputs	-Plan and implementation of landslide management and community infrastructure development - Plan and implementation of community development concept -Formulation of organization (Working commission) for planning and execution promotion in the community -Organization and system for landslide monitoring and early warning -Civil works for landslide disaster reduction and community infrastructure development - Organization and system for maintenance of community infrastructure

4.2 Community Based Approach (CBA)

4.2.1 Public Assistance (Given Conditions and Issues)

Given conditions of community landslides and budgets for landslide management are summarized in Table 4.2.

Table 4.2 Outline of Community Landslides

Numbers of Communities for which Damage is Reported（1,017 communities in RA）	121 communities (12％ of all communities)
Total Potential Damage by Landslides to Communities and Inhabitants	AMD 22.3 billion (USD 49 million) (USD 400 thousand/ community)
Budget for Landslide Management（MoUD in 2005）	AMD 92 million/ year (USD 0.2 million/ year) (Approximately 1/245 to the total potential damage to communities and inhabitants)

The budget for landslide management (MoUD, 2006) was zero as of November 2005. MoUD requested AMD 28 million (USD 62 thousand) from the Prime Minister as an annual landslide management budget for 2006 for selected landslide management projects and information services.

It is an issue that the Government of the RA has not recognized landslide risk and effect of measures and management, and consensus of investment has not been formulated yet. The Feasibility Study of the Pilot Projects show that the landslide countermeasures which contribute to community infrastructure development are economically feasible when the willingness of inhabitants to pay (effectiveness of community infrastructure development) is included in the benefits.

Therefore the Government of Armenia should formulate landslide management programs and invest in them.

The Study Team suggested to MoTA through MoUD a formulation of 'Community Support Program for Landslide Management and Infrastructure Development: subsidy systems'. However, this program had not yet been adopted as of February 2006.

There is an existing system of Honorarium for Work (HFW). In this system inhabitants who work for community projects are paid AMD 1,200/day (USD 2.6/day). This system should be incorporated into the landslide management program (public technical and financial assistance program), which will contribute to community infrastructure development.

The budget of USD 62 thousand/year (by MoUD) is a given condition for public assistance in the next three years. It is a repurposed budget from MoUD to Prime Minister in December 2005 as 2006 budget.

The average subsidy of small-scale communities (less than 1,000 people or approximately 60% of all Armenian communities) is AMD 3.4 million/year (USD 7.5 thousand/year). This is mainly used as

salaries for staff and retirement reserve. Therefore, the greater part of Communities are in difficult situations to execute projects.

4.2.2 Given Conditions of Community Self Reliance Effort

For these pilot projects, inhabitants worked as general construction workers receiving AMD 1200 (USD 2.6)/ day which is 1/3 of the market rate. Skilled workers were available from communities and neighboring cities for AMD 8,000-10,000 (USD 18-22)/day. Landslide monitoring teams and early warning systems in communities were formulated using labor from the communities. In this case inhabitants' labor input is possible to some degree.

Communities are reluctant to start and continue landslide management programs because of their limited financial conditions.

4.2.3 Given Conditions of Support from the International Organizations

Support programs for communities are available as follows, based on communities/ NGOs applying with a planning proposal and cost proposal:

- Japan: Grant Assistance for Grass-roots Human Security Projects （less than JPY 10 million, USD 90 thousand, AMD 38 million scale)
- The USA: Save the children NGO – Community Self Help Found （less than USD 2,000, AMD 910,000 scale）

GTZ supports the establishment of Community Unions (CU) and the formulation of community development projects through the CUs. CUs have the function to secure transparency of projects and their accounts, and the function of adjustment among neighboring communities. Most international cooperation organizations require the above-mentioned functions as necessary conditions; therefore there are many cases when CUs are the receivers of donations instead of communities.

4.2.4 Rationality of Community-based Approach

Given the condition of limited finances, the Community Based Approach (CBA: planning by communities, implemented through community participation) is a reasonable way to start and sustain the projects for landslide management and community infrastructure development. The merits of CBA are as follows:

- Local inhabitants have detailed knowledge of the damages caused by the specific landslides and the resources, which can be used for landslide countermeasures and

community development.

- Local inhabitants can check and maintain community infrastructure such as water supply and drainage facilities. They can undertake daily monitoring of landslides, if technical guidance from specialists is provided first.

4.3 Methods of Planning and Execution

4.3.1 Resource Acquisition Plans

(1) Kinds of Resource Acquisition Plans

Resource acquisition plans are the basic element supporting community landslide management.

Resource acquisition plans are subdivided into two methods as follows:

- Resource acquisition as an effect of landslide measures which contribute to community infrastructure development and
- Income generation plan.

Income generation is a resource acquisition plan of projects and at the same time it is the projects' ultimate goal.

(2) Planning and Execution of Landslide Management which Contributes to Community Infrastructure Development

1) Meaning

In pilot projects sites, the Study Team investigated the willingness to pay of inhabitants for "landslide countermeasures which contribute to community infrastructure development". Willingness to pay of the whole community is 1% of the potential direct damage of landslides. This may be expanded, as the multipurpose effects of the projects are recognized.

The ultimate goal of resource generation can be achieved by investing the disposable income of preliminary projects to continuous projects.

As stated previously, for landslide management it is recommended that designs be built-in with all types of development programs such as roads, water supply, sewage, surface water management, irrigation and agricultural development sectors.

2) Examples of Landslide Management Plans which Contribute to Community Infrastructure Development

In most community landslides, water supply systems exist but they have deteriorated and leak. Most leaking and surplus water is not drained and flows in landslide land. Community roads t generally do not have side ditches, and become muddy shortly after rainfall and snowmelt. In the landslide monitoring of the Gosh village, this was confirmed during the thawing of snow.

The influence of water supply leakages on landslide activation may be large because the landslides in the RA show stability with only minimal precipitation. The drainage works may therefore have a significant effect on landslide mitigation.

In pilot projects, landslide mitigation and muddy road improvement by drainage works were included.

Landslide countermeasures which contribute to community infrastructure development are summarized in Table 4.3 and Figure 4.1.

Table 4.3 Landslide Management which Contributes to Community Infrastructure

	Gradual Improvement (Short-term)	**Ultimate Target (Medium and long-term)**	
Community Roads	-Constructing road-side ditch drains	Improving Community Roads by landslide-friendly method (masonry pavement road is recommended)	The structure should be simple one to be repaired according to the ground displacements.
Water Supply	-Repairing leaks, -Leading spilling water from storage tanks off from the landslide areas	Rehabilitating/reconstructing water supply system by landslide-friendly method	
Sewage	-Connecting sewage water to side ditch drains	Installing sewage drain networks by landslide-friendly method	
Irrigation	-Repairing leakages, -Minimizing water-use	Rehabilitating/reconstructing water supply system by landslide-friendly method	
Community Drainage	-Installing surface, underground drains, and/or borehole drains	Installing of entire network of drainage system by landslide-friendly method	

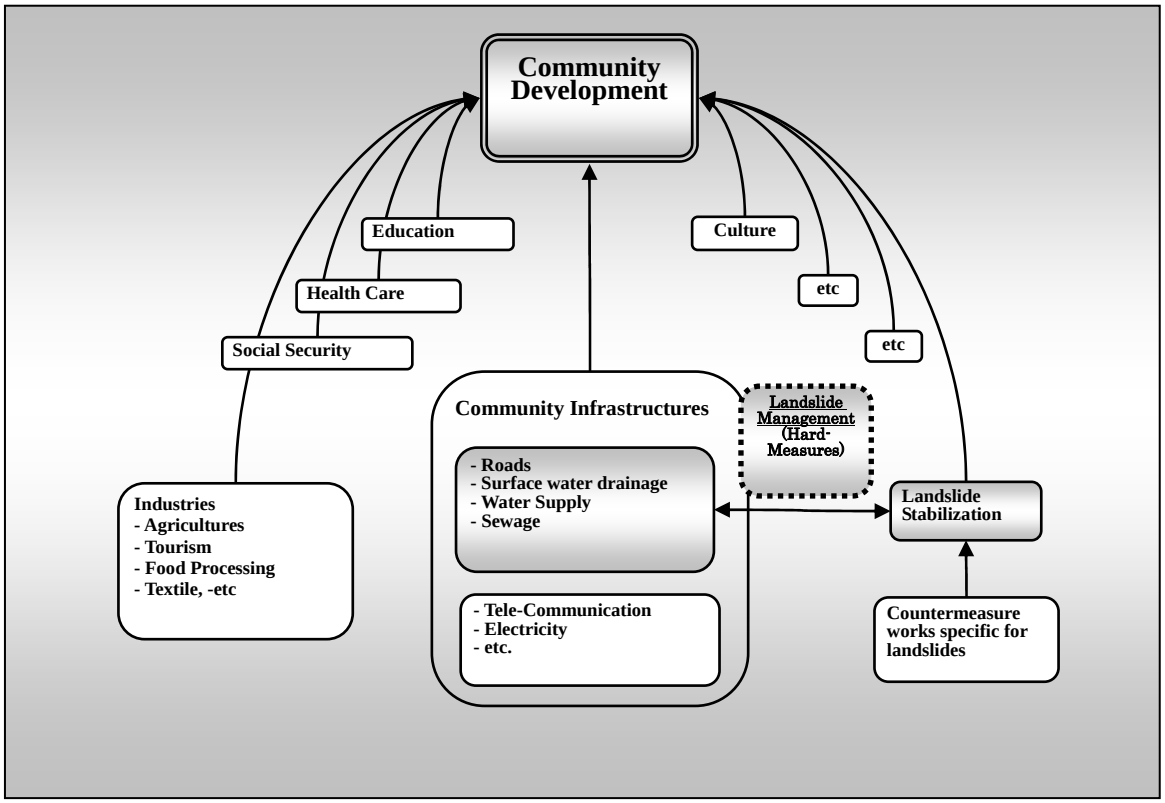


Figure 4.1 Landslide Management Useful for Community Development

(3) Income Generation Plan

In most communities which have landslide issues, the following fields of productive resources are typically identified.

Table 4.4 Existing Resources related to Income Generation

Category	Resources
Agriculture	Wheat, Bee keeping, Fruits, Vegetables, Forage, Medical herbs and trees
Animal Husbandry	Cows, Pigs, Goats, Sheep, Poultry
Food Processing	Cheese, Milk, Juice, Wheat flour, Meat
Tourism	Logging, Eco-tourism, Souvenir shops, Local guides
Others	Rock Mining
Employment	Local kiosks, Office of local self-government, Small-scale construction laborers

Levels of utilization for those resources at present are generally low. This is most likely due to lack of technical skills, investment capital, means of transportation, know-how of marketing, and so on.

The current likely conditions of rural communities and examples of expected conditions regarding the income generation activities in the short-term and medium to long-terms are shown in Table 4.5.

Table 4.5 Present Conditions and Expected Conditions for Income Generation

Present Conditions	Expected Conditions	
	Short term	**Long term**
Agriculture / Animal Husbandry		
Small productivity and scale; production for self-consumption	- Trial production of large value-added products	- Shift to processing and value added agricultural production
	- Gradual increase of own income/ external finance to develop production	- Savings and credit groups; - Agricultural loans
	- Gradual increase in landholding	
Lack of skills/ technology/ capacity for individual farming	Development of: - Agricultural support organizations; - Service extensions; - Better use of resources	Strengthened skills: - Agricultural techniques, - Use of water, - Facilities, - Business plans, etc.
	Gradual improvement of: - Irrigation system management, - Operation/ maintenance	- Water systems adjusted and maintained for agricultural production
Lack of markets for sales of agricultural products	- Market organizations middle-men/ intermediaries to sell products, cooperatives	- Developed markets to sell products
	- Market information for agro-products	- Production responding to demand
	Inter-Community roads gradually improved - Dissolving physical isolation to sell products	- Improved market accessibility - Telecommunication infrastructure to be developed linking with major consumption locations
Employment		
Unemployment, few opportunities for additional sources of income	- Promotion of self-employment and small business development	- Self-employment as strong additional source of income
New ideas of self-employment, entrepreneurship, private small business	- Support for food processing companies, local manufacturers, services - Private capital to be invested on the communities for new industries (i.e., food, beverage, dairy products, hides and skins, leather-related products)	- Small business consulting and training services - Infrastructure development to cater new industries

Based on the above identified resources and present conditions generally encountered by communities, the following conceptual framework can be formulated as illustrated in Figure 4.2.

