# Sabo, Sediment Control Strategy in Indonesia

Bambang Hargono
***General Manager of Jeneberang River Basin Development Project, South Sulawesi,***
***Directorate General of Water Resources, Ministry of Settlement and Regional Infrastructure, Indonesia.***

ABSTRACT: One of the missions of the Directorate General of Water Resources of Indonesia is controlling of destructive power of water. This mission also includes the power causing sediment related disaster; among others erosion, landslide and debris flow. These types of disaster occurrence in Indonesia have been increasing lately. Deforestation and illegal cutting is probably the cause as the chain effects of increase of population and thus increase demand for exploitation of natural resources. In order to reduce and mitigate the disaster, the Integrated Sediment-Related Disaster Management (ISDM) Project is being carried out currently. This project is involving community in planning of mitigation of the disaster. This is in line with the Water Sector Adjustment Program (WATSAP) being implemented by the Government, in which involvement of stakeholders for sustainability of water resources system is emphasized. However, the success of the ISDM in the national level requires active involvement of all stakeholders mainly to overcome problems concerning budget and sustainability. Involvement of politicians, government and all people especially in the area of disasters are essential for mobilization of fund and improvement of quality of life of the people. With the improved quality of life, it is expected that excessive exploitation of natural resources including forest can be minimized.

*Key words: Integrated Sediment Related Disaster Management, ISDM, WATSAP, erosion, landslide, stakeholder, forest cutting, quality of life.*

## 1. INTRODUCTION

Comprising more than 13,000 islands located along the equator, Indonesia archipelago is blessed with precipitation ranging from 700 to 7,000 mm, with 2,800 mm mean annual rainfall (Hasan, 2002). Two global volcanic belts pass through the country; Circum Pacific and Trans Asiatic Volcanic Belts (STC, 2002). These volcanic belts form series of earthquake centers and active volcanic zones. There have been 129 active volcanoes identified in Indonesia (Hasan, 2002). Changes of shapes of the earth by uplifting, supply of material from volcano eruptions, as well as flushing action by water and wind are very common phenomenon. Supplied fertile material produced by the volcanic activities and high intensity of rainfall also contribute to the formation of tropical forest, which naturally reduced the power of wind and water in changing the earth shape. Therefore, nature has made their equilibrium state.

With pleasant warm weather, 21° to 33° Celsius throughout the year (except in high mountains), fertile land, despite the earthquake and volcanic eruptions, Indonesia is inhabited by around more than 203 million of people (2000 census, Surbakti, --); fourth in the world. Mostly agrarian, people live in the volcanic high land, live in harmony adapting with dangerous behavior of volcanoes. However, in the last two decades, increase of population (1971 census: 119 million people, Suharto, 1973) also brought consequences of less ownership of land. People start cutting forest and cultivate the land for agriculture. The worse, illegal logging also occurred. We could anticipate what happened; higher intensity of erosion, followed by sedimentation in the lower reach of rivers. Less forest means less protection from destructive force of water. The sedimentation in the river reduces its capacity. It is unquestionable that flood will occur, while scarcity of water become common in dry season. Further, loss of fertile soil after erosion also resulting in poor soil that reduces agriculture production. Bare land, exposed to rain and sunshine, is rapidly weathered. This weathering process combined with other natural action also disastrous. This may entail with mass movements, landslides, or slope failures beside slow erosion process. People still love volcanoes, and stand to live with them as the volcanoes supply fertile soil. But currently, the fertile soil is also gone despite the continuous supply by the volcanoes.

## 2. PROBLEM

From the above paragraphs it is clear that people is poor and threatened by natural disasters: to be more specific, sediment related disaster. In order to recover, soil conservation is the key. It means that there shall be actions

on reducing the intensity of erosion, and thus prevention of the sediment related disasters. For this special purpose, there are some strategies to be applied.

1. Reforestation; this must be implemented although the result can only be seen after quite a long period. People cannot wait.
2. Application of sabo works, including construction of civil structures. This will need money for construction and maintenance.
3. Guidance and law enforcement to maintain sustainability.

At the same time, there shall be a strategy on helping people to improve their quality of life. Otherwise, forest cutting and activities that may endanger the civil structure may continue and prevent the sustainability of the system.

## 3. FACTS

An aerial survey conducted in 1983 revealed that 63% of land area still covered by forests, while the Department of Forestry is responsible for 75% of Indonesia's land area (1,909,051 $km^2$). Trees cutting, illegal logging, have increased lately; these coincides with the increased occurrence of forest fires, landslides and floods. Forest fires in Kalimantan (Borneo) are never heard before, since it was only natural phenomenon in an acceptable acreage. According to one report of Ministry of Environment in 1998, the fires destroy almost 20,000 ha every year, while it was only 1,600 ha previously (White, 2002).

