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Short-term & Mid-term Road Disaster Prevention Management Plan Manual

JICA

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CHAPTER 1 GENERAL INFORMATION ON THE SHORT-TERM AND MEDIUM-TERM ROAD DISASTER PREVENTION MANAGEMENT PLAN MANUAL

1.1 General information about the Manual and budget request

Short-Term and Medium-Term Road Disaster Prevention Management Plans will be developed on the basis of scientific data, such as results of inspection, monitoring, historical data on the occurred disasters and similar data.

The Short-Term and Medium-Term Disaster Prevention Management Plan Manual provides the guideline that summarizes the three guidelines below for implementing a road disaster prevention management plan.

Figure 1.2-1 gives the general process for developing the road disaster prevention management plan.

- Road Safety Inspection and Assessment Manual
- Protective Measures for Road Disaster Prevention Manual
- Database System Manual

Figure 1.1-1 shows the process and distribution of responsibilities during the implementation of the road disaster prevention management plan. Following Figure 1.1-1, a general description of each manual will be given further. DEU bear responsibility starting from inspection to the development of preliminary estimate documentation. The Inspection and Assessment for Road Disaster Prevention Manual (hereinafter referred to as the Inspection Manual) contains information on methods of inspection and risk assessment. Inspection results and historical data on disasters should be recorded, therefore in the Database System Manual (hereinafter referred to as the Database Manual). In relation to the sites subject to protective measures, appropriate measures should be adopted according to the scheme for determining the protective measures, and then preliminary estimates of these measures are compiled, following the Protective Measures for Road Disaster Prevention Manual (hereinafter referred to as the Countermeasures Manual). UADs/ RO receive preliminary estimate documentation developed by DEU. Then the UADs/ RO employees sort out all these materials, prepare a short-term / medium-term plan, assess priorities given to RMD in the form of a budget request. The Short-Term and Medium-Term Road Disaster Prevention Management Plans Manual can be used to assess priorities at this stage of work.

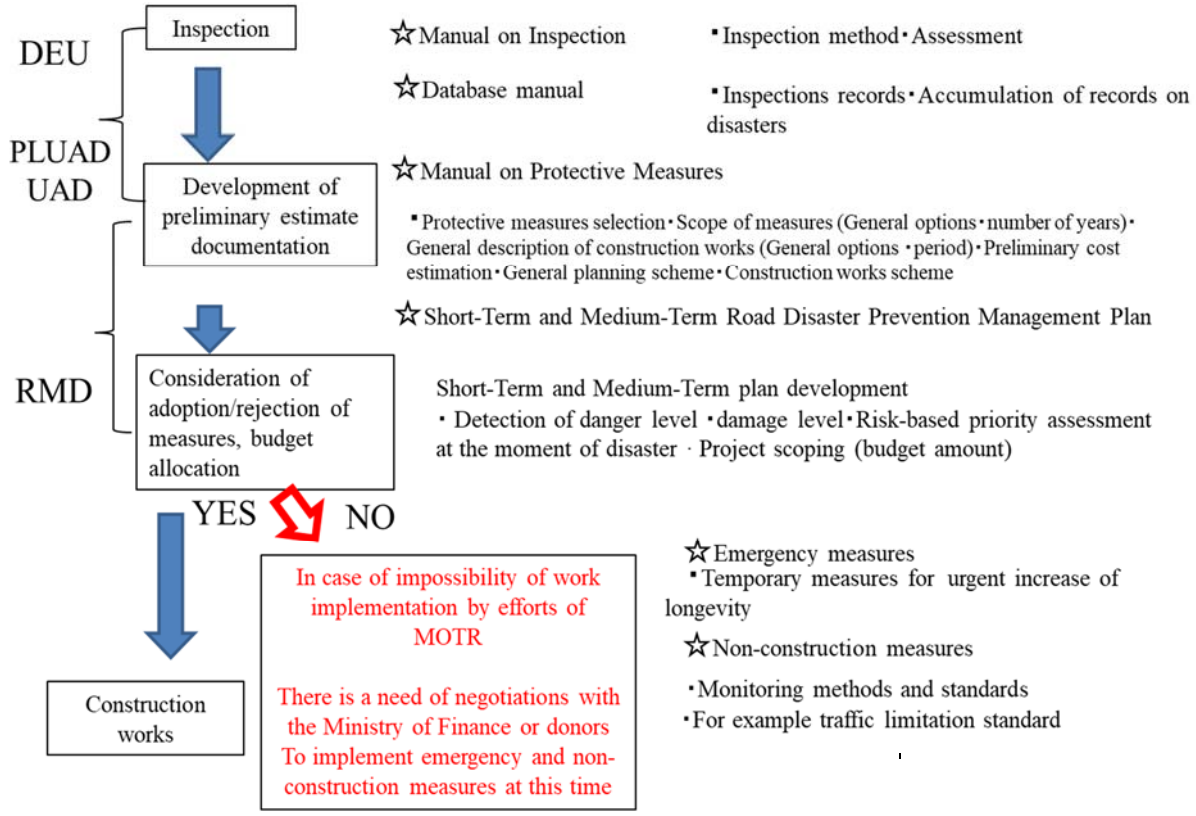


Figure 1.1-1 Distribution of roles in the Road Disaster Management Plan and budget request scheme

RMD collects protective measures applications from all UADs and RO and issues an opinion on the feasibility of implementing these measures and on allocating a budget. However, in the event of a conclusion on the impossibility of the implementation of protective measures by MOTR due to a large scope of work or there is no similar experience in various technical works, it is necessary to request funds from the Ministry of Finance or to apply to the international donors.

Before the appropriate construction measures are implemented, it is necessary to take non-construction measures (monitoring, during the risk of a disaster, it is necessary to implement traffic restrictions on the road, to disseminate information about this site, etc.). Along with this, it is necessary to take emergency temporary measures that should be aimed at suspending the development of the site deformation and extending the service life.

1.2 The process from inspection to construction

This section will cover in detail, starting from an inspection aimed to prevent disasters, inspection results and dynamic monitoring data. Based on this scientific data, an opinion will be given, a decision will be made and the issue regarding the budget should be addressed.

Inspection, implies the following types of inspections: routine visual inspection on a car while patrolling the road, scheduled visual inspection at close range 2 times, in spring and autumn. As well as an unscheduled inspection, which is carried out after a disaster, for example, a rock / slope collapse, avalanche, etc., as well as subsequent abnormal weather conditions.

The opinion of the inspection results, depending on the type of inspections, distinguishes the inspector's professional skills and method of inspection. Moreover, the extent of deformation of the facility has a different impact on its functionality, depending on the facility's individual characteristics. However, it is desirable to be able to use a unified classification system for making an opinion for each type of facility. It

is necessary to refer to the Inspection Manual for the assessment of an individual facility. In opinions, based on the inspection results, the opinion "essential measures (urgent measures)" were made. "Essential measures (urgent measures)" are applied to the state when the damage is significant and there is a strong impact on performance, which can become an obstacle to the safe road passage and safety of third parties. The road sector of Japan, in the case of an opinion "essential measures (urgent measures)" (risk assessment: corresponds to S) requires monitoring the deformation (damage), restricting traffic and taking urgent measures. In the case of "essential measures" (risk assessment: corresponds to A) are applied to the state where there is damage and impact on performance, it is therefore necessary to consider the implementation of the measures. "Inspection card" (risk assessment: corresponds to B) is applied for the condition when there is damage, but there is no impact on performance, therefore constant monitoring of the damage condition is necessary using the inspection card. No need to take measures, since there is no damage or minor damage.

In addition, if there was a detailed inspection and monitoring in relation to the site, which was evaluated as "essential measures" during the opinion, it is necessary to make a second opinion, which will be based on individual assessment criteria using the results of detailed inspection and monitoring.

Table 1.2-1 shows the standard value during the maintenance of landslides in Japan. When a landslide is monitored, the opinion is made in accordance with the standard values given in Table 1.2-1 based on the monitoring results. In particular, when the displacement size is large, which is a "warning / emergency measure", urgent measures should be taken (such as mandatory change monitoring and traffic control), and then emergency (urgent) measures should be implemented.

Table 1.2-1 Example of the standard management value (landslide) at the maintenance stage

Tools and equipment classification / Relevant classification	Inspection/Monitoring or monitoring strengthening is necessary	Protective measures consideration	Preventive and emergency measures	Emergency alertness / Temporary evacuation
Extensometer Borehole extensometer Light range sensor — Land surface displacement velocity	More than 10 mm / 30 days	5~50 mm / 5 days	10~100 mm / day	more than 100 mm / day
Build-in borehole inclinometer — Underground site displacement velocity	More than 1 mm / 10 days	5~50 mm / 5 days		
Ground inclinometer — Aggregated values	10~50 second / 10 days			

Reference

Table 1.2-1 gives the criteria for managing a landslide during the maintenance phase, applied on Japanese roads. For example, if there is a slope displacement, rated as a warning / emergency measure, then the management responsible for this site should urgently response (If the management does not response, then it is responsible). The expenses necessary for taking measures are always allocated from the budget, due to the gradual reduction of the costs for other works envisaged by the plan. This system of finding money is similar to the practicing system in the Kyrgyz Republic, when funds are allocated for cleanup work after natural disasters. Having standardized the management in Table 1.2-1, there is no need to request a budget and this is practically rational.