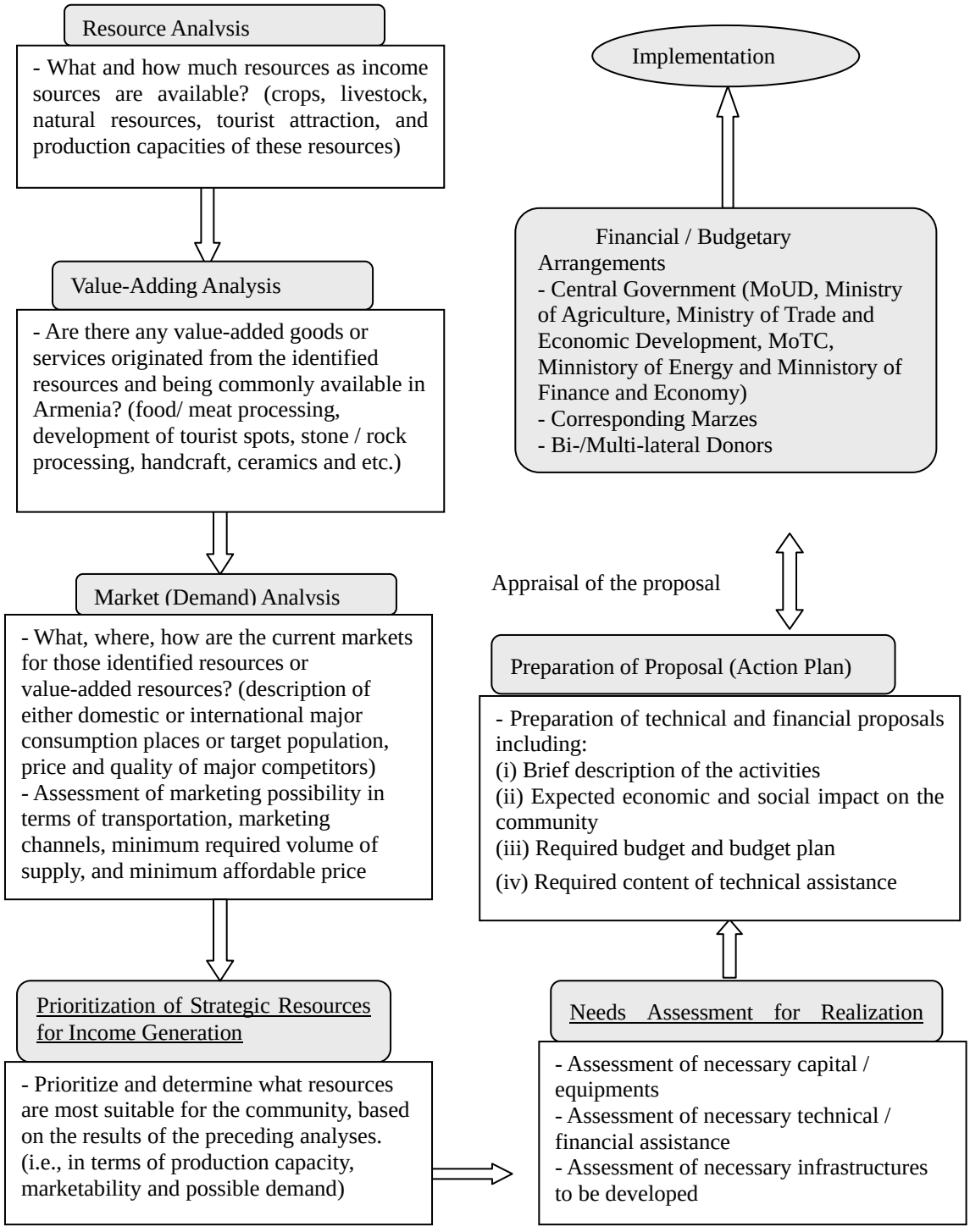


Figure 4.2 Conceptual Framework for Implementation of Income Generation Activities

The analyses and work items shown in Figure 4.2 should initially be conducted by communities. The Pilot Projects of the Study have demonstrated the capability of the community to prepare development plans and prioritize their resources, with assistance from the Study.

Assistance from local or external experts will be needed for taking steps and implementing plans. Experts should do analysis of resources, marketing, and distribution. And they should also do human capital development.

Human Capital Development

Most people in rural areas have encountered difficulties in adapting to the new market economic system. An effort to promote income generation activities should be made in parallel with human capital formation (i.e. capacity building). One of the most important goals of the specialists' activities (in Pilot Projects) is to develop entrepreneurship among the community.

As a necessary starting point, the local or external experts should discover the hidden progressive talents in the community as a basic target for transferring their knowledge, and they should provide on-the-job training during day-to-day work. As a result, the project develops in a sustainable way.

Necessary Conditions of Sustainable Income Generation Activities

i) The surplus should be not equally but proportionally distributed among participants as their own benefits subject to volume of work and production, for the purpose of enhancing one's incentive (more work should get more reward).

ii) Disposable income should be used for projects on "landslide management and community infrastructure development" and "community development".

iii) Expenditure decisions should be a subject of approval of the village leader and the village council, while a working commission should prepare investment proposals.

iv) Audit unit (internal / external or both) as a check system should be introduced to monitor the revenue and expenditure records.

Moreover, in the longer term, if sufficient public investment funds are accumulated, it is recommended that a community credit union or credit institution be established. Such a union will

make credit available as a revolving fund to support various activities of inhabitants on an individual or group basis.

4.3.2 Development of Community Organizations

(1) Basic Policies

Plan for improvement of solidarity and development ability for project sustainability is shown in the following.

In the Pilot Projects, the Community Based Approach (CBA) was used, and the germ of local social solidarity was confirmed. The continuance of CBA and development in other communities is desired.

MoUD should organize an advisory committee and conduct information services for experience sharing.

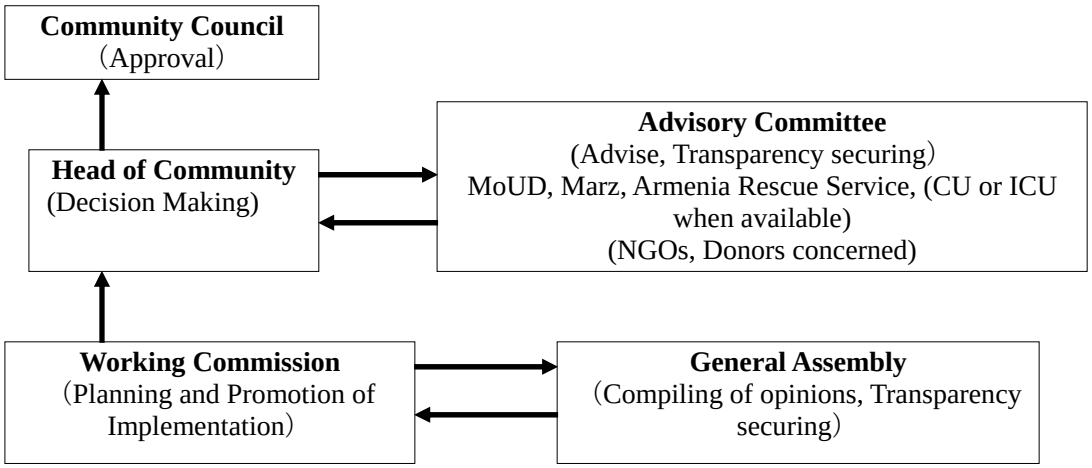


Figure 4.3 Planning and Implementation of Projects by Community Based Approach

(2) Method

1) Working Commission (Planning and Promotion) and Community Council (Approval)

The Working Commission (WkC) is a voluntary organization which discusses issues and formulates “plans for landslide management and community infrastructure development” and “community development plans”.

The Community council approves the plan and the implementation starts. Voluntary discussions and implementation of conferred contents would improve community solidarity.

WkC shall not include a formal officer such as the village heads, who has power to decide, because most villagers remain silent in their presence.

The plans would be reported to heads of communities by the WkCs and approved by the community councils.

2) General Assembly (Compiling of Opinions, Securing Transparency)

Transparency of plans and activities would be secured by general assembly and information dissemination, such as, for example, the use of a bulletin board.

3) Formulation of Landslide Monitoring Team and Early Warning System

The landslide monitoring team should be organized in the communities. The head of the community should formulate an early warning and evacuation system in cooperation with the monitoring team, inhabitants and community staff.(At this Study's Pilot Project sites, Japanese monitoring equipment were installed, although in other communities a simple movable beam, the Nuki-ita, would be installed on a first stage.)

Inhabitants would be not only receivers of a warning or evacuation recommendation, but would also be the reporters of hazard forewarning. To ensure the dissemination of knowledge of landslides, the inhabitants dwelling in the vicinity of the watchpoints should be entrusted with the monitoring.

(3) Planning and Implementation of "Landslide Management and Community Infrastructure Development"

1) Activities by WkC and Use of Specialists and Information

WkC should plan. The implementer should be inhabitants with WkC and community staff promotion. The specialists' assistance is necessary for these activities. Table 4.6 shows the planning method according to given conditions of public assistance. When public assistance is not available, specialists in community or the vicinity organizations are brought into play. When specialists' assistants is not available, experience information of pilot projects which disseminated by MoUD by newsletters or technical bulletins should be used.

Table 4.6 Use of Specialists and Information for Community-related Landslides

Given Conditions of Specialists	Planning Methods
Specialists are turned in （Selected projects such as this Study's Pilot Projects）	WkC should make the plan; specialists who contract with MoUD assist the planning.
Specialists are not turned in （Most communities）	- Specialists in communities (e.g. former engineer of the Kolkhoz) make simple plan (maintenance of water supply system, drainage etc.) - Make use of specialists of the vicinity hub city, CU, and ICU if possible. - Referring newsletters, technical bulletins of MoUD - MoUD and Urban Development Department of Marzpetaran declare the intention of consultant for community's planning in newsletters by indicating telephone No.

2) Investigation of Basal Conditions and Assessment (Risk & Resource Assessment)

To specify the landslide outline and predict assumed hazard area and activity, technical expertise is necessary, e.g. MoUD employed contractors to undertake geotechnical surveys in several selected communities.

Without geotechnical survey, WkC should organize the following activities to confirm basic site conditions.

a. Risk Mapping and Listing: mapping and listing of damaged risk objects, mapping of ground cracks, collapsed slopes (lists of risk objects were made by communities in Jul – Aug 2004, as part of this Study's landslide inventory survey). Lists should be updated as necessary.
b. Simple Landslide Monitoring: Installing of simple movable beam (Nuki-ita) or movable stakes. Results of the monitoring (e.g. amount of movement per month) should be shown on the risk maps.
c. Resource Mapping and Listing: mapping and listing of public facilities, farmlands, springs, etc.
d. Installation of simple movement measure board (Nuki-ita) to remarkable open cracks and showing of measurement results (monthly movement results).

3) Planning and Implementation

WkC should formulate a draft plan and promote its implementation by the community

government.

The basic policies for landslide countermeasures by CBA for communities lacking resources are as follows:

- Simple methods which may be executed by the inhabitants should be implemented as the first stage (e.g. drainage works, maintenance of water supply system).
- Landslide countermeasures, which contribute to community infrastructure development, are priority activities.
- To avoid casualties, an early warning system should be formulated (associated work of landslide monitoring team and community staff).
- A community infrastructure maintenance system should be formulated to avoid leakage of water supply and drainage systems.
- Resource acquisition and income generation should also be planned and implemented.

4) Information Sharing Activities in Communities

All information associated with landslides has to be open to the public. For example, the hazard and risk maps should be presented for public viewing on a wall of a public space. Landslide monitoring results should be periodically presented on a notice board of the community hall and inhabitants' opinions of the plan should be compiled.

5) Maintaining Landslide-related Information in Communities

The landslide management will be done more efficiently with accumulated knowledge of past experiences. Landslide monitoring data and information obtained from inhabitants should be maintained in a form of documentation. The following information (shown in Table 4.7) is recommended to be maintained at the community level.

Table 4.7 Documents and Data to Keep in Community

Information/Data	Form of Files	
	Hard Copy	Electronic
Plans for "Landslide Management and Community Infrastructure Development" and "Community Development"	○	○
History of Landslide Management (Hazards, Countermeasures)	○	○
Records of Seasonal/After Rain Inspections	○	○
Landslide Monitoring Data	―	○
Other Observable Data (Precipitation, Snow Depth, Spring Water Amount etc.)	―	○
Investigation Reports by the RA Government	○	―

4.4 Ideal Public Assistance

4.4.1 Pilot Project Development by MoUD

These Pilot Project sites are still at the stage of implementing self-reliance. The plans have been formulated but implementation has stayed at the stage of execution.

The guidance of the central government is necessary to continue this Study's Pilot Projects and to start up projects in new communities. MoUD should continue and develop the pilot projects.

The purposes of pilot projects development by MoUD are the following:

- To enforce the communities' self-reliance efforts and abilities, and ensure the success of the projects,
- To share successful experiences among communities affected by landslides,
- To provide consensus that landslide management contributing to community infrastructure development and targeting community development is a priority program of the RA.

4.4.2 Technical Assistance

For initiation of a project and experience sharing, the first priority role of public assistance is information services. MoUD should continue to publish newsletters and technical bulletins (information which can be used for "landslide management and community infrastructure

development").

Secondly, MoUD should provide technical assistance to selected projects centering on the continuance of this Study's Pilot Projects. This includes continuous landslide monitoring, geotechnical investigation（drilling survey etc.), and horizontal drainage boring as countermeasures. MoUD should direct the activities to contractors using donated equipments from this Study (GIS, landslide monitoring, boring, etc.).

4.4.3 Technical Support by Advisory Committee

MoUD should form an Advisory Committee consisting of officers from the central government, Marzes, community head, ARS, donors, CU/ICU, NGOs, etc. The advisory committee should be called to obtain advice, provide transparency in the decision-making processes within the community, decrease negative environmental effect, and adjust conflicts among the communities.