Therefore, it is desirable to standardize this system in the Kyrgyz Republic. Developing standards is an important work for government officials promoting the development of the country. However, these criteria have been created and standardized by organizing and analyzing the relationship between displacement and deformation (damage) of a landslide area that occurred on a high-speed highway in the past. Standardization requires dynamic monitoring data, and data accumulation is mandatory.

If it is difficult to make an opinion only on the basis of an inspection with a visual inspection, then a detailed inspection is needed, determining the scale and causes, or a professional and simple measurement, including detailed monitoring, is required in order to conduct a study to determine the stability of the site. If necessary, to conduct a soil survey. The detailed content of such studies should be carried out in accordance with the Inspection Manual.

Based on the results of the aforementioned inspections, monitoring and detailed inspections, it is necessary to determine the protective measures, scale of these measures and preliminary costs of implementing these measures, following the scheme for selecting protective measures, which is given in the Countermeasures Manual. This Manual, those activities that should be implemented in the next 1-3 years, will refer to short-term planning, and those over the next 10 years will refer to medium-term planning. However, those measures that are considered in short-term and medium-term planning with costs more than 100 million KGS, due to the limitation of the maximum amount for activities or absence of technology in MOTR, cannot be implemented at the expense of the ministry. In this case, financing for the implementation of measures should be requested from foreign donors.

If, prior to the implementation of construction measures, there are concerns that the damage is progressing, and this could affect traffic or cause harm to 3 persons, then it is necessary to implement non-construction measures. It is necessary, along with temporary measures that suspend the development of damage, to strengthen the monitoring system. It is necessary to approve a traffic regulation standard (evacuation standard) in order to avoid casualties and regulate traffic. Details are in the Countermeasures Manual.

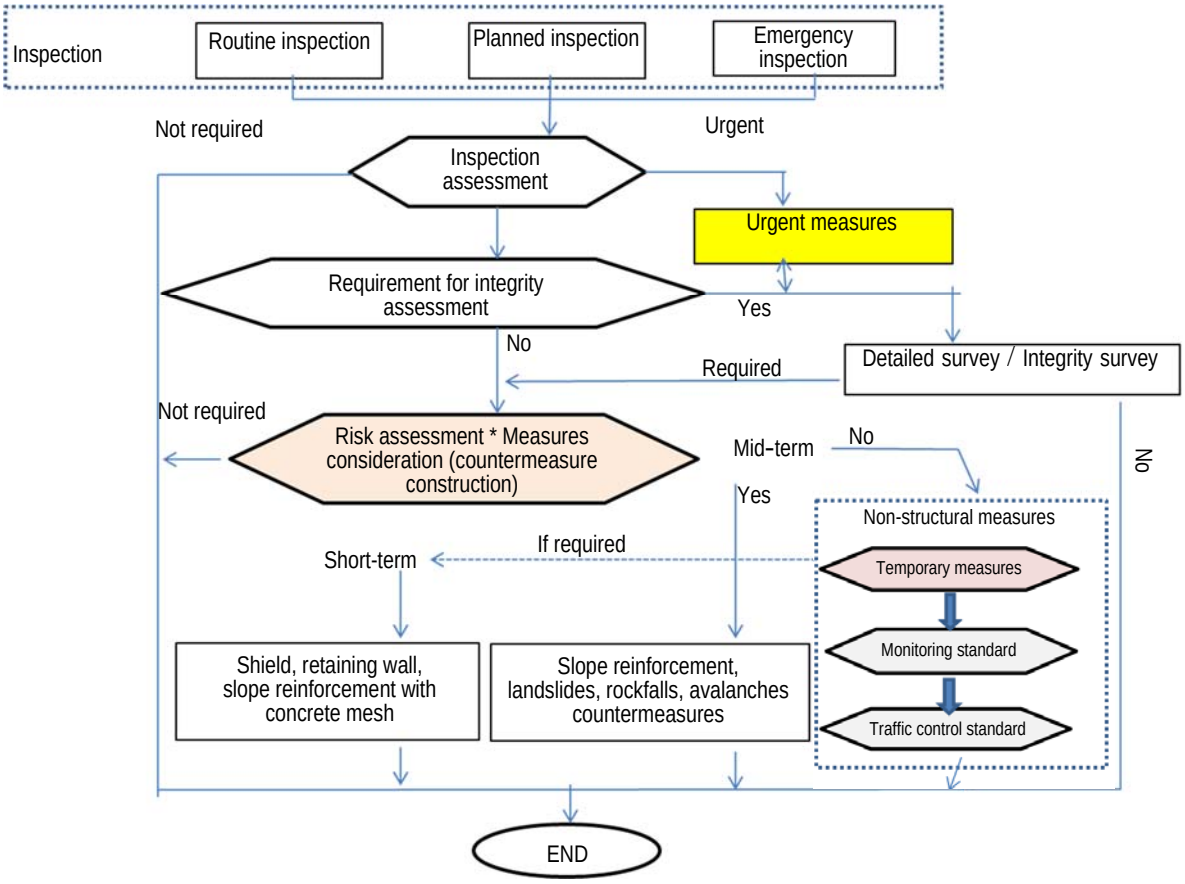


Figure 1.2-1 General structure of road disaster management

CHAPTER 2 RISK ASSESSMENT OF POTENTIAL DISASTER OCCURRENCE SITES

2.1 Objects of survey for risk assessment

The main idea of hazard assessment (risk assessment) of potential disaster occurrence sites is the same for disasters on the slope, disasters on the riverbanks, disasters caused by snowfall. Risk assessment is based on a joint assessment of the disaster scale (state of development) and impact on traffic. "Assessment elements based on the type of disaster", given in the Inspection Manual, are presented below.

Table 2.1-1 Objects of research for risk assessment by type of disaster

Type of disaster	Scale ／ development ／ frequency of disaster	Assessment, which mainly considers the impact on traffic
Rockfall	Height from road to unstable rock mass / rock top	The presence or absence of human victims, damage to vehicles and restriction of traffic over the past five years
Landslide	Land slide volume	The presence or absence of human victims, damage to vehicles and restriction of traffic over the past five years
Slope disasters	Slope height	The presence or absence of human victims, damage to vehicles and restriction of traffic over the past five years
Mudflows	Number of slides per year	The presence or absence of human victims, damage to vehicles and restriction of traffic over the past five years
Avalanche	Frequency of slides, history of slides	Traffic limitation time, disaster scale
Snowdrift	Potential snowdrift, which is estimated in points based on the analysis of weather conditions, environment, damage to traffic, etc.	Snowdrift level of damage caused by visibility failure and traffic obstruction by snowdrift.

2.2 Risk assessment ranking

Risk assessment for each hazardous area is classified by four S / A / B / C classes, as shown in the lower table, combining the above inspection facilities. Assessment level S> A> B> C is obtained in descending order of hazard level for traffic.

Table 2.2-1 Risk assessment（Rockfall, landslide, disasters on the slopes, mudflows, river erosion, avalanche)

Assessment		Traffic impact assessment		
		H	M	L
Scale, development, frequency	H	S	A	A
	M	A	B	B
	L	A	B	C

Table 2.2-2 Risk assessment（snowdrift)

Assessment		Traffic impact assessment (category of drift damage)		
		H	M	L
Scale, development, frequency category of drift potential)	A	S	A	A
	B	S	A	C
	C	A	B	C
	D	B	B	C

As for the facilities to be studied for each type of disaster, then H> M> L corresponds in descending order with respect to the scale, extent of development, frequency and extent of impact on the road. Risk assessment S / A / B / C is roughly equivalent to the classification described below. (For details, see the Inspection Manual).

Table 2.2-3 Hazard assessment indicators

Class	Hazard assessment indicators
S	・ For a long time, disaster risk is extremely high. ・ Disaster prevention is urgently required.
A	・ Disaster risk is high, but changes occur under the influence of external factors, such as weather conditions ・ It is necessary to perform repair-rehabilitation work in the event of a disaster. But there is a high need for work to prevent disasters (time and cost required for repair and rehabilitation is immense, so we can assume that work on disaster prevention will be efficient)
B	・ Risk of disasters is moderate, periodic monitoring and repair is performed (time for repair and rehabilitation is small, restoration of traffic can be assumed within the stipulated budget) ・ There is a need for work to prevent disasters, but there is no urgency in its implementation
C	・ Risk of disaster is low ・ Periodic monitoring is performed as measures. ・ Repair and rehabilitation is performed as necessary, but the need for work to prevent disaster works is low

※ Repair and rehabilitation involves the work that is carried out after the occurrence of a natural disaster to restore traffic as stone removal, etc. of works

CHAPTER 3 PRIORITY LEVEL ASSESSMENT BASED ON ROAD IMPORTANCE

3.1 Road priority level assessment

As a final assessment of the general standard for road disaster prevention management, the priority level assessment is based on the road importance. The priority is estimated by the road maintenance level and risk assessment (S / A / B / C), as shown in Table 3.1-1.

The road maintenance level is the assessment proposed in previous years by JICA Project on strengthening capacity in managing maintenance of bridges and tunnels. Below is each of the levels where the importance of roads is indicated.