In view of the existing capacity of MoUD, its representative should participate as a chairman in only three existing pilot projects (Gosh village, Martuni village, Kapan City). For other pilot projects as Advisory committee support, Marz/ CU/ ICU representatives should be a chairman under the guidance of MoUD.

The advisory committee would coordinate seminars/ study tours to neighboring communities when the output of a project becomes available to some degree.

4.4.4 Public Assistance of Finances

(1) Time Frame Targets

Time frame targets of public financial assistance with the given conditions of stakeholders are shown in Table 4.8

Table 4.8 Given Conditions of Public Financial Assistance and Roles

Time Frame	**Given Conditions/ Roles**		
	Public Assistance	Self-reliance Effort and Mutual Aid	External Assistance
Short Term Steps	- MoUD and MoTC plan the pilot projects (continuation of the study's projects and additional new projects) and provide inputs to the communities on geotechnical investigation, specialists in civil engineering and income generating activities.	- In pilot projects, communities formulate "landslide management and community infrastructure development plan" and "community development plan" and execute them.	- External assistance available as experts dispatch or materials procurement
Medium Term Targets	- MoTC and MoUD examine and select communities applying for "Community infrastructure development and landslide management plan" preparation and provide subsidies for selected projects.	- Successful examples are disseminated. - Germ of self-reliance effort is outlined to other communities	
Long Term Targets	-Subsidies to communities are substantial. Role of subsidy to selected projects is small.	- Communities implement landslide management as a part of the community development plan	-External assistances has finished its role

It is difficult to predict the development speed and to set clear borders thus the time frame figure cannot be provided.

(2) Geotechnical Investigation and Specialists Dispatch by MoUD (Short-Term Steps)

At present, the community generally has no abilities of risk and resources assessment and planning. MoUD should provide inputs to the geotechnical investigation and specialists by tender and contract for selected pilot projects.

- Geotechnical investigation, horizontal drainage boring
- Materials procurement, construction machines leasing, skilled workers, honorarium for inhabitant workers

Information service is also conducted for supporting voluntary start-up of new projects (see Chapter 7).

(3) Subsidy Program for Selected Projects among Applications from Communities (Medium-Term Targets)

The Study Team suggested a ”Support Program for Landslide Management and Community Infrastructure Development” in October 2005 to Ministry of Territorial Administration (MoTA) through MoUD. This is a subsidy system to promote community plans both financially and technically. In this support program, MoTC/MoUD examines “Landslide Management and Community Infrastructure Development Plan with Cost Proposals”, which is to be applied by communities. It supports materials procurement and skilled/ general workers’ fee. The subsidy is not directly offered to communities but is offered through a contractor.

MoTA/MoUD retains guidance of the program to communities, showing successful example of pilot projects and explaining the form of application.

At this stage, projects are selected by their importance and efficiency, depending on the state’s financial conditions.

(4) Enhancement of Subsidies (Long-Term Targets)

One-sided investments of capital from the central government ensure that the communities remain dependent on the central government’s constitution. This is not a basis for sustainable community development. Therefore the long-term targets of public assistance of finance are the enhancement of subsidies that do not specify use.

CHAPTER 5 WIDE AREA INFRASTRUCTURE LANDSLIDE MANAGEMENT

Implementing bodies responsible for wide area infrastructure maintenance (government organizations or private companies) formulate and implement landslide management plans. Management authorities financially and technically support the planning and implementation activities.

Regarding landslide management undertaken by various implementing bodies and managing authorities, MoUD should coordinate these agencies to avoid overlapping and to improve efficiency.

To wide-area infrastructures not only direct damage is caused but also big indirect damage accompanied with the interruption of services and traffic. As a result, the influence on the state economy is also large. Therefore the state should identify the priority landslides and plan pre-disaster measures for . Of the selected 12 priority landslides (see chapter 2), there are 8 wide area infrastructure landslides as shown in Table 5.1.

Table 5.1 Priority Wide Area Infrastructure Landslides

Landslide/ Community Name	Area (ha)	Potential Risk Objects of Wide Area Infrastructure
Kapan City Harutyunyan Street Landslide	15	600m length railway, 800m^2 area of detour of state main road M-2, (Kapan tunnel of M-2 road is bottleneck for large tracks traffic, and sure traffic of the Harutyunyan street is necessary).
Voghjaberd Village	287	18,000m^2 area of H-3 inter regional road, 8 bridges, wide area gas supply pipe etc.
Odzun (Tbilisi-Vanadzor Railway and Road)	1	100m length railway, 2,000 m^2 of state main road M-6
Haghartsin (Ijevan-Hrazdan Railway 69 km)	49	95m length railway, 120m length Aghstev River.
Hovk Village M-4 Road 117 km	628	1,000 m^2 area of state main road M-4, 1 bridge
Yerevan Cemetery	11	5,000 m^2 area of state main road M-15
Geghadir village Toxicity Waste Reclaimed Ground	10	Pollution by cyanide in upper stream of Yerevan Capital City

The RA law doesn't clearly assign organizational responsibility for landslide management according to sector nor is the organization in charge of landslides clearly defined. For example, the Armenian Security Service is sometimes responsible for landslides from the crisis management viewpoint,

while MoUD is sometimes responsible from the housing viewpoint. Responsible organizations are determined by 'Government Decisions' on an ad-hoc basis, which appears to result in inconsistent implementation of state policies.

And private companies also managed the wide area infrastructure such as railway, water supply, energy and gas supply, and communication systems.

Based on Government Decree No. 1074 accepted in 2001, the MoUD has been appointed as the general executing organization for the initial landslide management program. The section in charge of engineering surveys and protection of territory and facilities, which employs four engineers, is in the science and technology policy department of MoUD.

Wide-area infrastructure landslide management should include a wide-area infrastructure development strategy. Table 5.2 outlines the proposal for organizations responsible for landslides affecting various risk objectives. Regarding landslide managed by various implementing bodies and managing authorities, MoUD should coordinate information sharing and program adjustment.

Table 5.2 Recommended Managing Institutions

<table>
<tr><th rowspan="2">Risk Objects To be Protected</th><th rowspan="2">Crisis Management</th><th colspan="2">Division of Terms of Reference</th></tr>
<tr><th>Plan and Finances (Project Owner)</th><th>Entrusted Engineering Implementation Agency</th></tr>
<tr><td>Railroads</td><td rowspan="2">Armenian Rescue Service (ARS)</td><td>MoTC</td><td>Ministry of Urban Development: MoUD</td></tr>
<tr><td>Interstate, Interregional, and Intercommunity Roads</td><td>MoTC</td><td>MoUD</td></tr>
<tr><td>Rivers</td><td>ARS
(Ministry of Environmental Protection: MoEP cooperates)</td><td>MoEP</td><td>MoUD</td></tr>
<tr><td>Community Infrastructure, Community and Private Asset</td><td>Community
(Supported by ARS, Ministry of Territorial Administration: MoTA and MoUD)</td><td>Community
(supported by MoTA and MoUD)</td><td>Community
(supported by MoTA, MoUD)</td></tr>
</table>

Regional government administration (Marzpetaran) has Department of Transportation and Communication, Environment Protection, Urban Development. MoTC, MoEP, MoUD and other related departments keep combination and correspond on related matters.

Detailed explanation of the knowledge management of landslide-related technologies is presented in Chapter 7.

CHAPTER 6 CRISIS MANAGEMENT PLAN

6.1 Crisis Management for Community Landslides

Community public offices should organize the landslide monitoring team for the early detection of any disaster signs. Community leaders warn and recommend evacuation of concerned inhabitants depending on the "index value (threshold)" of landslide monitoring, including precipitation levels, signs, etc. When disaster occurs, the safety and/or recovery of victims are done by the command of the head of community with support from the ARS, Marzpetaran, and local inhabitants.

6.2 Crisis Management for Wide Area Infrastructure Landslide

Management organizations formulate the crisis management plan (landslide monitoring and warning, control of the use of facilities such as road closures for safety of users, system for restoration of facilities and system for providing alternative facilities) and implement landslide monitoring and regular patrol.

The heads of Marzes for interregional road and heads of the regional offices for other infrastructure of private companies, should direct the management organization staff patrol during emergency situations, limit the use of facilities, and notify ARS depending on the "index value (threshold)" for landslide monitoring, precipitations, and results of the patrol. The patrol, during emergency situations, should limit facilities use (install barricades on roads, etc.) jointly with the staff of the management organizations for wide-area infrastructure and ARS.

When the landslide disaster occurs, the victims' protection and disaster recovery are lead by a head of Marz command with the support of ARS, Marzpetaran, management organization staff and local inhabitants.

6.3 Technical Support by MoUD and ARS

MoUD and ARS should provide technical support for the setting of the "index value (threshold)" for landslide movement, precipitation, and other signs of early warning, as well as recommendations on site evacuation and limitation on the use of facilities.

Some minor phenomena may be observed before rapid and abrupt movement of a landslide. Therefore, minimizing the level of disaster may be possible by implementing suitable crisis management measures.

Characteristics of crisis management for both community and wide-area infrastructure landslide types and their appropriate crisis management methods are outlined in Table 6.1.

Table 6.1 Crisis Management according to Landslide Types

	Community Landslides	**Infrastructure Landslides**
Management organization	Community	Public Organizations, Private Companies
Purpose of Crisis Management	Evasion of personal loss Aid for victims	Evasion of personal loss Aid for victims Functional recovery at early stage
Main Means of Communication	Management of early warning and evacuation by community office and slide monitoring team Rescue and aid activities after disaster by community, supported by Armenian Security Service	Early warning and use limitation measures (risk avoidance) by management organizations with ARS Recovery of infrastructure or securing of alternatives

Notifying the ARS is the accepted means of correspondence in the event of community landslides. Because early detection and implementation of actions in the case of landslide activity is an important factor to avoid casualties, actions by local inhabitants are necessary. From this viewpoint, an early warning and evacuation system should be developed based on cooperation between the landslide monitoring team, community public office and ARS.

Index values such as landslide monitoring for early warning and evacuation should be set by technical public support (MoUD and Armenian Security Service) and policies shown in Table 6.2.

Official announcers of early warning and evacuation recommendations are the heads of communities for communities, and management organizations for wide area infrastructures.

Index values should be reviewed to accompany the accumulation of data on precipitation and hazards.

Methods of setting the index values for early warning and evacuation recommendations

are shown in the technical bulletin of Landslide Volume 1, (December 2005), Appendix 7 Landslide Monitoring Manuals, Early Warning Manuals that the Study Team and MoUD have prepared jointly.

Table 6.2 Methods of Early Warning and Evacuation Recommendations

Index Value of Landslide Monitoring	- Early Warning; daily movement of 1 mm, monthly movement of 10 mm - Evacuation Recommendations; daily movement of 2 mm, monthly movement of 500 mm
Index Value of Rainfall Gauge	No reliable hazard database is available. Only daily precipitations at cities are available. According to Japan Meteorological Agency's analysis of 10 years sediment disasters, around 90% of disasters occurred in the cases of maximum modified accumulation rainfall index during 10 years. Therefore index values are set as follows: - Early warning index: 1/2 of maximum 24 hours rainfall for 10 years - Evacuation recommendation index: 2/3 of maximum 24 hours rainfall for 10 years

CHAPTER 7 PLAN OF TECHNOLOGY APPLICATION FOR LANDSLIDES

7.1 Introduction and Application of Practical landslide-related Technologies

MoUD has collected new information on disasters, etc. in addition to technical materials provided by this study including landslide location maps, inventory and countermeasure examples. MoUD then disseminates this information through newsletters on landslide management and other technical bulletins, etc.

An important role of MoUD is the dissemination of technologies related to landslide management, which should be undertaken under existing conditions.

Table 7.1 outlines the results of the Pilot Projects and applied policies.

Table 7.1 Introduction and Application of Policies for Practical Landslide Management

Item	Community Landslides	Application Policy
Landslide Monitoring		
Landslide Monitoring Equipment and Rain Gauge	The monitoring equipment was effectively used by the pilot projects and the early warning system has been formulated.	The early warning system will be continued and reviewed in one year. For applications excluding these pilot projects, installing such expensive monitoring equipments will be avoided, because maintenance is difficult for most communities.
Simple Movable Measuring Beam (Nuki-ita)	This was applied to pilot project sites and other sites such as the national road slope and MoUD budget investigation sites.	This method will be disseminated as a cheap, practical monitoring technique.
Landslide Countermeasures		
Drainage	Open ditch with sub-drainage and horizontal drainage boring were conducted; the works mitigated landslides and improved muddy roads.	Newsletters, technical bulletins will be handed out, with the aim of sharing experiences.
Earth Works	Some examples of landslide recovery earthworks are only partially or improperly completed.	When earthworks were conducted at Kapan Harutyunyan pilot project, specialists guided the works to ensure its success.

7.2 Development of Information Services

7.2.1 Disclosing Technological Materials to Related Organizations

The Study has created a GIS-based landslide distribution map, which covers the entire territory of the RA and is more comprehensive than the previously available one. The map needs to be distributed to relevant organizations as a part of the technical bulletins on landslides in the RA and also should be available on the web.