Level 1: Roads of international importance and equivalent level of roads of national importance

Level 2: National roads and equivalent level of local importance roads

Level 3: Local importance roads

The equivalent level considers high traffic intensity, natural disaster prevention and economic importance of the road.

Table 3.1-1 Priority level assessment

		Road maintenance level		
		Level 1	Level 2	Level 3
Risk assessment	S	Priority level 1		
	A		Priority level 2	
	B/C			Priority level 3

Order of priority 1	Urgent
Order of priority 2	Inspection / monitoring
Order of priority 3	Enhancing inspection

In addition, the extent of priority 1 implies a high urgency and urgent implementation of measures. Priority 2 considers studying and monitoring as the basis, which are the minimum measures for extending the service life. Priority 3 considers enhancig inspections and monitoring changes.

3.2 Important points during road priority assessment

Priority level assessment, taking into account the importance of the roads mentioned above, is reasonably correct, but there are concerns that budget allocation will be considered only on restricted roads. Also should be noted that the road functions as a network, i.e. during the closure of the road after the occurrence of a natural disaster, it is necessary to ensure a detour along a different path.

In addition, for the implementation of road disaster prevention throughout the country, it is important to widely disseminate the implementation of disaster prevention works, and thereby have a productive impact. In other words, when practicing road disaster prevention (preventive work) at different sites, it is necessary to raise awareness on dissemination and development of road disaster prevention for the whole society. Therefore, during budget planning, it is advisable to draw up a budget allocation plan so that each region in the country can implement measures within the budget, based on an assessment of the level of priorities that takes into account the importance of roads.

CHAPTER 4 ASSESSMENT BASED ON THE RATIO OF COSTS AND EFFECTIVENESS OF PREVENTIVE PROTECTIVE MEASURES

When determining the categories of priority levels assessing them, taking into account the importance of the road, as well as with further distribution of priorities, it is possible to assess by calculating the ratio of costs and effectiveness of protective measures of preventive methods.

4.1 On effectiveness and cost of protective measures for designing road protection against disasters

It describes the effect of preventive countermeasures when protecting roads against disasters. ???????

4.1.1 Slope

If, before the occurrence of a natural disaster, protective measures were taken on the slope, compared to the case of rehabilitation after the disaster shown in Figure 4-1 below, one can see the benefits and effects of preventive protective measures

1) **Costs of pre-disaster measures are more expensive than measures afterwards**

Protective measures that prevent the formation of disasters are much cheaper (besides, less for human and material damage) compared with permanent measures undertaken after generation of disasters. Successive events following a disaster have many limiting conditions, and therefore not a lot of choice is provided. Therefore, there are cases when you have to choose high-tech and costly protective measures. Moreover, compared to preventive protective measures, damage and losses progress/grow under successive measures.

Table 4.1-1
Disaster condition on slopes

*Calculation formula

Part of the sum of overstated consecutive measures = Costs of consecutive measures − Costs of preventive measures.

Consequitive measures: Calculation of the cost for long-term protective measures based on the envisaged damage and cross-sectional shapes after generation of a disaster. ??????????????

2) **Costs of response and rehabilitation**

With generation of disasters, there are costs for cleanup works, for example, after a landslide or until the situation stabilized, when the threat of secondary disaster waves disappears. In these cases, due to the continuous work around the clock, the costs for working in the dark, as well as for lighting and security, are increased.

*Calculation formula

Costs of response and rehabilitation = Expenses for day work + Costs for night work + Costs for night equipment

Costs of response and rehabilitation: Calculation of costs of response and rehabilitation for envisaged loss / damage. Day time and night time expenses are calculated individually.

3) **Bypass construction costs**

When a situation arises that leads to a long traffic stop, in order to ensure the traffic passage, it will be necessary to build a bypass road. In these cases, due to continuous work 24 hours a day, expenses for work in the dark time, as well as for lighting and security are increased (time for traffic passage as well)

*Calculation formula

The construction cost for a bypass road
= expenses for a day work + costs for a night work + costs for night equipment

The construction costs for a bypass road: calculating the cost of a possible bypass plan and its construction. The costs are calculated separately for day and night work.

4) **Costs of property damage (vehicles) and human casualties**

Costs for property damage and human casualties caused by accidents due to disasters on the slopes.

*Calculation formula

The amount of material damage (vehicles) = number of vehicles × cost of damage per 1 vehicle

The amount of losses due to human casualties = number of people × amount of losses per 1 person.

The amount of material damage (vehicles) is calculated by the amount of the expected material damage (vehicles) arising due to a disaster. For reference, one can consider past similar cases.

The amount of losses due to human casualties: the number of the suffered people and losses due to a disaster. For reference, one can consider past similar cases.

5) **Damage caused to third parties (main traffic, rivers, pipelines, railway).**

Disasters on the slopes can cause damage to 3-rd parties (main traffic, rivers, pipelines, railway): as a result, costs for rehabilitation and compensation occur.

*Calculation

Damage to 3-rd parties is calculated by the estimated amount of rehabilitation costs for the estimated losses / damage.

6) **The amount of damage caused to economic activity due to a traffic stop**

As a result of a natural disaster, the time required for emergency rehabilitation has a significant impact on economic activity due to traffic interruption and suspension of transportation. (Increasing the time for detour movements, worsening load of surrounding roads, etc.)

*Calculation formula

Damage caused by the closure of the road for economic activity = Closing time × Volume of economic loss per hour

(Influence of vehicle closures = traffic closure × traffic volume)

Economic losses per hour: Economic losses at the closure of the road for 1 hour

7) **Damage to economic activity due to damage to a third party caused by the infrastructure shutdown**

As a result of damage to a third party infrastructure, especially the pipeline, power outages can affect economic activity, leading to compensation.

*Calculation formula

Damage caused by the infrastructure shutdown to the economic activity = infrastructure downtime x economic damage per hour

8) **Maintenance costs**

The deformation of the slope surface progresses and expands when it is left unattended, and finally, it leads to destruction. Maintenance charges, such as cleaning required for the period before the collapse and removal of small collapsed earth and sand, will be required continuously if a collapse occurs. It makes sense to take countermeasures early, before it is too late if you know that a landslide will happen.

*Calculation formula

Maintenance costs before disaster occurs = Period prior to the disaster (year) × 1 year.

The maintenance charge for one year should be calculated from the last maintenance cost record.

9) **Summary of the slopes**

Figure 7.1 shows the preliminary cost of countermeasures for slopes and scheme of the effect / benefits of protective measures. As shown in the following formula, the difference between the costs of preliminary and consecutive measures is noticeable by the effect and benefit of countermeasures, where preventive measures have a great advantage.

The effect and benefit of protective measures = costs of successive measures - the cost of preventive measures

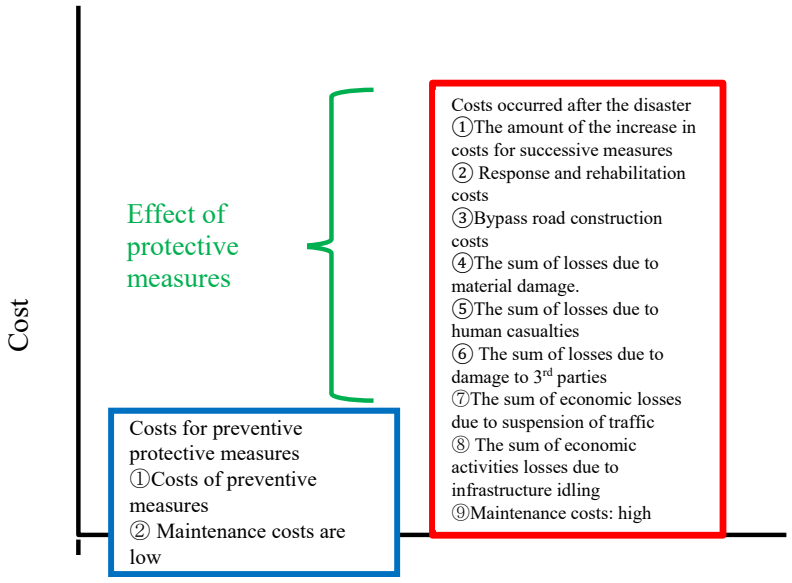


Figure 4.1-1 Scheme of costs, effect and benefit of protective measures on slopes

< For reference >

In order to make preliminary protective measures cheaper and more efficient, it is necessary to erect them along with the general construction. On the Nippon Highway, preventive measures are provided to protect the slopes in accordance with the design criteria of the slope surface, as shown in Figure 5.2, an appropriate gradient of stability, method of protecting the slope surface, drainage system and anti-rock falling measures must be established during construction. These measures show the desire to build a safe road, on which road users will pass freely.

Figure 4.1-2 The view of slope protection measures along Japanese Highway

4.1.2 Types of winter disasters

the effect and benefits of protective measures against winter disasters can be described by the following points of the consequences that can be avoided or mitigated.

1) Snow removal costs

When carrying out snow protection measures in this area, it is possible to reduce the cost of snow removal during the service period of the snow / avalanche structure.

* Calculation formula

Costs for snow removal during a snowfall = Costs for snow removal at the site where protective measures are installed against snow / avalanches for 1 year × useful service life (years)

Costs for snow removal at the site where snow / avalanche protective measures are installed for 1 year: Costs for snow removal at the site, where snow / avalanche protective measures are installed, is calculated based on the average value of past records.

Moreover, in the areas, where avalanches often occurred in the past, costs are separately calculated as the costs for snow removal after avalanches and added to the costs of snow removal.

*Calculation formula

The costs for snow removal during an avalanche = frequency of avalanches (times / year) × the costs for snow removal per 1 time × useful life (year)

Frequency and costs are calculated using past results.

2) Traffic jams

Because of freezing and slippery road surface or poor visibility, vehicles slow down, leading to traffic jams due to traffic accidents, eliminating their consequences or snow removal. Snow protection measures facilitate or eliminate traffic jams, and the level of convenience and safety of road users increases.

*Calculation formula

Costs of losses due to traffic jams = the sum of losses due to traffic jams of the relevant part per one year × useful service life (year)

The sum of losses during traffic jams of the relevant part per one year: to obtain the total amount of time for traffic jams per 1 year from past records, as well as additional time spent on overcoming traffic jams and cost of labor per hour.

3) Damage caused by suspending the economic activity flows

In the interval between the disaster and execution of urgent rehabilitation, the economic activity suffers due to suspended flow of goods (increased time of traffic through detours, worsening traffic jams on adjacent roads)

*Calculation formula

The amount of damage caused by suspending the economic activity flows

= time of traffic stop for 1 year × the sum of damage to economic activity for 1 hour × useful service life

(vehicles affected by suspending traffic = suspension time × number of vehicles per hour)

The sum of economic activity loss for 1 hour per year: it is an economic loss in case of traffic suspension for 1 hour on the relevant road.

4) Material damage (vehicles) and human casualties compensation

Accidents and incidents caused by winter disasters and involving road users cause material damage and human casualties compensation. However, they can be avoided by performing measures against winter disasters.

*Calculation formula

Material damage (vehicles) and human casualties compensation = number of vehicles × the sum of damage per 1 vehicle

Compensation for human casualties = number of people × compensation per 1 person.

Material damage (vehicles): Estimated material damage (by vehicles) and other losses during winter types of road disasters are calculated. Calculated on the basis of past data on the frequency of disasters and losses. One can also be guided by similar cases in the past.

Compensation for human casualties: Estimated loss of human casualties and other losses are calculated for winter types of road disasters. Calculated on the basis of past data on the frequency of disasters and losses. One can also be guided by similar cases in the past.

5) Summary of winter road disaster.

The costs for protective measures for winter disasters, their effect and benefits are described in the scheme in Figure 4.1-3. As shown in the following formula, the difference between the costs for preventive protective measures and the cost value (over the service life of the protective measures) incurred, when not implementing measures, is the effect and benefits of countermeasures. Conducting protective measures gives a huge result.

Effect and benefits of countermeasures =

The costs arising from non-implementation of measures (service life of protective structures against winter disasters) - costs for protective measures

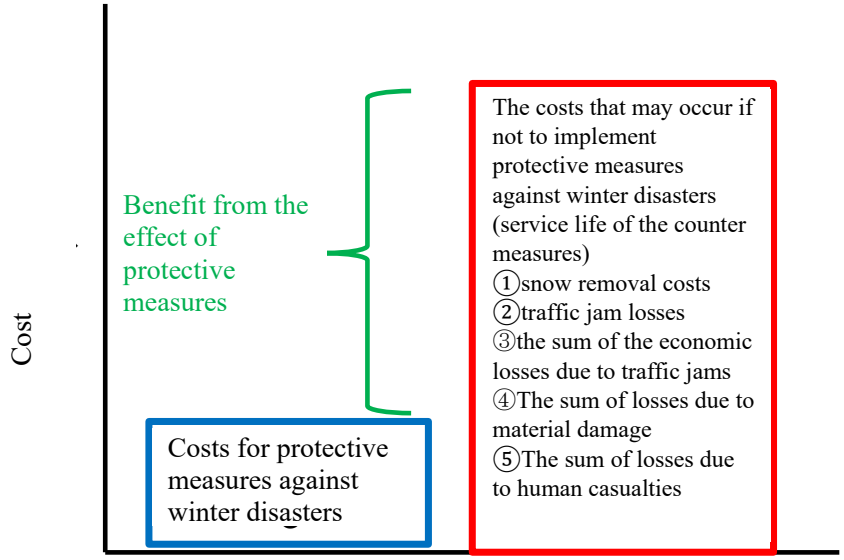


Figure 4.1-3 Scheme of effect and benefits of protective measures against winter disasters

4.2 Costs for preventive protective measures and road traffic stop damage

The rail transport in Kyrgyzstan is underdeveloped, and motor roads are the basis of logistics. However, since the road network is underdeveloped, the closure of main roads has a large impact on the economy. Moreover, roads are important in the daily life of people, the closure of which makes it extremely difficult, so even the simple closure of traffic is not permissible.

For the Kyrgyz Republic, it is extremely important to compare and evaluate "profit / loss" in the absence of any protective measures and a disaster that caused traffic suspension, with the costs in the case of available protective measures to avoid road closure.

Therefore, below we will show the methods of calculating profits and losses due to a traffic stop.

4.2.1 Road traffic stop damage

Methods of calculation are proposed here, how to use the benefits of reducing time with increasing losses due to increasing transportation time due to traffic jams and suspension.

According to the Analysis of Costs and Revenues Manual of the Road Bureau, as well as the Bureau for Urban and Regional Development of the Ministry of Land, Infrastructure and Transport in November 2008, the benefit in reducing time is as follows.

Time saving benefit = unit of time value separately by vehicle type × time × traffic volume

Unit of time value separately by vehicle types　Unit ： Yen / minute x number of transport

Car 40.10　note: prices for 2008

Here, the unit of time value per unit of vehicle type means that the remaining time due to time savings is assigned to other profitable activities. Alternatively, in the case of a driver, one can save on labor costs. On the other hand, when calculating 8 hours a day from the base unit of time value in a car and calculating the amount specified in the following formula, it is 19,200 yen / day, considering that the unit of consumption of a unit of time in a car is equal to the expenses of the driver's personnel.

*Calculation of the amount per day per time unit in a car

40.1 yen / min × 60 min × 8 hours = 19,200 yen / day

Therefore, when Japanese labor costs are replaced by the equivalent of those in Kyrgyzstan (13,483 KGS per month according to the statistical data, p.105) and the unit of the time value of a car in Kyrgyzstan is calculated, it will turn out:

13,483 KGS / month ÷ 22 days (net working days) ÷ 8 hours ÷ 60 min = 1.3 KGS / min.

Also, the time for increasing profit / loss due to increased travel time due to traffic jams / closure is calculated using the following formula.

Profits and losses by increasing time = Time unit consumption × traffic jam / road closure time x traffic overload in the total time corresponding to traffic jams and road closure time

Consumption of time units in passenger cars in Kyrgyzstan: 1.3 KGS / min

*Calculation example

100 cars in normal time / profits and losses when the 8-hour stop on the road, with heavy traffic.

1.3 KGS / min × 60 min × 8 h × 100 units. Car/ h = 62,400 KGS

4.2.2 Assessment of costs for preventive measures and road traffic stop damage

Based on the B / C comparison ratio, profits and losses are estimated: B- losses due to road closure received in Section 4.2.1, and C- costs for preventive measures to prevent disasters. More B / C, higher the score.

Figure 4.2-1 is a monograph to simplify the calculation of profit / loss when closing a road in accordance with the method of calculating profits and losses described in Section 4.2.1. Using this figure, one can easily find the cost of closing the road losses from the traffic volume and number of days for closure.

In addition, if labor costs in Kyrgyzstan change, one can create a similar calculation. The number of road closure days used here can be obtained by calculating the number of closure days.

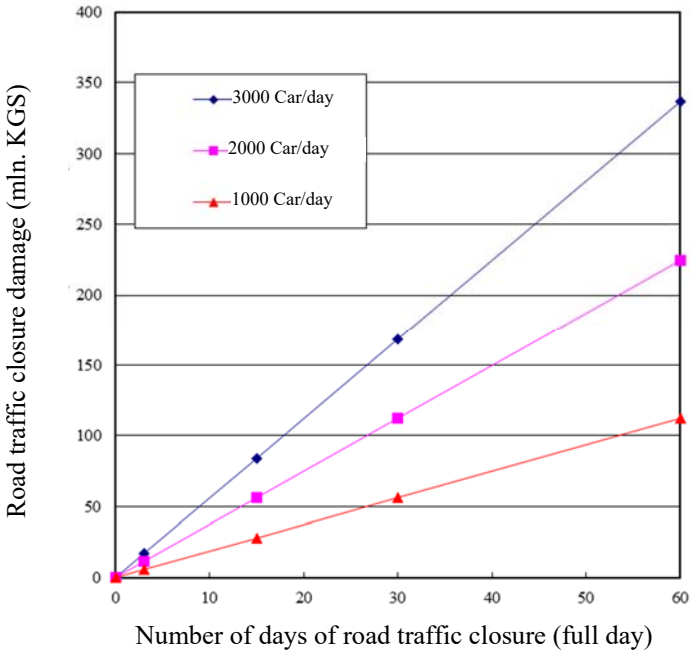


Figure 4.2-1 Monograph showing losses from the number of closing days

CHAPTER 5 REQUEST TO DONORS

It is difficult to ensure the implementation of all necessary protective measures to prevent road disasters, based only on the budget of Kyrgyzstan. Therefore, it is necessary to contact donors from other countries. Requests considered by donors: (1) if the project cost in Kyrgyzstan exceeds 100 million KGS or more and it is difficult to allocate the budget, (2) If it is necessary to obtain advanced technologies that are absent in Kyrgyzstan.