MoUD continually provides technical support to the communities through the Department of Urban Development of Marzpetaran on appropriate landslide management.

Earthworks and water flow caused by wide area infrastructure development may cause new landslides. Planning and implementing organizations (government organizations and private companies) should use the landslide-related technical materials collected by MoUD for project planning, design and construction works.

Managing authorities have the responsibility for the projects and should guide the planning and implementing organizations. MoUD, as the responsible authority on the technicalities of landslides, should review the infrastructure development plans and provide guidance to correct these plans.

It is planned that these materials will be used in the "Millennium Challenge of Armenia": an inter-regional road and irrigation feasibility study to be commenced in 2006.

Examples of utilization of technical materials of this Study are shown in Table 7.2

Table 7.2 Utilization of Technical Materials of this Study

Governmental agencies	**Examples of utilization**
Ministry of Urban Development (MoUD)	- Establishment of policy for housing and land use
Ministry of Environmental Protection (MoEP)	- Establishment of policy for erosion prevention - Establishment of policy for preserving forestry
Ministry of Transport and Communication (MoTC)	- Inspection of roads or railways in landslide areas - Planning of construction or rehabilitation of roads
Ministry of Agriculture (MoAG) Ministry of Territorial Administration (MoTA)	- Planning of construction or rehabilitation of irrigation and water supply systems
Armenian Security Service under MoTA	- Preliminary training for emergency response - Planning of policy for emergency response
Educational institute, Crisis Management Institute under MoTA	- Education for knowledge and know-how for landslide

7.2.2 Dissemination of Information to the Public

The most distinctive cause of community landslides is watering without precaution. In this respect it is necessary to recognize the following:

- Viable land such as areas with shallow slopes and areas where water accumulates readily is often land affected by landslides;
- Watering and leakage of water significantly influences landslide activation in the RA in those areas where precipitation is low.

Education on natural disasters in the RA commences in the lower classes of schools and continues through society. Although social concern for landslide damage is strong, by expanding information dissemination on landslide disaster, this understanding will further deepen and an approach to 'living with landslides' may be developed.

Table 7.3 shows public relations exercises that were conducted within the Pilot Projects. The continuation of these exercises by MoUD is supposed to increase the success of these Pilot Projects.

Table 7.3 Public Relations by MOUD

Item	Content
Newsletters Technical bulletins（Publication and Web site）	-Successful cases of landslide management within the Pilot Projects
Landslide physical model	-Educational materials for schools（Reorganization of landslide activity and watering）
Brusher for landslide management	- Notes for co-existing with landslides

The consultative object from the community viewpoint is assumed to be the urban development department of regional government administrations (Marzpetarans in Marzes and Yerevan City Municipality) and for important problems, MoUD should respond to reports through regional government administrations.

CHAPTER 8 INITIAL ENVIRONMENTAL EVALUATION (IEE)

8.1 Scoping and Action policy

The proposed master plan was evaluated using the JICA Guidelines for Environmental and Social Considerations (2004) and the relevant laws, regulations and guidelines in the RA.

Table 8.1 outlines the results of scoping of expected impacts and assumed mitigation measures.

Table 8.1 Summary of Impacts of Master Plan Execution (Negative/Unknown Impacts)

<table>
<tr><td colspan="2">Name of Cooperative Project</td><td colspan="3">Study of Landslide Disaster Management in the Republic of Armenia: Master Plan</td></tr>
<tr><td>Likely Impacts</td><td>Rating</td><td>Impact severity</td><td>Methods used for prediction</td><td>Assumed mitigation measures</td></tr>
<tr><td>Land use and utilization of local resources</td><td>C/-</td><td>Depends on the form of use, and whether landslide will be activated or settled down.</td><td>Landslide Investigation</td><td>Earthworks and drainage measures are necessary to increase landslide safety factor. (or decrease fanger factor)</td></tr>
<tr><td>Local conflicts of interests</td><td>C/-</td><td>There is a possibility of violating the resources of the people concerned.</td><td>Confirmation at stockholder meeting (advisory committee)</td><td>Understanding and collecting opinions by notification, project conferences and correspondence.</td></tr>
<tr><td>Water Usage or Water Rights and Rights for Common</td><td>C/+-</td><td rowspan="4">There is a possible influence during earthworks, such as underground water level decrease and water pollution. Influence may remain after earthworks.</td><td rowspan="4">Hydraulics, water quality investigation</td><td rowspan="4">-Consensus among stockholders meeting</td></tr>
<tr><td>Sanitation</td><td>C/+-</td></tr>
<tr><td>Groundwater</td><td>B/-</td></tr>
<tr><td>Water Pollution</td><td>C/+-</td></tr>
<tr><td>Noise and Vibration</td><td>B/-</td><td>There is a possibility of temporary noise and vibration during earthworks</td><td rowspan="2">-Household investigation in vicinity of construction. Generation of vibration and noise results in confirmation of work type and construction machinery.</td><td rowspan="2">-Shortening time construction time
-Relocation of construction</td></tr>
<tr><td colspan="3">Note: Rating Criteria:
A: Serious impact is expected.
B: Some impact is expected.
C: Extent of impact is unknown.
+: Positive impact is expected.
- : Negative impact is expected.</td></tr>
</table>

8.2 Procedure of Environmental Evaluation

Implementing bodies on landslide management (communities and management organizations for wide-area infrastructure) should evaluate the environmental impacts and undertake a study of the mitigating methods under the guidance of the Department of Environmental Protection of Marzpetaran.

In communities, the following methods are proposed for information dissemination for stakeholders:

Newsletters and bulletin boards (community facilities, Marzpetaran) Stakeholders meetings to include the heads of families.

Marzpetaran calls for the regional stakeholders meeting to gather and consolidate opinions for revision of the implementation body's ideas on environmental assessment and proposed actions on the negative environmental impact. Participants in the stakeholders meetings are the implementation bodies on landslide management (communities, management organizations for wide-area infrastructure), Marzpetarans, ARS in the regions, heads of communities, and the Community Unions in the regions. MoEP and management authorities are called to participate when important environmental problems are considered.

Marzpetaran reports the results of the regional stakeholders meetings to the management authorities and to MoEP. They review the reports and provide appropriate guidance to the implementing bodies for landslide management through Marzpetaran.

PART-III PILOT PROJECTS

CHAPTER 9 OUTPUTS AND ISSUES OF THE PILOT PROJECTS

9.1 Execution of Pilot Projects

9.1.1 Outline of the Pilot Projects

(1) Objectives and Purpose

The main objective is related to community landslides, as approximately 80% of damage by landslides is related to communities and private sector.

The purpose of the Pilot Projects was to undertake a trial and confirmation of the effectiveness of the 'Community Based Approach (CBA)'.

(2) Outline of Outcomes of the Pilot Projects

The Pilot Projects have become multipurpose projects, which contribute to community infrastructure development, resulting in expanded benefits. The reduction of construction costs by the participation of inhabitants showed that the pilot projects can serve as examples of economically feasible projects.

'The landslide management and community infrastructure development plan' and 'the community development concept plan for acquisition of project resources' were formulated by focusing on the working commissions in the communities. Parts of the plans, including drainage works for community roads and the implementation of landslide monitoring and early warning systems were initiated through the participation of local inhabitants. Residents' awareness of the benefits of self-help and mutual assistance was markedly improved in conjunction with the improvement of community infrastructure and the reduction of landslide activities.

Stakeholders meetings (advisory committees) were held and chaired by MoUD. Technical support, such as environmental assessment, was provided through these committees.

Plans for "landslide mitigation works which contribute to community infrastructure development" formulated from the Pilot Projects of Gosh and Martuni Villages, were assessed as economically feasible. The Pilot Project in Kapan involving hazard recovery works (opening of 2-lanes of Harutyunyan Street) was economically beneficial in keeping regional traffic safe, including the flow of bulky international cargo, which is the major means of trade across the Iranian border. The project is highly recommended for implementation.

Landslide monitoring was undertaken by the Study Team together with communities in the landslide areas. Monitoring technologies were transferred to the communities and monitoring systems were established and are operational. Drilling and GIS equipment were provided as grants to MoUD to provide technical support to the public.

(3) Items of Landslide Management

The following items were discussed and formulated at the Working Commission (WkC), which is the planning and execution center of the community, and at the general assembly:

a. The ultimate goal is community development. Project purposes are landslide damage reduction and community infrastructure development. Multi-purpose projects contributing to community infrastructure development are a priority.

b. Formulation of landslide management and community infrastructure development plans.

c. Formulation of community development concept plan (plan of project resource acquisition).

d. Formulation of task teams（landslide monitoring and early warning, community infrastructure maintenance, and countermeasure works).

(4) Pilot Projects Promotion System

The system shown in Figure 9.1 was formulated for the promotion of community initiatives.

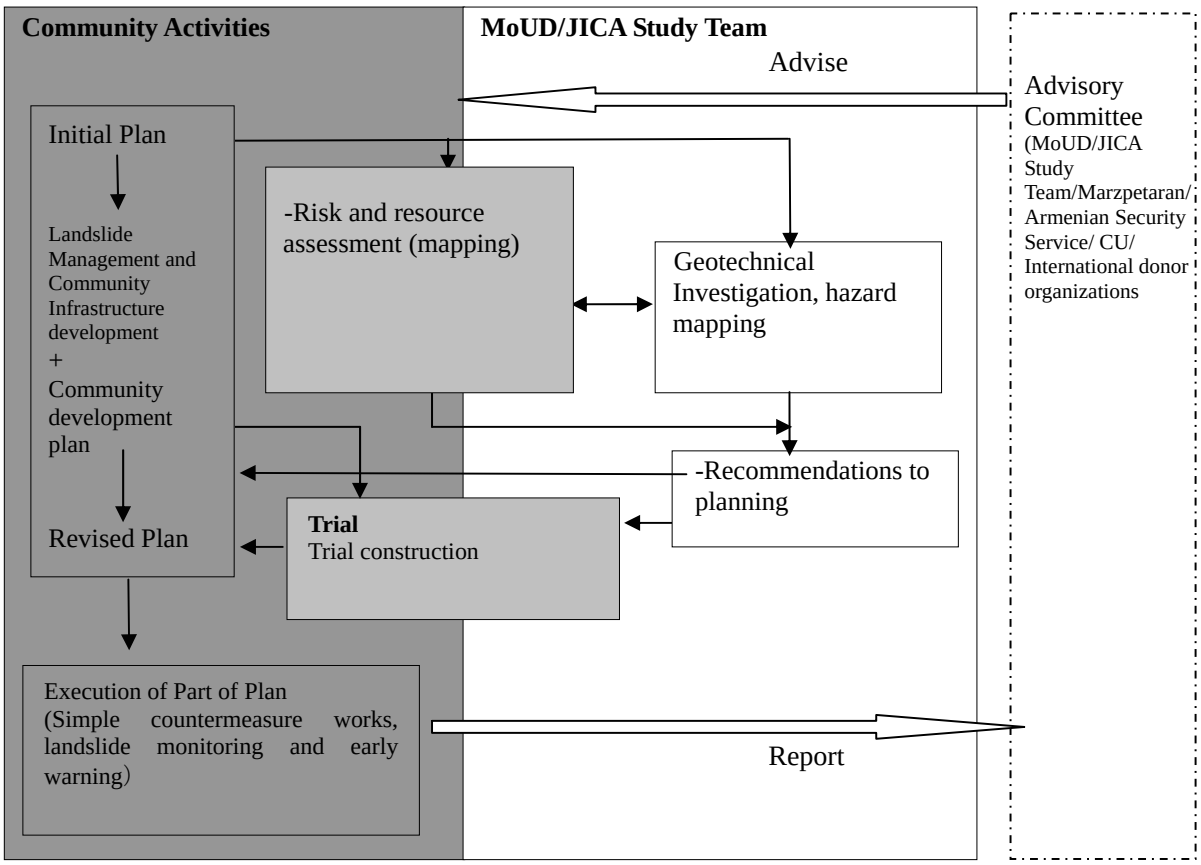


Figure 9.1 Pilot Projects Promotion Syste

9.1.2 Execution System

Preparation and execution of the plan was conducted by centering on WkC.