The results of a donor survey on supporting road disaster prevention projects are described below as reference information.

- Asian Development Bank

Current status providing roads disaster prevention assistance.

· Asian Development Bank has been providing roads disaster prevention support in other countries and has experience.

· Asian Development Bank can support a project in the Kyrgyz Republic to improve road safety through road disaster prevention measures.

- World Bank

Current status providing roads disaster prevention assistance.

・World Bank in Kyrgyzstan provide disaster prevention assistance

・It is possible to assist Kyrgyzstan in preventing road disasters.

*Reference

Construction companies in Kyrgyzstan have little experience in the field of preventive measures for disaster prevention in the Kyrgyz Republic. In the future, it is necessary for Kyrgyzstan to be able to independently carry out construction, therefore, introduction of technologies is required and to find ways to develop its own technologies.

For example, with a catching retaining wall, where there is enough space, the installation of an earth dam (the wall has a gentle slope) with a base of stabilizing cement is considered. With cement, produced in the country and using local soil, it is possible to carry out the work with the existing road equipment, therefore, compared to other types of retaining walls, construction is not complicated and one can save money.

CHAPTER 6 DEVELOPING A SHORT-TERM AND MEDIUM-TERM ROAD DISASTER PREVENTION MANAGEMENT PLAN

This chapter will cover the preparation of a list for the short and medium-term plan, following Inspection Manual and Countermeasures Manual, based on the Long List, which was compiled based on inspection results. It will also describe documents necessary for the process of requesting budget from foreign donors.

6.1 Types of lists

Distribution to the Short-term Plan and Medium-term Plan is shown in Table 6.1-1. The Short-term Plan considers the sites where it is possible to carry out work for 1-3 years in order of priority. In general, in relation to these sites, it is necessary to implement measures for about 3 years, and start with those that require emergency measures, which are identified by inspection and risk assessment as Priority Level 1.

Medium-term Plan implies the implementation of work over several years, that is, the period of work implementation is 3-10 years.

Table 6.1-1 Distribution standard for short-term and medium-term plans

Distribution	Scope of works, etc *	Risk assessment
Short-term	・ Priority works that require urgency. ・ Scope of works that can be implemented within 1 ～ 3 years. ・ By assessment of the level of priority assigned to Level 1	S/A
Medium-term	・Measures where construction works will last for several years ・ Implementation of such measures will require from 3 to 10 years.	S/A/B/C

* If costs exceed 100 million KGS or if there is absence of technologies when implementing these works by the ministry itself, then the request for work should be made to foreign donors.

Table 6.1-1 shows the budget request procedure. The content of the short and medium term plans for the budget request is approved at each UADs/ RO, taking into account the priority assessment, and then this request is submitted to RMD. RMD collects all requests from UADs/ RO and compiles a Short List, which is given in Table 7.2, which will be used as a document for the budget request.

Measures that are difficult to implement within the framework of the current MOTR budget should be requested from the Ministry of Finance, following Table 6.1-1. The cost of activities if will exceed 100 million KGS or there will be absence of technologies for implementing these works by the Ministry itself, this request for work implementation should be requested from foreign donors.

Even if there is an urgent need for the implementation of activities, it may be difficult to implement the work due to budget constraints. In this case, it is necessary to take temporary measures to extend the period of stability, monitoring and regulating traffic. That is, comprehensive planning of non-construction measures is needed.

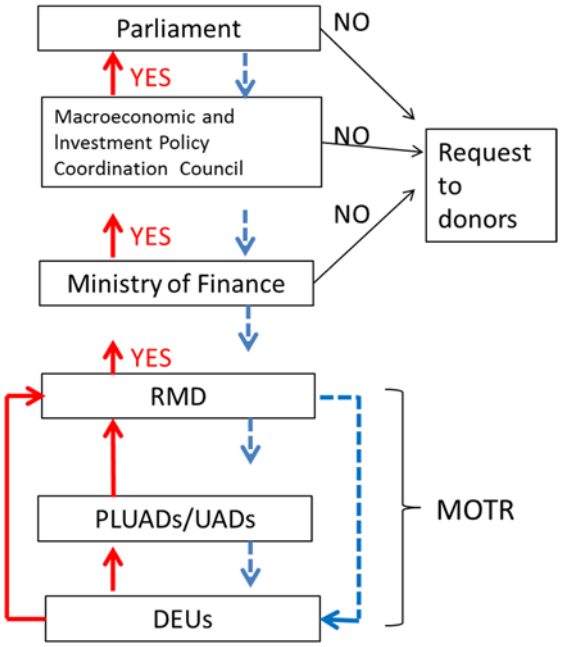
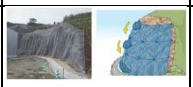
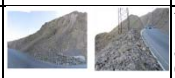
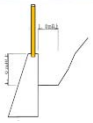
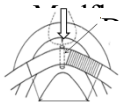


Figure 6.1-1 Budget request procedure

Table 6.1-2 Short list pattern

No.	DEU	Road name	Kilometer column	Disaster	Site photo	Site condition	Structural/Non-structural measures Site scale	Image of measures	Cost (mln Yen) KGS	Scheduled implementation year	Short-term/Medium-term plan
1	9	Bishkek-Osh	1165 km	Rockfall		The actual damage of the Rockfall is unknown. But artificially rocky cliff wall is standing near the road. Unstable rock mass are on the upper part of the cliff.	[Structural measures] Protective mesh Height (H)=20m (average) Length (L)= 130m		40.7	2018	Short-term plan
2	30	Bishkek-Osh	4147 km	Rockfall		Rockfall happens frequently. DEP 30 is required to clean rocks from the road every week. Unstable slope directly border on the road.	[Structural measures] Retaining wall and protection from rocks Height (H)=30m, Length (L)= 140m		19.0	2018	Short-term plan
3	30	Bishkek-Osh	4248 km	Rockfall		The actual damage of the Rockfall is unknown. But artificially rocky cliff wall is directed to the road. The large volume of the falling rocks stays along the road.	[Structural measures] Retaining wall and protection from rocks Height (H)=30m, Length (L)= 70m		9.5	2018	Short-term plan
4	30	Bishkek-Osh	422 km	Mudflow		Mudflow disasters were absent over the past years. In 1998 the traffic was closed for 2 days and in 2012 for 3 hours. Dumping of the rock wreckage was on the valley, Usually water does not flow	[Structural measures] Concrete protective covering (Open drain): Length (L)= 100m Retaining wall on the side of the mountain: Height (H)=2m, Length (L)=100m Dismantling (cleaning) of the existent retaining wall on the side of the river: Length (L)=70m Works on sill laying: Height (H)=3m, Length (L)=15m		27.2	2020	Medium-term plan

Items listed.

The short list shows the items listed from (1) to (12).

(1) Number: Sequence Number

(2) Management: DEU number

(3) Road name: The name of the road to which the site belongs

(4) Location (kilometrage): Kilopost

(5) Type of disaster: Types of disaster (avalanche, landslide, etc.)

(6) Site photos: Photo, which captured the state of the site

(7) Site condition: Damage, deformation, condition of these damages and deformations

(8) Engineering / Non-engineering measures: Types of measures, scale

(9) Images of measures: Construction measures scheme

(9) Cost：million KGS

(10) Risk assessment: Assessment based on Inspection Manual

(11) Scale of Natural Disaster / State of Natural Disaster： Distribution based on the type of disaster

(12) Assessment based on traffic impact ： Distribution based on type of disaster

RMD has a budget framework, so it cannot satisfy all requests for a budget request for road disaster prevention. Moreover, if you request a budget from foreign donors, this will take time before the implementation of activities. In these cases, in accordance with the Countermeasures Manual, it is necessary to prevent damage from natural disasters on the roads, increasing the period of stability of the site and implementing non-construction measures. In general, preliminary movement restrictions and evacuation measures should be planned in accordance with the risk rank, which is determined during monitoring in the event of abnormal weather. Even in countries like the Kyrgyz Republic, there is a hope that such evacuation measures will be introduced and promoted in the future.

*For reference

In Japan, on August 18, 1968, two tourist buses fell into the Hida River due to mudflow caused by heavy rain on the national route No. 41 in Gifu Prefecture, Kamo district, Shirakawa town. This incident claimed 104 people. During the trial of this incident, it became clear that only road signs were installed on dangerous sites of the roads as decided by the road maintenance administration. It was taken into account that the responsibility of the road maintenance administration is to provide the necessary means for the implementation of the evacuation measures. As a result of this incident in Japan, it was decided to adopt laws and standardize the road disasters prevention, such as the disaster prevention inspectorate; standards for regulating traffic during precipitations.