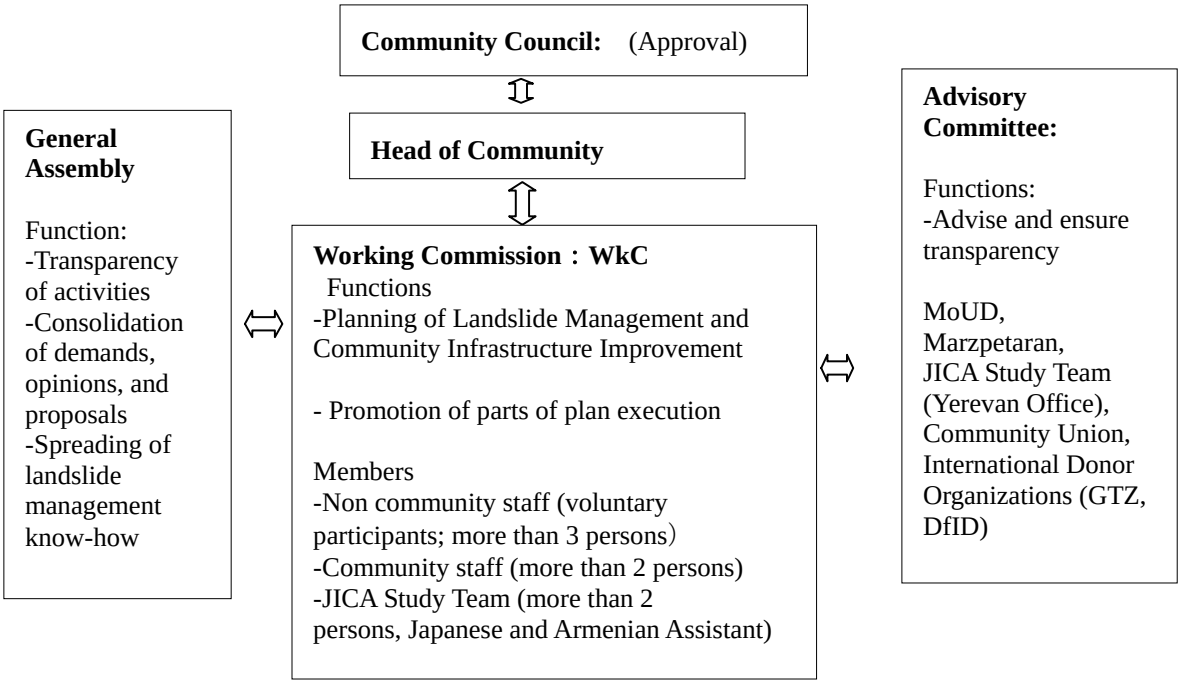


Figure 9.2 Execution System of Village Type Pilot Projects (Gosh & Martuni Village)

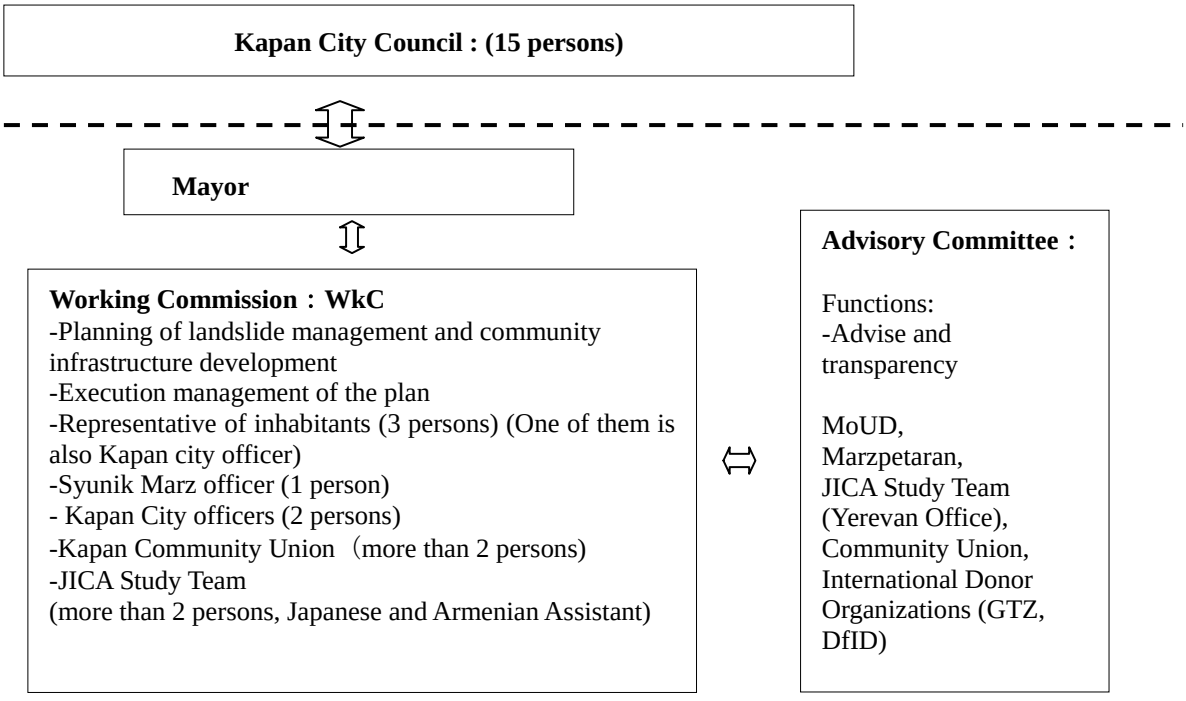


Figure 9.3 Execution System of City Type Pilot Project (Kapan City)

9.1.3 Execution Content and Achievement

Execution content and achievement level of each Pilot Project is outlined in Table 9.1.

Table 9.1 Outline of the Pilot Projects

Project Name	Execution	Purpose	Achievement
Kapan City Harutyunyan Street Landslide	-Geotechnical investigation and risk assessment (by MoUD/ JICA Study Team)	Overall goal: Development of Kapan City	-Project effects were confirmed among the stakeholders. This project secured an alternative route for the M-2 highway. (Kapan tunnel is bottleneck for trucks). -Landslide monitoring team was organized. Early warning system was formulated.
		Project purposes: -Securing of two-lane traffic of Harutyunyan Street -Bare land landscape improvement -Avoidance of casualties	
		Output: -Risk assessment -Landslide management plan	-Risk assessment was done and landslide management plan was formulated.
Gosh & Martuni Village Landslide	-Geotechnical investigation and risk assessment (by MoUD/ JICA Study Team)	Overall goal: -Community development, income generation	-Landslide management and community infrastructure development plan and community development plan were formulated.
		Project purposes: -Improvement of life and industry basis -Landslide risk reduction - Avoidance of casualties	-Project purpose was achieved by simple countermeasure works and landslide monitoring and early warning systems.
		Outputs: -Landslide management and community infrastructure development -Community roads drainage -Community infrastructure maintenance system -Landslide monitoring and early warning system	- Output was achieved.
Yerevan City Cemetery Landslide	-Geotechnical investigation and risk assessment (by MoUD/ JICA Study Team)	Ultimate goal: -Landslide technology of this type is used for urban/ regional development plans	-New findings about the landslides were disseminated by technical bulletins. -Methods of geotechnical investigation and monitoring were transferred to a private company related to National Science Academy through contracted work.
		Project purposes: -Information sharing of technology of this type of landslides	
		Outputs: -Technologies for landslide investigation and monitoring -Geotechnical investigation results (Issue of technical bulletin)	
Information Services	Newsletters	Dissemination of landslide-related information （related government organizations, international organizations, community inhabitants）	Publication four times
	Technical bulletins		Publication of volume one in December 2005. It included landslide distribution map, landslide inventory of this Study.
	Others		-Landslide physical model and experiment video -Brusher of landslide management -Manual of landslide management and early warning -Technical transfer, experience sharing seminar（Yerevan） -Experience sharing seminar in Ijevan and Gavar Cities -Study tour to Martuni Village

9.1.4 Outcomes and Issues of Pilot Projects

(1) Social and Organizational Outcomes

The ‘Landslide management and community infrastructure development plan’ and the ‘community development plan’ were formulated by the Working Commissions. The inhabitants constructed an open ditch with conduit along the community road, and horizontal drainage boring was executed by a Japanese company (contract with an Armenian Company). Landslide monitoring teams and early warning systems were established. Methods of maintenance of community infrastructure were discussed. And the systems started to operate. Inhabitants planned a cleaning activity of tourism resources for the community development.

Inhabitants recognized that their participation in simple countermeasures such as landslide monitoring can mitigate landslide activity, and improve their life and industrial base, as, for example, having a dry community road.

It was confirmed that planning and implementation by the inhabitants, consensus building about priority projects, and sharing of issues among themselves can enhance the self reliance of the community.

Social and organizational outcomes and issues are summarized in Table 9.2.

Table 9.2 Outline of the Pilot Projects Outcomes and Issues

Item	Outcomes	Issues
Working Commission (WkC)	-WkC was formulated for 3 pilot projects (Gosh, Martuni, Kapan), with the role of plan making. -For obtaining various needs, the head of community was not a proper member and non-community staff members participated in the WkC. - In WkC, various opinions were obtained step by step.	-For the project continuance, the WkC should not be dissolved. -For continuous implementation of the project, public and international assistance (technical and financial) is necessary. Application for assistance should be made by the WkC.
General Assembly	- General assembly was called at Gosh and Martuni Villages as required. - The purposes were to secure project transparency and to compile various opinions. In general assembly, WkC members were recruited and approved. -Participants were less than 30 people. Remarks were not active in the Gosh Village; it did not seem to carry out its functions.	-This is necessary to avoid overemphasis of the plan on some stakeholders. -To be practical, bulletin boards and neighboring circulars should be used.
Advisory Committee	-MoUD chaired the advisory committee. -The purpose was to support the Pilot Projects and to secure their transparency. -Agreement of responsibilities and roles for the Pilot Projects was made by signed document. -Advisory committee carried out the function of stakeholders committee for the environmental assessment.	-MoUD should support the holding of advisory committee meetings.
Geotechnical investigation and risk resource assessment	-Geotechnical investigation was done by JICA Study Team and MoUD with local contractors. -House damage investigation was done by Armenian specialists. -Installment of landslide monitoring equipment was done by local contractor. - Landslide monitoring was undertaken by landslide monitoring team with the support from the Study Team. - For the resource assessment only itemization was done by WkC.	-Carrying on the investigation (by the contractor) by MoUD is indispensable.
Simple countermeasure works	-At Gosh Village, active landslide damage was minimized by drainage and horizontal drainage boring. Due to this effect, motivation was improved. -In Gosh and Martuni Villages, muddy roads were improved. -In Gosh Village and Chambarik City, which neighbors Martuni Village, there were experimental civil engineers who performed the role of construction supervisors.	- To provide materials and workers' rewards public and international assistance is necessary.

(2) Landslide Management and Community Infrastructure Development Plan

1) Gosh Village

Table 9.3 Plan of Gosh Village

Item	Outline
Features of landslide, risk and resource assessment	-It is 1000m wide, 500m long, and is divided into 15 sub-blocks. Risk objects are houses and community roads. The road across H block is important for accessing pasture and for tourism. - H block (100m long, 50m wide) is active. During Jan-Sep 2005 (before drainage works), landslide movement was approximately 10mm/day. In snow melting season, Mar 2005, the movement was 75mm/day. In winter, inhabitants were watering using domestic water to prevent freezing of water systems. This aggravated the landslide activity. H block damaged 4 houses and the important community road. - C block and J block are also active (1mm/day to 10mm/day movement); other blocks are not active (less than 1mm/day movement). - Resources are itemized (farmland, sand and rock mines, and lake and monastery for tourism)
Landslide Management and Community Infrastructure Development	- As project resource acquisition, tourism development (tourist homes, ecotourism) , agriculture and stockbreeding development (juice, meat, dairy processing) were planned. - Execution system (landslide monitoring team, WkC, and community staff) was established. - Drainage works against assumed main causes (precipitation, thawed water, watering using domestic water) were planned, including the installation of community road drainage to prevent the road from becoming muddy, and ensure passableness by vehicles all year. (This pilot project had the following plan: 770m length open ditch with conduit, 160m long conduit, 1,480m long open ditch, 570m long horizontal drainage boring, 1,830m long road stone pavement).
Executed Activities	- In Sep-Dec 2005, 470 m long open ditch with conduit, 160m long conduit, 400m long horizontal drainage works were installed at H block. Activity of H block was reduced. Boring and materials procurement were executed by Japan side through the local contractor. Community input was in the form of general workers (Japan side assisted reward for about 1/3-of market price AMD1200 =USD 2.6 /day, as well as supplemental materials (sand etc.)).