6.2 Materials for the budget request

The overall budget request within MOTR is implemented on the basis of forms 1 - 3, created as a result of each manual. However, in the case of a budget request to donors, one should understand the need for taking preliminary measures to prevent road disasters. Especially when a budget for disaster prevention is requested, it is necessary to clearly demonstrate the need for implementation of these measures and their effectiveness after implementation. Therefore, a scientific base is important, such as meteorological data, dynamic monitoring data, history of natural disasters, etc.

It is necessary to create a forecast form of the occurrence of natural disasters, based on damage history and monitoring results. It is necessary to show specifically how to forecast the impact of a natural disaster on traffic and on third parties. To prevent such disasters, preventive measures (preventive maintenance) must be implemented in advance. To do this, it is necessary to prepare explanatory materials on the fact that there is an economic effect due to preventive maintenance in comparison with rehabilitation after the occurrence of a natural disaster. In addition, in case of difficulties in terms of technology of any work, it is necessary to describe these difficulties in detail. Based on the above, the budget request will refer to the documents listed below.

- Budget request documents

・Inspection card (Topography, geology, form and condition of damage, photos) Form 1

・Past damages history Free form

・Dynamic monitoring results Free form

・Disaster forecast form (disaster scale forecast map · impact on traffic · impact on third parties, etc.) Form 2

・Engineering measures scheme (protective measures elements and quantity) Form 2

・Schedule of implementation of measures and responsibility during implementation Free form

・Reasons for a budget request Free form 3

6.2.1 Inspection card

Photographs of the damage must be taken in such a way that all the damaged parts of the site are visible at a long distance, and the details of the damage are visible at a short distance. In addition, it is desirable to have photographs in which the damage is immediately visible, and which vividly demonstrate the state of the damage.

As a note, you must specify the following. ① Slope steepness and existing protective structure on the slope. ② General damage scale parameters as height, length, depth. ③ General distance parameters such as the distance from the road surface to damage, remoteness. ④ The condition of the coastal area such as a road, rivers and water. ⑤ General information about the volume of the descended soil and volume of a loose soil. It should be noted that the results of the study should describe the cause of the damage. It is necessary to describe the physical properties of a rocky soil: strength, expansion during water saturation, weathering resistance, erosion resistance, soil cracks and so on. As a structure of the rocky soil, you must specify or map the layers, connection surface, fault plane, direction of the boundary surface of the soil and rocks, slope direction, boundary surface between the permeable and impermeable layer. At the very end, it is necessary to indicate surface water as the state of the water, condition of the surface layer of groundwater.

6.3 Past damages history

Past damages history in the target site should indicate the date of occurrence, scale, etc. information that will help present the damage. It is desirable to have photos. What can be stated based on the history of past damage. There is a high probability that the same collapse can occur in the sites where the soil is similar by geological properties. Thus, past damages history is an important document for determining the need for action at the target site.

6.4 Changes monitoring results

Based on the changes monitoring results, it is possible to make an opinion about a danger of a landslide or other types of natural disasters, need for protective measures, and presenting valuable information during a budget request. It will state about the use of study results.

The ratio between time and deformation, which causes a landslide, is shown in Figure 6.4-1. The changes monitoring results should be reflected schematically based on the ratio of deformation and time, movement and time. Landslides, as a rule, as deformation grows at a certain speed, dramatically increase the deformation area, reaching collapse, as shown in the figure. In fact, after a landslide study, it is necessary to determine the stage of development in order to approve the timing of engineering activities. In addition, under the influence of changes in precipitation and groundwater, the development of deformations can progress. Therefore, along with enhancing the monitoring of changes, it is necessary to implement the diversion of water accordingly as an additional method.

Creep collapse

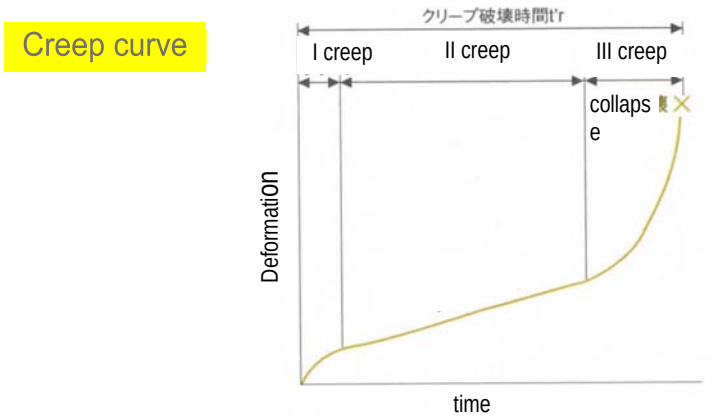


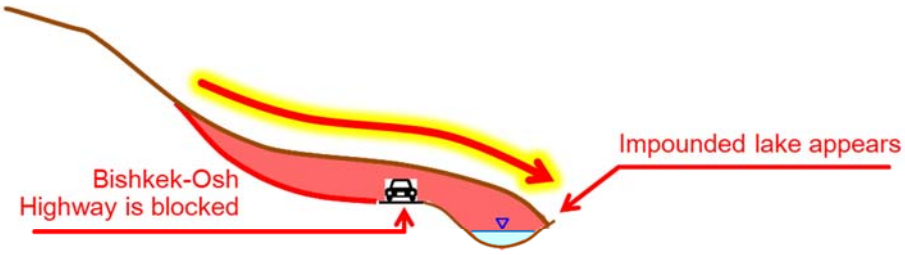
Figure 6.4-1 Ratio of time and deformation, leading to the occurrence of a landslide

Thus, the opinion is made in accordance with the criteria for assessing the level of maintenance, taking into account such factors as topography, geology, precipitations, then a budget request is made depending on the need. For example, maintenance level assessment criteria applied in Japan can be used.

6.4.1 Disaster forecast

A disaster forecast is a prediction of the extent of damage that would occur if damage progresses. The scale of damage implies a forecast of the impact on the road, period of traffic regulation until recovery, impact on the surrounding rivers / private houses.

Figure 6.4-2 gives an example of damage estimate caused by a landslide and estimated period until traffic is recovered.



Items	Quant	30	60	90	120	150	180	210	240	270	300	330	360	390
Quantity of collapsed soil	300,000m^3													
Quantity of cleaned volume	2,000m^2													

Figure 6.4-2 Example of a damage assessment scheme and estimated recovery period

6.4.2 Structural measures

Structural measures are determined on the basis of the predicted consequences of a natural disaster and Countermeasures Manual. Based on the standard drawing, the scope of measures, elements of measures and quantity are indicated.

Engineering activities should be planned on the basis of the Countermeasures Manual and standard drawing when the preliminary approval phase of the engineering type and quantity is approved. However, in the event of difficulty in approving the scope and structure, due to the lack of stability calculations and structure calculations, it is necessary to separately implement detailed design.

When it is assumed that foreign donors will sponsor the implementation of protective measures, it is necessary to prepare a scheme for the implementation of urgent measures to extend the period of stability and scheme for a long-term protective measure.

6.4.3 Scheme of the construction process and distribution of roles

When requesting a budget from international donors to implement protective measures, it is necessary to clarify the distribution of roles between the Kyrgyz Republic and international donor. Figure 6.4 shows an example of an overall process for the implementation of landslide measures with the assistance of the international donor.

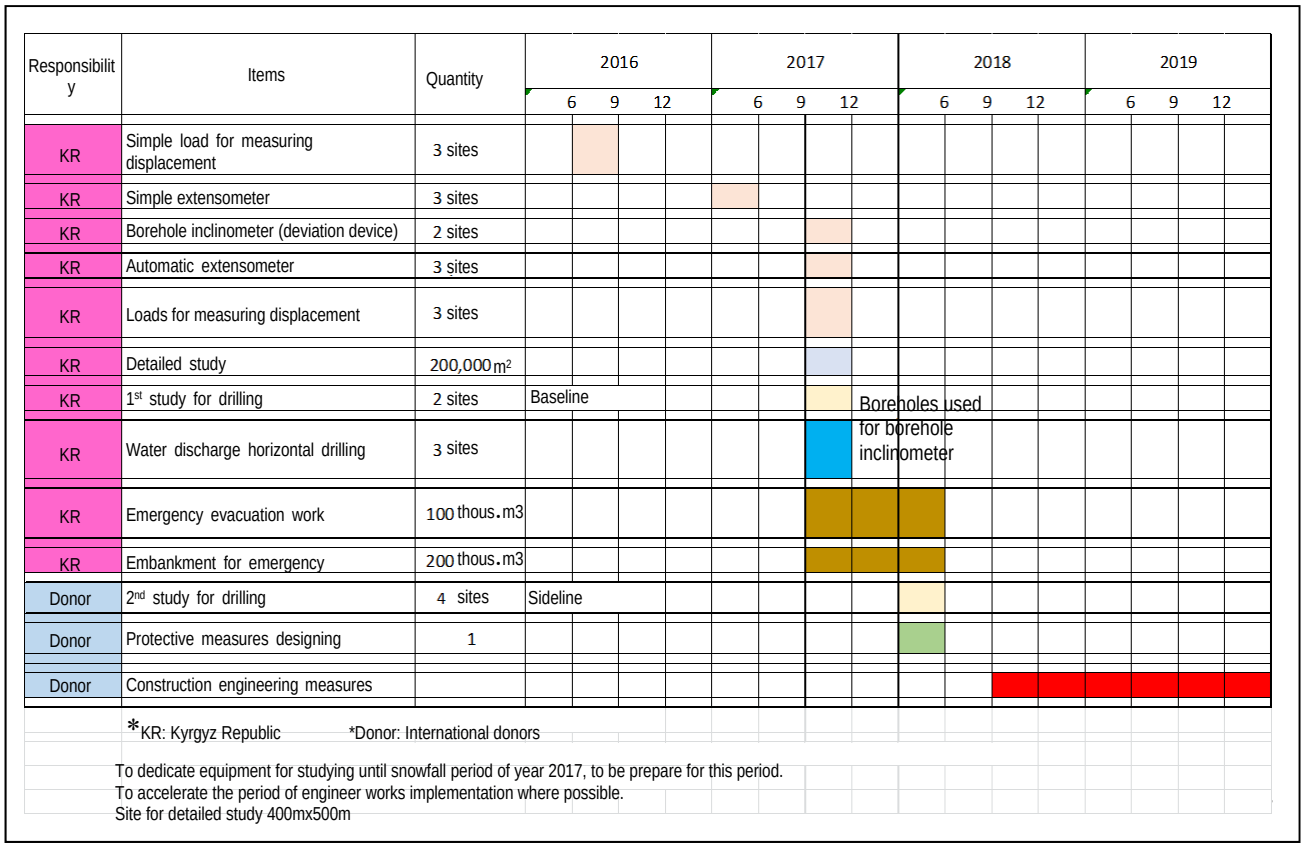


Figure 6.4-3 Example of a general scheme for the implementation of measures and distribution of roles

6.4.4 Validation of the requested budget

The procedure for calculating the required amount from the budget will be described below. Based on the cost analysis of protective measures that were implemented in the past, a preliminary unit price was calculated, which is used in Figure 6.4-1. The calculation of the required amount from the budget is determined at a preliminary unit price, calculated for the types of construction, taking into account the quantities that are indicated in the preliminary scheme of construction, shown in the schematic diagram of the counteraction driver and its quantification. However, if the preliminary price does not correspond to the real situation or if there is no price per unit for new types of work, etc., the works must be calculated individually.

Table 6.4-1 Preliminary estimate sample

Preliminary estimate for budget request
(direct construction costs)

UAD: UAD OSI

Materials	Details	Q-ty	Unit price (KGS)	Note
Unreinforced concrete		m3	1,500	
Reinforced concrete		m3	2,500	
Masonry		m3	725	
Gabion mesh	2×1×0.5	pc	1,750	
Drilling		m3	85	
Filling		m3	85	

The unit price was clarified during an interview with UAD OSI employees

Form 1

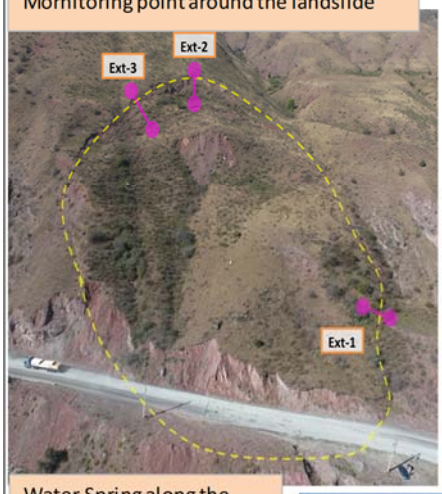
Inspection Sheet

2016/11/1 -2018/6/2

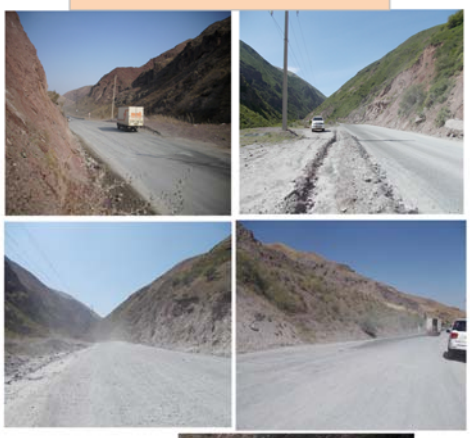
No		Items	Landslide	Route	BO road (DEU 9)			Recorded by
Continous	mm	Hourly Rainfall	mm	KP	85.5 km	to	km	K.Kawakami

Photo Image ／ **Sketch or Drawing**

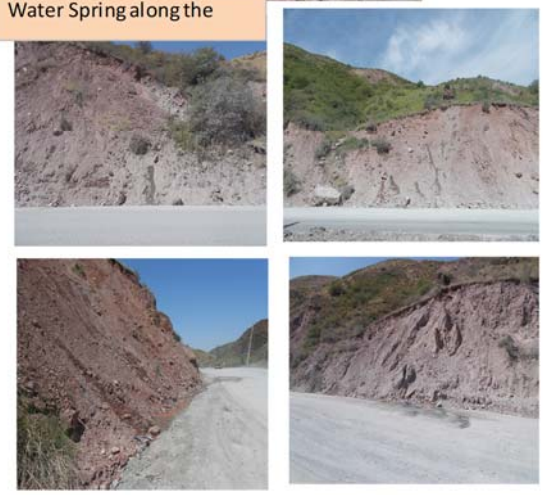
Mornitoring point around the landslide



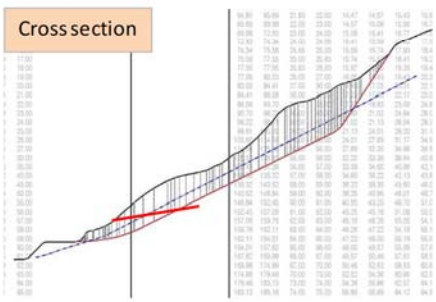
Deformation on the road

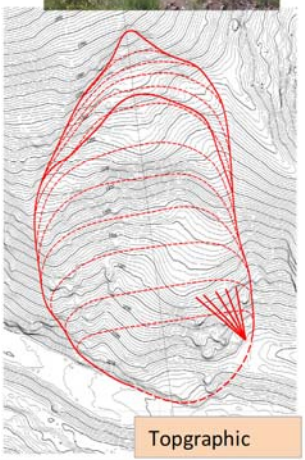


Water Spring along the



Cross section





Topgraphic

Comments

The lamdslide mass at the site has been moved over 1000mm from 2016 Oct to 2017 Apr.
The moving speed of landslide has been decreased after summer in 2017.
But monitroing work around the landslide area should be countinued for watching out sudden re-move

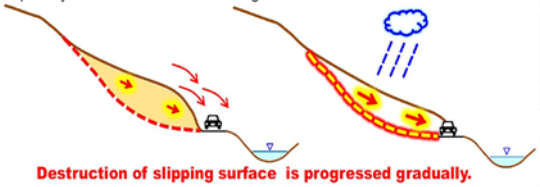
Form 2

Predictive disaster damage and countermesure work plan

No		Items	Landslide	Route	BO road (DEU 9)	KP	85.5	to	

Disaster damage

Rockfall and Collapse are occurred frequently.
Especially after rainfall and snow melting season.

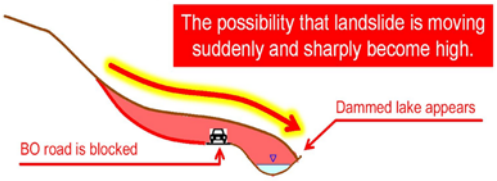


Destruction of slipping surface is progressed gradually.

Estimation of Disaster Scale (Maximum)

Length of Section : 1200m
Period of blocked : 1 month

Landslide is continuously sliding regardless of weather condition.

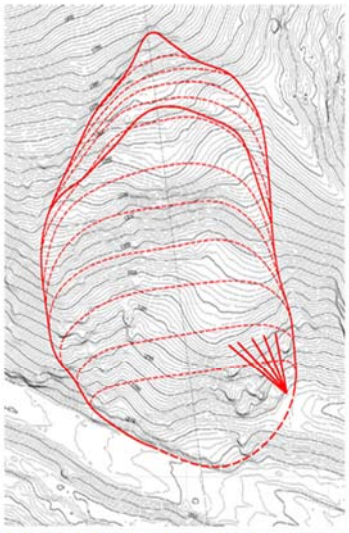


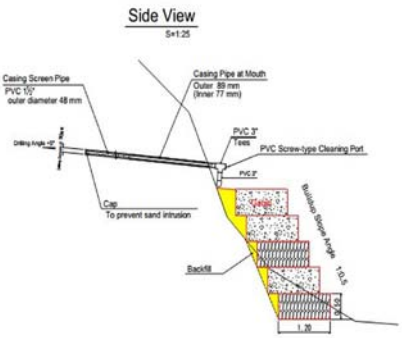
Estimation of Disaster Scale

- Residents will be died.
- Houses will be destroyed.
- Agricultural land will be destroyed etc

The flood simulation is necessary to estimate about details.