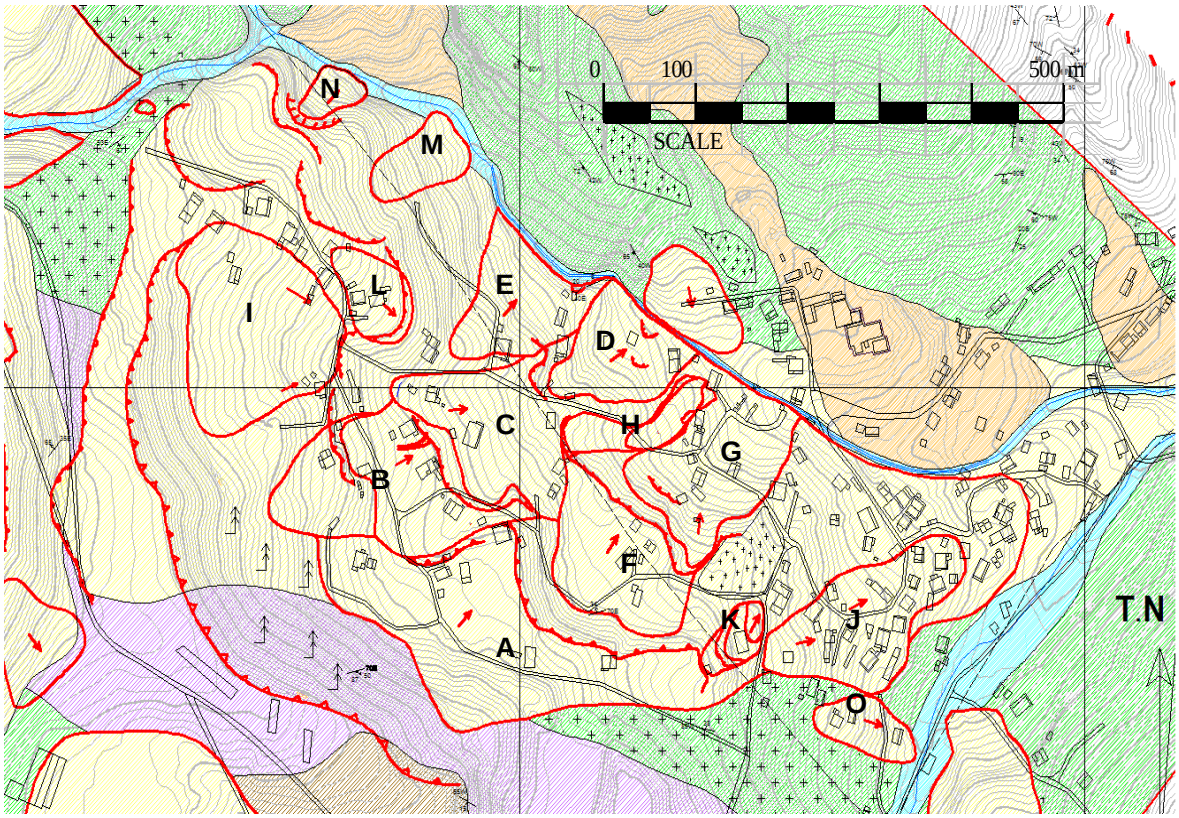


Figure 9.4 Landslide Sub-Blocks of Gosh Village

Village Landslide

Figure 9.5 General View of H block of Gosh

	Landslide deposit	Tuffish Clay and clayey Sand with crystalline or gabro gravel
	River deposit	Sand with gravel
	Talus deposit	Sand with gravel
	Old river deposit	Silt and sand with gravel
	Gabbro	Partially clayey caused hydrothermal metamorphic
	Pyroclastic Rock	Tuff breccia, Tuff, lapilli Tuff, intrusive Gabbro-porphyrite
	Hydrothermal metamorphic rock	Clayey rock or Crystalline rock

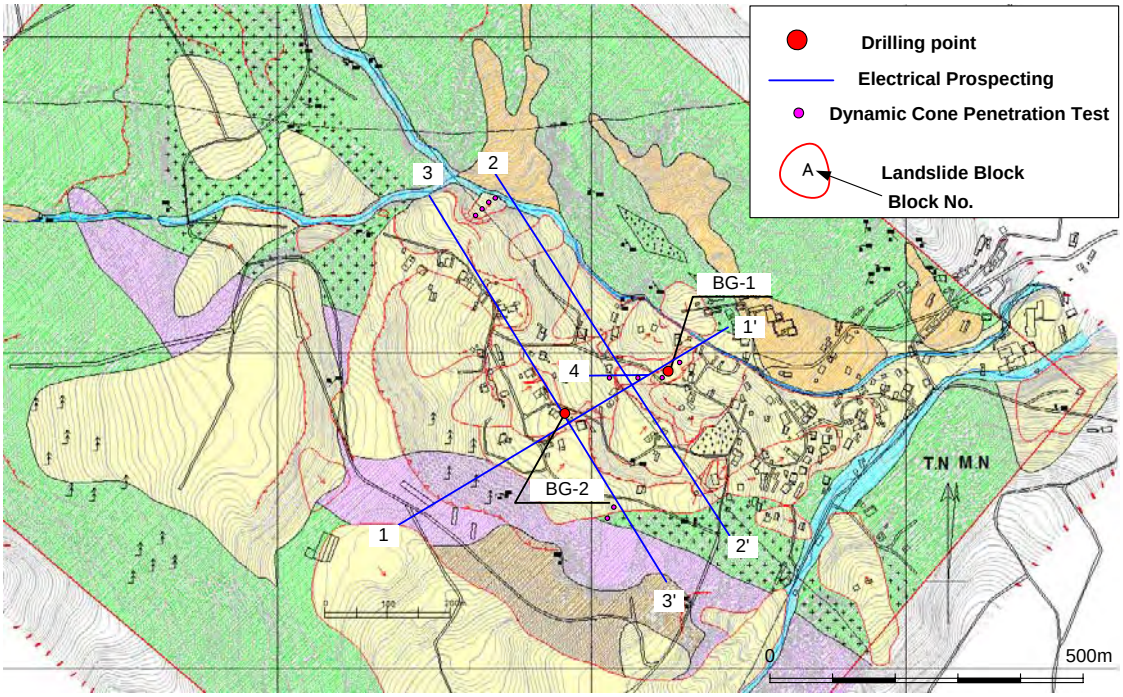


Figure 9.6 Enginering Geological Map of Gosh Village Landslide

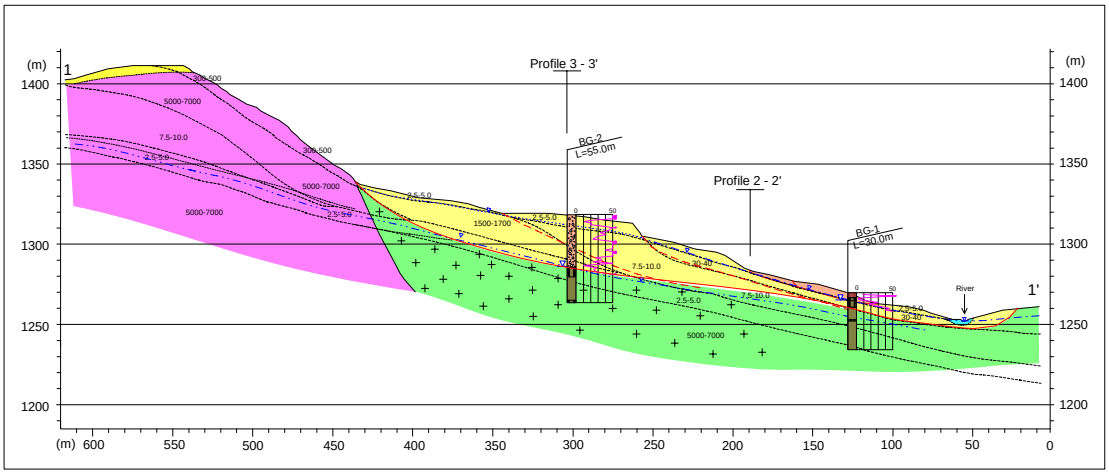


Figure 9.7 Enginearing Geological Profile of Gosh Village Landslide

2) Martuni Village

Table 9.4 Plan of Martuni Village

Item	Outline
Features of landslide, Risk and resource assessment	-Martuni Village is located at the foot area of a huge landslide (8km length, 1.5km width). The landslide shifts to the Getik River. - Small secondary landslides are distributed in the inhabitable area.. About 8 secondary landslides caused damage. A total of 108 out of 196 houses were damaged.. A block is the most active and has many risk objects. Landslide monitoring from Aug to Dec 2005 shows no cumulative movement, just tentative movement with precipitation. - Assumed induced cause of landslide activity is invading water from water tank leaks and a small river. Existing effective drainage is available only in the upper portion of the village; lower portion of drainage is without watertight lining and the drainage capacity is small. Inflow water activates landslide activity, and the community road becomes muddy. - Community road through A block is important as it accesses sharing pastures, the church and the cemetery. - Resource is itemized in firm land, pastures, and ruins as a tourism place.
Landslide Management and Community Infrastructure Development	- As project resource acquisition, wheat mill business was itemized. - Execution system (landslide monitoring team, WkC, and community staff) was established. Responsibility for community infrastructure maintenance is given to the head of the village. - Drainage works and river revetment works (concrete wall and gabion) were planned and prioritized. (This pilot project had the following plan: 54,400m long open ditch with conduit, 11,000m long conduit, 790m long open ditch, 400m long horizontal drainage boring, 8,100m long river side concrete wall, 2,470m long gabion wall, 1 site of small bridge, 200m long earth bank).
Executed Activities	- In Oct-Dec 2005, 400m long open ditch with conduit and 400m long horizontal drainage works were installed at A block. Community road through H block was improved. Boring and material procurement were inputted by Japan side through the local contractor. Community input was in the form of general workers (Japan side assisted reward for about 1/3-of market price AMD1200 =USD 2.6 /day, as well as supplemental materials (sand, etc.)).

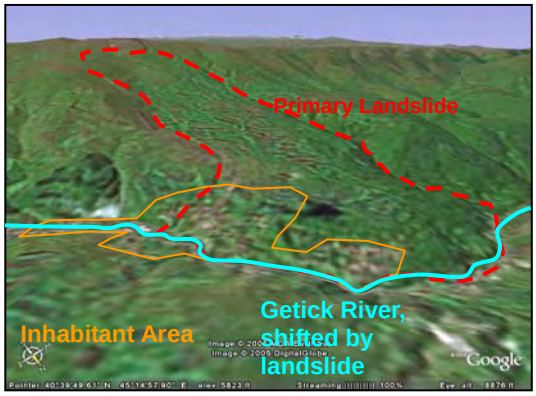


Figure 9.8 General View of Martuni Village Landslide (from North West)

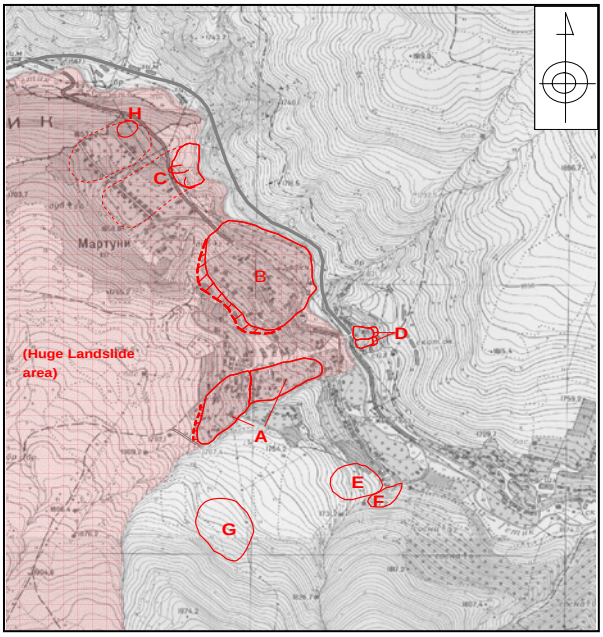


Figure 9.9 Distribution of Secondary Landslide Block in Martuni Village

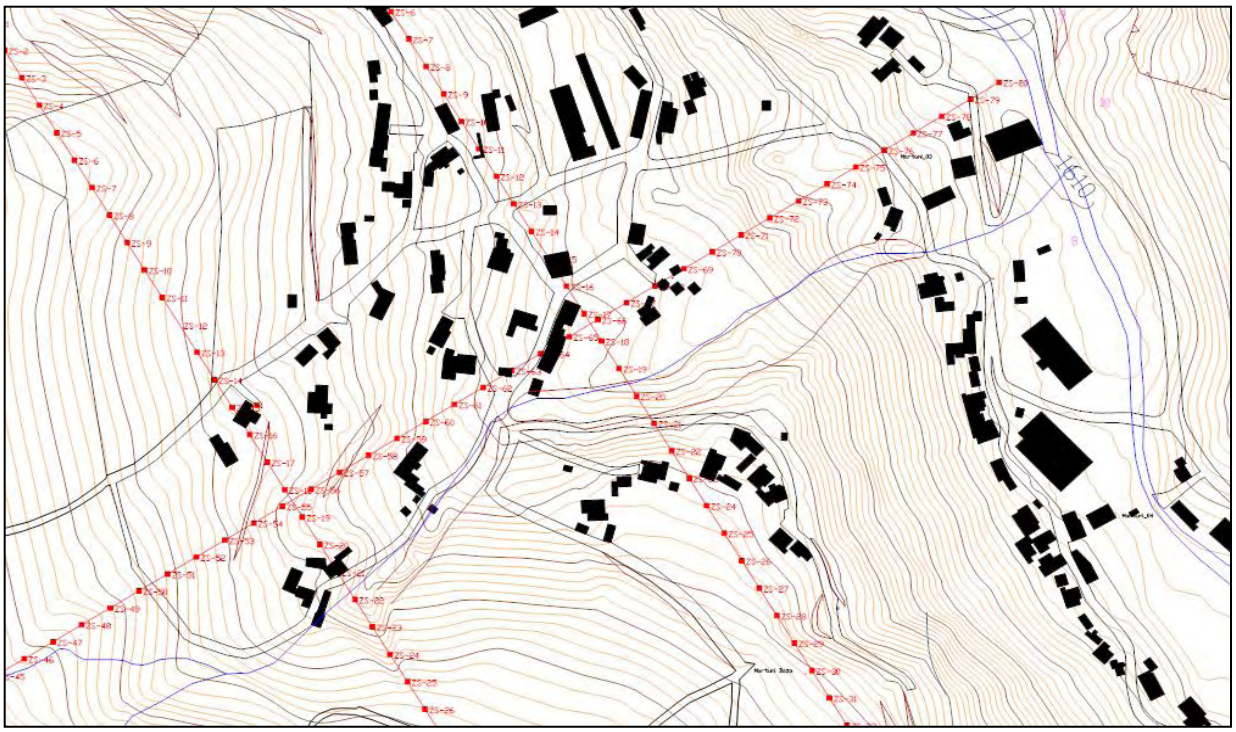


Figure 9.10 Enginering Geological Investigation Layouts at A block in Martuni Village

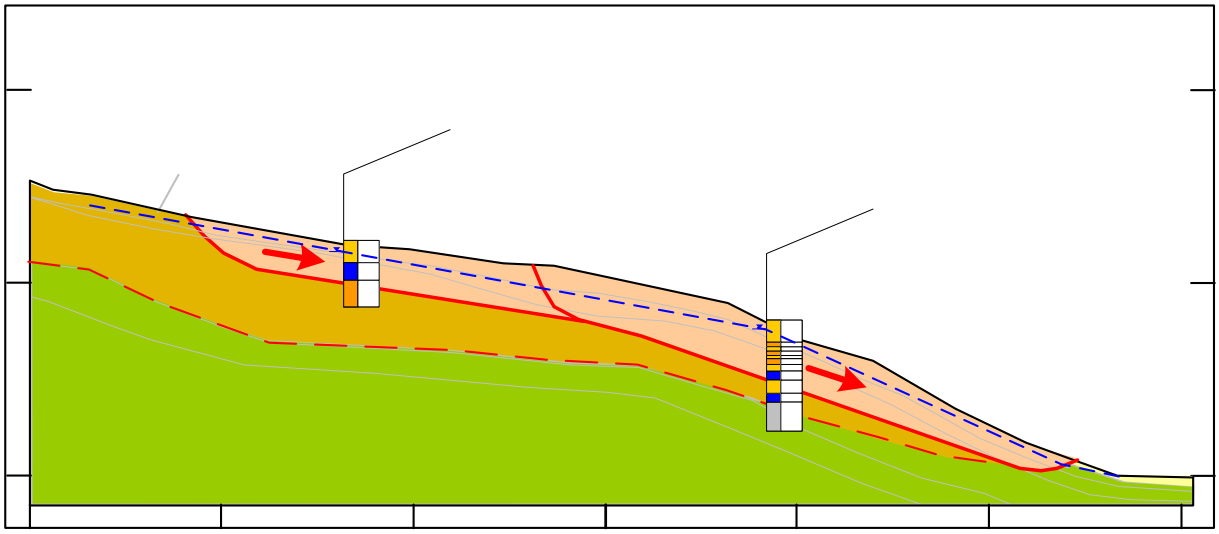


Figure 9.11 Engineering Geological Profile of A block of Martuni Village Landslide

3) Kapan City Harutyunyan Street Landslide

Table 9.5 Kapan City Harutyunyan Street Landslide

Item	Outline
Features of landslide, Risk and resource assessment	- 200m width, 400m length - Landslide 400 thousand m^3 failure occurred in 1994. Collapsed materials are weathered pyroclastic deposits. Three people died. Springs were assumed as cause (the source of water might be irrigation). -Landslide monitoring of this Study shows 0.1mm-0.2mm/day crack extension at the upper slope. - Boreholes pipe strain gauge monitoring shows the surface depth of the failure (upper slope B-1 boring has 8m depth, B-3 boring has 3m depth). - In the lower slope (dumped soil zone), no movement during Aug to Dec, 2005 was identified. Fresh scarp of shallow slide or earth flow traces occurred. The dumped soil closed 2 lanes of total 80m length of Harutyunyan street. -West side Yerkatughain district is a potential landslide area. Because house damage is scattered, it is not caused by landslides. - M-2 road is an interstate road; Kapan Tunnel has a narrow inner section, and it is bottleneck for large vehicles transportation. When Harutyunyan street 2 lanes are secured, they can carry out the function of an alternative road to the M-2 road. - Kapan citizens think that the bare land at the landslide damages the landscape at the entrance to Kapan city.
Landslide Management and Community Infrastructure Development	Alternative landslide countermeasures: I: 1-lane securing (detour maintenance): soil removing 1,800m^3 with gabion and drainage works II: 2-lane securing: soil removal 8,300m^3 with gabion and drainage works III: Complete removal of the dumped soil: soil removing 139,200m^3 with gabion and drainage works The WkC of the project prioritized the alternative II.
Execution Activities	- Organization of disaster management conference (Chairman: Mayor), establishment of landslide management task team - Formulation of early warning system based on extensometer and rain gauge data.

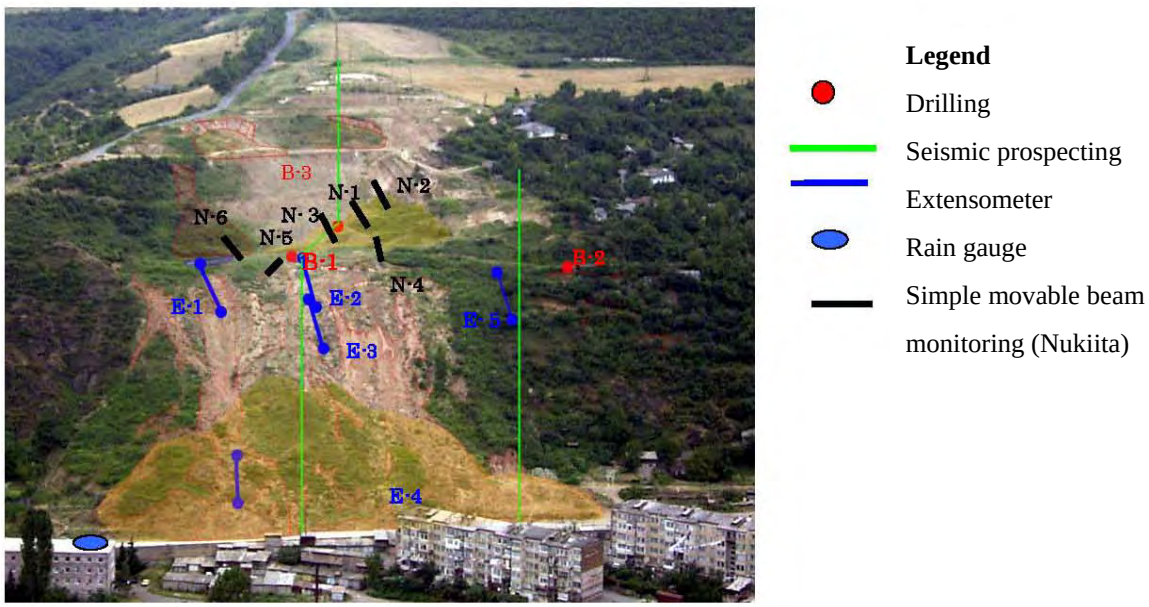
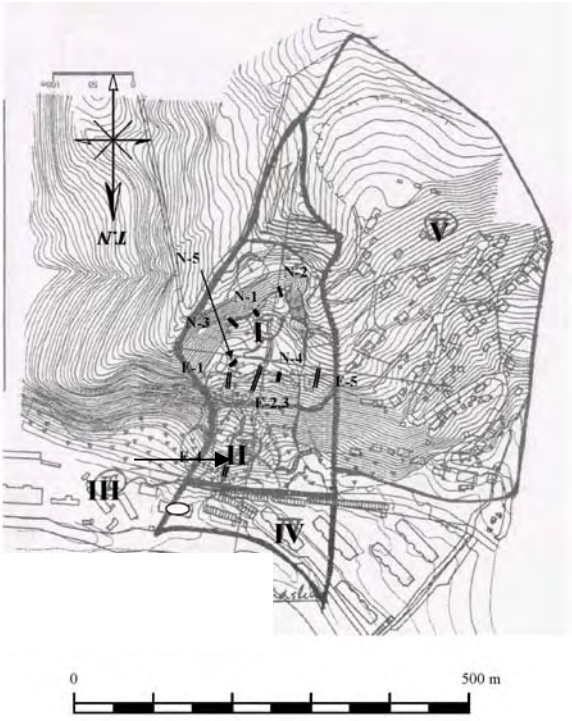
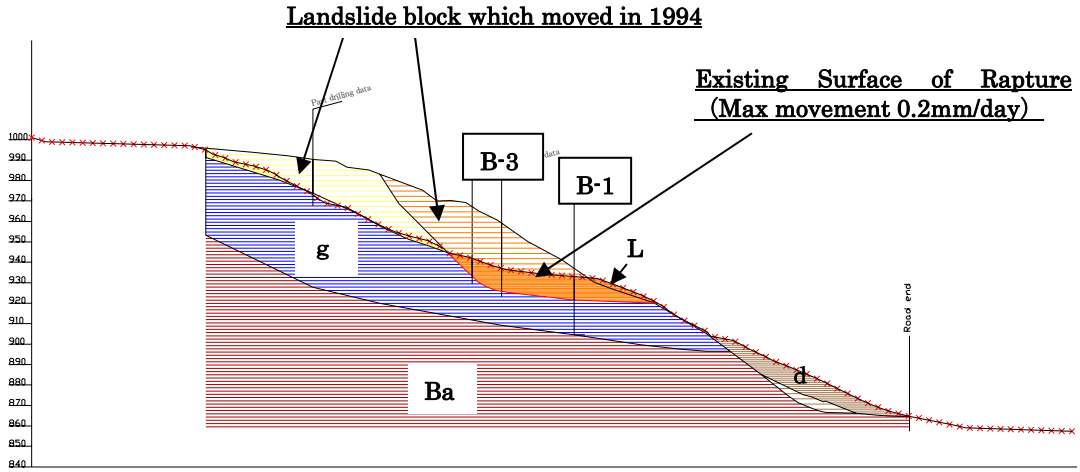


Figure 9.12 General View of Kapan City Harutyunyan Street Landslide



Area	Hazard and risk	Management plan
I: Upper Slope	Approximately 60 thousand m^3 soil is moving (maximum 0.2mm/day movement)	-Landslide monitoring and early warning -Drainage of surface water
II: Lower slope	Approximately 60 thousand m^3 soil is dumped no movement was observed. New surface failure, shallow small slide, immature debris flow are recognized	-Drainage of surface water - Soil Removal
III：Road	The dumped soil closes one lane of 2 lanes, total of 80m length of Harutyunyan street.	-Landslide monitoring and early warning
IV：Condominiums		
V：Yerkatughain district	51 families Potential landslide, existing damage is not caused by landslides	- Periodic inspection - Improvement of drainage

Figure 9.13 Management Division of Kapan City Harutyunyan Street Landslide



Ba: Basalt (Hard rock), g: Gravelly soil, L: Weathered pyroclastic deposit(clay), d：Damped soil (Clay)

Figure 9.14 Enginearing Geological Profile of Kapan City Harutyunyan Street Landslide

4) Yerevan City Cemetery Landslide

Table 9.6 Risk Assessment of Yerevan Cemetery Landslide and Technology Dissemination Policy

Item	Outline
Features of landslide, Risk assessment	**(Yerevan Landslide)** - 500m width, 1000m length - Base rocks are soft sedimentary rocks. Slip surface is in weathering rocks and old colluvial deposits. Depth of slip surface is confirmed (head – 24m, center – 14m, foot – 8m) by drilling and pipe strain gauge monitoring. - Induced causes: weathering sedimentary rocks contain swelling clay minerals, which accumulate to bedding and formulate potential slip surface. Highly weathering rocks: residual soil is susceptible to erosion. In the cemetery area, bedding is 20 degree and slopes are available. In the east upper portion, permeable gravelly soil develops. Therefore, groundwater is easily supplied to the landslide. -Induced causes: Water supply pipe at landslide head leaks at several points（one of them is 30L/min). Irrigation water flows to the gravelly soil. **(Similar Type Landslide from South East of Yerevan to Kotayk Marz)** - Many landslides are distributed along the M-15 road (Yerevan bypassing road). Two kilometer section is impassable, and many summer houses are damaged. - Landslide is distributed near the border area of gravelly soil, sedimentary rocks and tuff. Landslide area density is more dominant in sedimentary rocks area. This is because in sedimentary rocks bedding is developed which may easily become slip surface. - Residual soil of tuff is reddish and includes swelling clay minerals. When saturated it has dispersive characteristics. - Induced causes may be leakage of water supply system, irrigation for orchards, or domestic sewage without drainage.
Technology Dissemination Policy	- Technical bulletin will be published and widespread to the related organizations. - Study Team and MoUD appealed to Yerevan City to use the technology of these similar type landslides in urban development plan. - This investigation results will be used in the cemetery improvement (water supply and asphalt pavement).