Countermeasure





The plan of Horizontal drainage drillng is effective as the quantity increases.
The contractor and the surpervisor should be improved the quantity and location of drainage work by looking at drainage work situation.

CHAPTER 7 ACTION PLAN

Below is the budget request process and allocation of roles for effective road disaster prevention management of the Kyrgyz Republic, given the lack of human resources.

7.1 Requesting budget 2 times a year in spring and autumn

The frequency of natural disasters on slopes (landslide) and avalanches increase during the spring snow melting in the Kyrgyz Republic. Moreover, there are sites in winter where the road surface can not be restored due to weather conditions, and the spring condition of the road surface is represented by a large number of holes and gouges. Therefore, as shown in Table 7.1-1, periodic inspection in the spring is a period when there is a greater likelihood of detecting more damage that needs urgent response. Therefore, it is necessary to collect all the results of ongoing inspections, scheduled inspections (spring and autumn), and unscheduled inspections for six months in order to sort out problems and maintenance tasks. Based on these results, it is very important to discuss urgent measures and issues that should be addressed in the current fiscal year so that the budget is quickly allocated for the implementation of activities.

Table 7.1-1 Distribution of roles in spring and autumn

Request period	Content
Spring	Urgent measures ● Monitoring ● Detailed survey
Autumn	Structural measures

In addition, with regard to the permanent measures necessary for a fundamental solution of the problems and tasks, arising annually according to the results of the planned inspection in spring and autumn, it is necessary to draw up a preliminary scheme of protective measures, a preliminary estimate to request a budget.

7.2 Joint meeting MOTR ・ MOF ・ MES

In the Kyrgyz Republic, large-scale natural disasters associated with snowfall and natural disasters on slopes outside the road area occur due to geological, topographical features of the location and weather conditions. In particular, there are many sliding slopes with landslides, slopes with variations, slopes with a large amount of soil sediments due to a sliding and unstable slope. In addition, in recent years, the intensity of precipitations has been increased, facilitating the risk of natural disasters and mudflows on the road.

Based on this state of affairs, it is considered effective that MOTR · Ministry of Finance · MES would mutually exchange information and cooperate with each other. Currently they hold a joint meeting in the event of a disaster, but we would like to recommend holding a scheduled meeting twice a year in spring and autumn.

Joint scheduled meeting of MOTR · Ministry of Finance · Ministry of Emergency Situations should consider: (1) the need to implement projects and allocate a budget for the implementation of protective measures to prevent road disasters, ② sharing information on disaster prevention and bringing this information to the public and road users (brochures with a map of hazardous areas, information about hazardous areas on the website, etc.), ③ clarification of roles and assignment of responsibilities for areas outside the road area.

In addition, the current MOTR budget limits funds for road disaster prevention. Discussion is needed regarding budgeting on a separate basis.

In particular, MOTR and Ministry of Finance should discuss the need for a list of protective measures, determine the necessary measures and consider options for allocating of MOTR budget individually. During the budget request for the implementation of the work, it is desirable to have a mechanism that displays a specific estimate of protective measures with a scheme of protective measures.

7.3 Annual plan

Figure 7.3-1 shows the dates of the annual action plan and distribution of roles, the content will be described below.

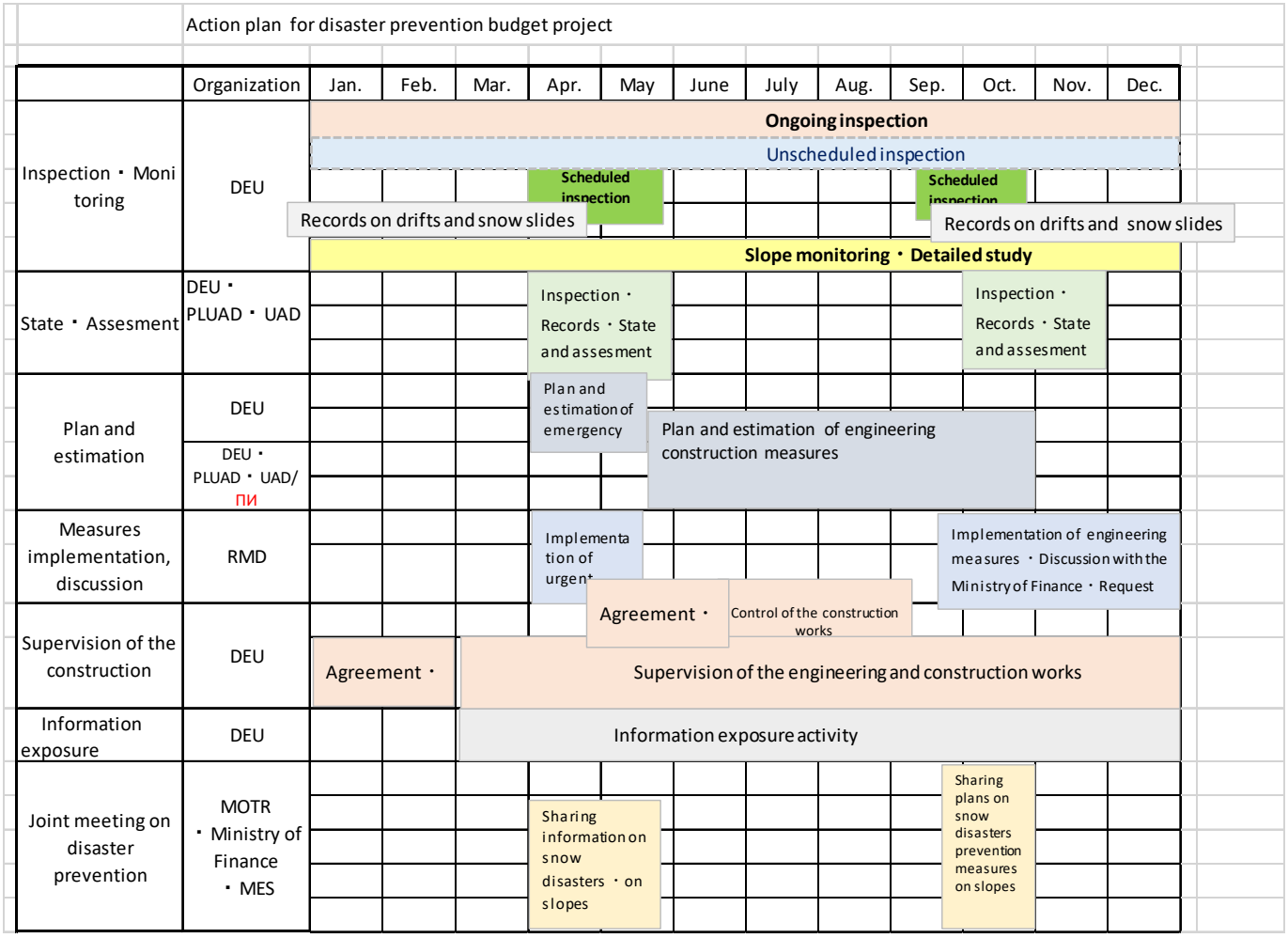


Figure 7.3-1 Annual action plan and roles

1) Inspection・monitoring

Plan implementation

· Ongoing inspection: conducting a disaster prevention inspection along with the roadway inspection

· Scheduled inspection: helding twice a year in April and September

· Unscheduled inspection: implementing unscheduled, when there is rockfall, landslide, avalanche, snowdrift, etc.

· Snowdrift: snowfall records

· Monitoring: implementation of dynamic monitoring of natural disasters

*Performer

DEU

2) **State・Assessment**

Implementation plan

・ Analyze the results of inspections and monitoring, and make an opinion

・ Select sites where it is necessary to conduct a detailed study (stability state)

・ Make an opinion about the level of danger, select sites where the implementation of protective measures is necessary

・ Make an opinion on the need for urgent action

・ Make an opinion on the priority of engineering measures

・ Make a short list ・ update

・ Make a complete list ・ update

*Performer

DEU, UAD, RO

3) **Plan and estimation**

Implementation plan

・ Prepare a plan for the implementation of urgent measures

・ Calculate the cost of urgent measures

・ Prepare the implementation plan of engineering measures

・ Calculate the cost of implementation of engineering measures

*Performer

DEU, RO, UAD

4) **Project implementation and discussion**

Implementation plan

・ Implementation of urgent measures

・ Implementation of engineering measures

・Distribution of the roles of MOTR, Ministry of Finance and foreign donors

・ Discuss the budget with the Ministry of Finance

・ Negotiate with partners and donors

*Performer

RMD

5) **Construction Control**

Implementation plan

・ Monitoring the implementation of urgent measures

・ Monitoring the implementation of engineering measures

*Performer

DEU

6) **Information exposure**

Implementation plan

・ Provide information as publicly available information on the prevention of natural disasters related to snowfall / slope conditions

*Performer

DEU

7) **Joint meeting on road disaster prevention**

Implementation plan

・Sharing information in reports on actual condition and damage (material / human) after the occurrence of a natural disaster caused by snowfall and a natural disaster on the slopes

・ Integrated policy for responding to urgent measures and roles

・ Integrated policy response to engineering measures and role distribution

*Performer

MOTR, MES, Ministry of Finance