Figure 9.15 Outcrop of Sedimentary Rocks and Erosion of the Residual Soil

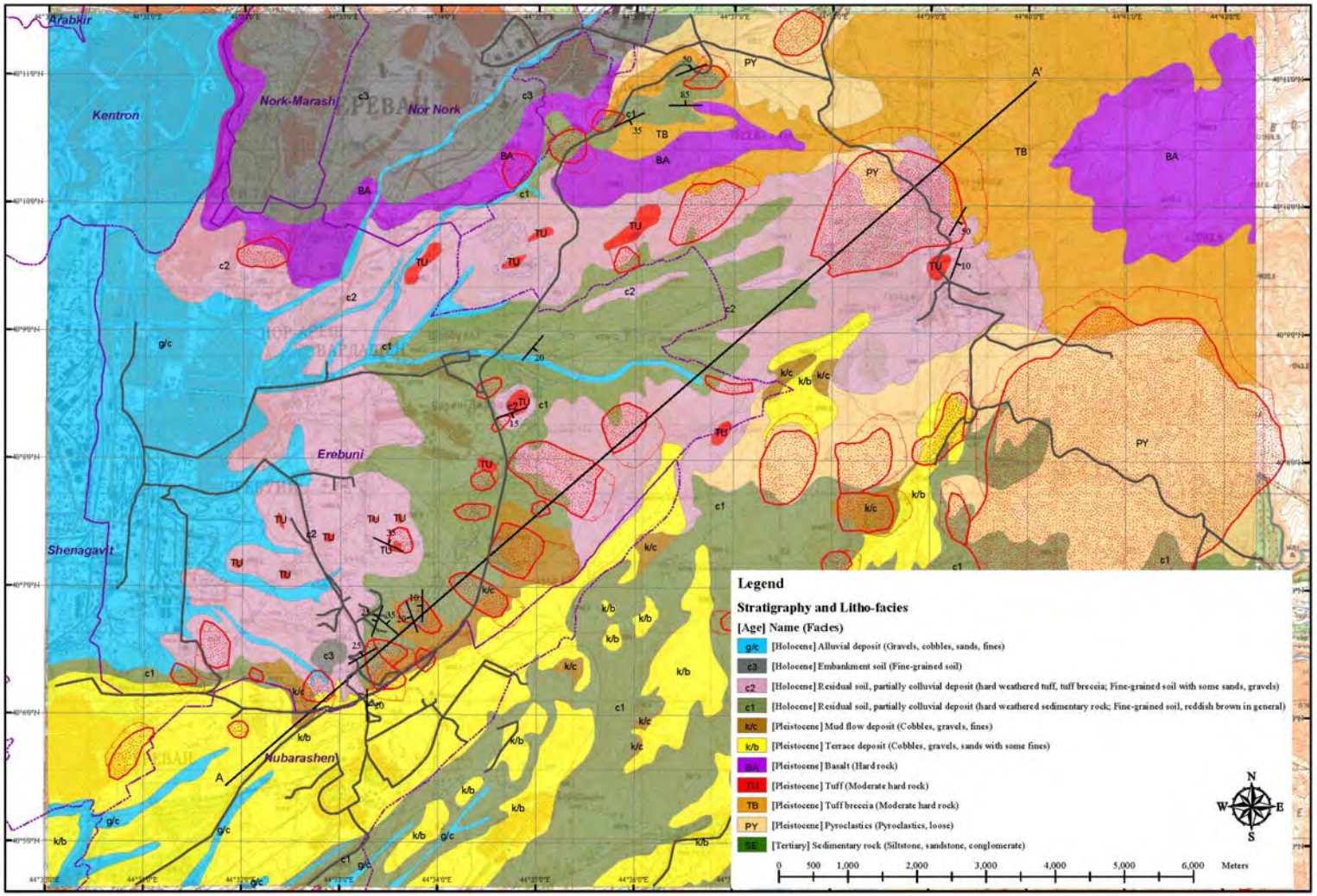


Figure 9.16 Geotechnical Map of South-East of Yerevan City in the Direction of Kotayk Marz

(2) Technical Issues Clarified during the Pilot Projects

Table 9.7 shows technical issues and policies for technical development.

Table 9.7 Technical Issues Clarified during the Pilot Projects

Item Work division	Technical Issues	Equipment procured from Japan	Technical Development Policy
Geographical analysis	A few engineers who can undertake geographical analysis are employed in private companies. But such technologies are used rarely, so technology has not been disseminated.	Stereograph	Dissemination by technical bulletins
Topographic survey	A necessary result can be achieved if the appropriate consultant is utilized.	Nothing	Nothing
Soil Test	Clay mineral identification analysis by X-ray is available. Mechanical test is not popular and was not done in the Study. MoUD will do mechanical test under their budget.	Nothing	In the future, installation of mechanical soil testing equipment and technical transfer should be done.
Geophysical Prospecting	Local contactor used analysis software. In the government agency there is no engineer to examine the result. In the RA, dynamite cannot be used so prospecting deeper than 30m is impossible. Limited private companies own equipment for geophysical prospecting.	Nothing	Examination and accumulation of results （MoUD with National Science Academy, National Seismic Institute）
Surface landslide monitoring	-It is done by association of Study Team, local contractor, and community landslide monitoring team. -GPS movable point monitoring, horizontal accuracy is less than 1cm, vertical accuracy is less than 5cm. Therefore, monitoring interval of 4 times/year is appropriate. -Simple movable beam（Nuki-ita）was adapted at the pilot project sites. MoUD adopted other landslide sites from 2005.	Landslide monitoring equipment	Landslide monitoring equipment was granted to MoUD. Communities will continue monitoring by the organized teams. MoUD will support this by budget and technology.
Boring, in-site test	-In the RA, almost all are Russian truck-mounted machines. They have poor performance. There is no experience of on-site testing (Standard penetration test and ground water prospecting were first done in this Study). -There is no experience of boring with water. Study Team provided instructions on boring with water to provide good quality coring.	Boring machine/in-	-MoUD will lend boring machine to contractor for landslide geotechnical investigation.
Borehole monitoring	-Local contractor was instructed on borehole monitoring equipment installation. - Monitoring is done by community monitoring team.		
Horizontal Drainage Boring	-In Gosh Village it was done by Armenian contractor's disassembly type drilling machine. -In Martuni Village it was done by the local contractor with Japanese disassembly type drilling machine.		
GIS data base	GIS is used by governmental organizations and private institutions.	GIS software and computer, plotter, printer	MoUD will accumulate landslide data. Compiled data will be published by technical bulletins and on web-site.

9.2 Economic Evaluation of the Pilot Projects

9.2.1 Project Benefits

Given the non-revenue generating nature of the projects, benefits will be estimated based on the expected losses (potential damages) averted due to the investments pursued in the projects. The damages are assessed for the "risk objects" grouped into the following sectors:
(i) Buildings, (ii) Transportation, (iii) Infrastructure for water, energy and communications, (iv) Agriculture and (v) Others.

The distinction is also made between (a) direct damages, and (b) indirect damages, where:
(a) Direct damages – are the effects on property, immovable assets and inventories, and
(b) Indirect damages – are other losses induced by the direct damages, e.g. the effects on production flows of goods and services.

Those benefits are a combination of (i) physical losses (direct damages) avoided, (ii) the costs of lost economic activities and disruptions in social welfare (indirect damages) minimized, and (iii) willingness to pay of the whole community, and are estimated as shown in Table 9.8.

Table 9.8 Estimated Benefits in the Pilot Project Sites

Item	Kapan	Gosh	Martuni
Direct Damages	AMD 0 USD 0	AMD 235,905,000 USD 519,000	AMD 482,506,000 USD 1,062,000
Indirect Damages	AMD 3,300,000 USD 7,300	AMD 41,155,000 USD 91,000	AMD 61,613,000 USD 136,000
Willingness to Pay of the Whole Community Inhabitants	AMD 14,411,000 USD 32,000	AMD2,375,000 USD 5,000	AMD 1,463,000 USD 3,000
Total	AMD 17,711,000 USD 39,000	AMD279,435,000 USD 415,000	AMD 545,582,000 USD 1,200,000
Percentage of Willingness to Pay to Direct Damage	-	1.2%	1.1%

'Willingness to pay of the whole community" in Table 9.8 was calculated by a simplified Contingent Valuation Method (CVM). This survey was conducted in three sites using a questionnaire asking "Willingness to pay (WTP)" for the projects, which potentially represents the project value for the residents. The result of WTP in each site is outlined in Table 9.9.

The CVM result is an estimation of monetary value of regional economic effect taking into consideration upgrading of the land use, improving regional roads, expected budget saving for villages, and incorporating landslide management into multipurpose programs of regional

development. Therefore willingness to pay includes the benefits of the project.

The CVM survey was conducted in November 2005 when the purposes of the Pilot Projects were discussed at the Working Commission and general assembly. Consciousness of the Pilot Project's purposes and self-help effort had risen to some degree. Therefore penetration of this consciousness and the CVM may expand more.

Table 9.9 Results of CVM in Each of the Pilot Project Sites

Item	Kapan	Gosh	Martuni
Annual Income/Household	AMD 882,000 USD 1,940	AMD 582,000 USD 1,280	AMD 576,000 USD 1,267
Willingness to Pay/Household (Weighted Average)	AMD1,550 USD 3	AMD5,951 USD 13	AMD8,083 US 18
Percentage of Annual Income to Willingness to Pay	0.2%	1.0%	1.4%
Whole City/Village	AMD 14,411,110 USD 31,704	AMD2,374,504 USD 5,223	AMD1,462,937 USD 3,218

9.2.2 Project Costs

Costs of the implementation of engineering countermeasures are estimated based on the basic design, prepared and shown in Table 9.10.

Table 9.10 Construction Costs

	Kapan*	Gosh	Martuni
Construction Costs	Plan II: AMD 98,293,000 USD 216,245 Plan III: AMD 344,549,000 USD 758,008	AMD115,579,000 USD 254,274	AMD 628,796,000 USD 1,383,351

***** At Kapan, Plan II is securing 2-lane traffic of Harutyunyan Street; Plan III is the complete removal of landslide dumped soil.

9.2.3 Results of Economic Evaluation

With the above mentioned project benefits (quantified) and costs, cost-benefit analysis was carried out and the results are presented in Table 9.11.

Table 9.11 Results of Economic Evaluation for Three Pilot Projects

	Kapan	Gosh	Martuni
Economic Internal Rate of Return (%)	N/A*	12%	10%
Net Present Value	Plan II: -AMD 62,005,000 USD 136,411 Plan III: -AMD 280,861,000 USD 617,894	AMD 15,766,000 USD 34,685	AMD 7,383,000 USD 16,243

Note: * Because the costs exceeded the calculated internal rate of return, the value is not available.

The results for Gosh and Martuni show positive Net Present Value (NPV) and higher Economic Internal Rate of Return (EIRR) than the discount rate of 10%. This indicates that these projects are economically viable for implementation. The earliest implementation will be required to protect the village properties and to avoid the economic losses incurred by the landslides.

Although the Pilot Project in Kapan shows a negative NPV, it is extremely important for the Armenian economy to secure regional safe traffic and, moreover, large international cargo, which are the key means of trade through the Iranian border. The project is highly worthy for implementation with Plan II, which offers a much less negative NPV than Plan III. This project should be examined for implementation.

9.3 Issues Resolved by the Pilot Projects and Integrated into the M/P

The Pilot Projects became economically feasible because of the expansion of the benefit streams by the transformation of the projects into multipurpose projects which contribute to community infrastructure development. The reduction in project costs through the participation of local inhabitants in project implementation adds to the economic feasibility. These positive experiences should be shared, new projects should be formulated and public finance allocated.

‘Community Based Approach' (CBA), planning by the community and implementation with the participation of local inhabitants, has proven to be useful for effective project formulation. While the initial investment requirements and specialists in the communities are still scarce, public technical assistance and initial investments are needed for the implementation of new projects. Funding for landslide monitoring and maintenance is needed after the project is ended. The continuation of the Pilot Projects and the implementation of new projects by CBA will be difficult without such kind of public or foreign assistance.

Therefore, the basic policies of the M/P include not only CBA, but also the responsibility of the State (management authorities) to ensure landslide management by the continuous provision of technical and financial assistance to implementing bodies for landslide management (communities and management organizations for wide-area infrastructure).

9.4 Environmental Evaluation of the Pilot Projects

9.4.1 Environmental Evaluation of the Pilot Projects

Prior to construction works in Gosh and Martuni Villages general assemblies were held and it was confirmed that conflicts in the communities and important negative environmental effects would not occur.

Confirmation among government and regional stakeholders was also taken at the advisory committees.

During the construction stage, the water-table at drilling sites and amount of spring water were confirmed. Water quality tests were performed at the existing springs and for water from horizontal drainage boring before and after the construction. For some drilling a lower groundwater table was shown. But negative environmental effects did not occur because in the neighboring areas there are no wells or saturated clay, which is concerned with consolidation. There was also no influence on spring volume and water quality. The quality test of horizontal drainage boring water in Martuni Village indicated the presence of sulfur exceeding drinking water standards, and detected arsenic, indicating that it is therefore inappropriate to use as drinking water.

9.4.2 Environmental Evaluation for Further Plans

Discussions at the general assemblies of Gosh and Martuni Villages confirmed that there were no conflicts or important negative environmental effects on the villages.

Confirmation by Government and regional stakeholders was also taken at the meetings of the advisory committees on the Gosh, Martuni, and Kapan Pilot Projects

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