Java, represents only 8% of total Indonesia area, shoulders more than 100 million of people, which is more than a half of the national population. When we travel along Java it is doubtful that the remaining forest still more than 20 % of the total land area.

Forest cutting seems to occur anywhere in Indonesia. Young volcanic area, undulating topography, loose material of volcanic eruption, high intensity of rainfall, and high intensity of weathering, have indicated the area where landslide and erosion may occur. This type of natural condition prevails in most area of the country. The following is the data recorded by Directorate of Volcanology and Geologic Disaster Mitigation, of Ministry of Energy and Mineral Resources.

**Table 1.** Landslide occurrence in Indonesia
(1990 – 2001*)

| No. | Year | Number of occurrence | casualties | | Destroyed houses | Destroyed agriculture land (ha) |
|---|---|---|---|---|---|---|
| | | | dead | Injured | | |
| 1. | 1990 | 48 | 57 | 6 | 108 | 70.57 |
| 2. | 1991 | 58 | 18 | 19 | 45 | 270.85 |
| 3. | 1992 | 112 | 119 | 17 | 107 | 206.56 |
| 4. | 1993 | 40 | 38 | 11 | 110 | 333.64 |
| 5. | 1994 | 90 | 51 | 5 | 89 | 332.80 |
| 6. | 1995 | 87 | 31 | 9 | 96 | 70.77 |
| 7. | 1996 | 98 | 63 | 28 | 176 | 109.65 |
| 8. | 1997 | 68 | 39 | 8 | 91 | 114.50 |
| 9. | 1998 | 86 | 59 | 61 | 203 | 198.10 |
| 10. | 1999 | 75 | 172 | 19 | 140 | 89.10 |
| 11. | 2000 | 67 | 214 | 48 | 138 | 1155.50 |
| 12. | 2001 | 54 | 421 | | 942 | 443.00 |
| | **TOTAL** | **883** | **1282** | **231** | **2245** | **3395.04** |

*) Source: STC, Yogyakarta.

Serious flood occurred from November 2001 to February 2002 in many cities in Indonesia. Probably it occurs every year, but it was the worst in Jakarta, the capital of Indonesia, ever since. Surprisingly, rain measurement shows that they were less than 100 mm, compared to 400 mm recorded at the time of lesser flood in 1996. This indicated that the actual meteorological conditions have not changed much, and not the main cause of the disaster.

The fact is that the increase of population from 119 million in 1971 to 203 million in 2000 and of course more today, has exerted pressure on the environment, in the form of increase of urban pressure due to developed

greater needs. Farmers also extending their land to fulfill increasing demand for food. Therefore the landslides and other soil movements are the process of the nature in seeking the equilibrium.

## 4. MITIGATING THE DISASTER

As it is mentioned previously, reforestation must be implemented. We understand that it takes quite a long period to witness the result. During the waiting period, efforts to maintain what have been achieved and to maintain the forest that have been in existence shall be made. Therefore, a program for fulfilling people's need shall be carried out to avoid deforestation.

In order to mitigate the disaster in a shorter period, civil infrastructures to protect people and their properties maybe built. We understand that the main problem for materializing this effort is difficulties in mobilization of fund. To reduce part of this problem, a self-help program from the inhabitants maybe arranged, among others is to design low cost protection structures.

When natural disaster comes, when nothing can be done to avoid, what to be done is to minimize the casualties and the loss of properties. This can only be implemented with the involvement of the communities. Based on the above premises, a program called **Integrated Sediment Related Disaster Management (ISDM) Project** is being implemented in Indonesia. With the assistance of Japan International Cooperation Agency (JICA), this project commenced in 2001 for a period of five years.

## 5. GOVERNMENT POLICY

Controlling destructive power of water is one of the missions of the Directorate General of Water Resources (DGWR) of Indonesia. This destructive power includes the eroding power of water. DGWR adopts the Water Sector Adjustment Program (WATSAP)[1] in implementing the missions since around a decade ago. This WATSAP covers among others the following.

- Decentralizing water resources management frameworks to conform with national legislation on regional autonomy.
- Activating a national Water Resources Management Decision-Support System based on an intergovernmental data-sharing network.
- Emphasizing non-government stakeholder involvement.
- Establishment of a national framework for collection of hydrological data on a sustainable basis.
- Autonomous and self-financing water users associations.
- Implementation of a nation wide irrigation service fee framework for sustainable financing of operation and maintenance.

## 6. ISDM PROJECT

Sabo is a system for soil conservation or sediment management. It is a Japanese system introduced in Indonesia in 1970 to protect people from debris flow of volcanic activities. However, it is currently applied mostly for sediment management along any rivers, which is application for non-volcanic areas. While previously, sabo structures may only have a single purpose to capture sediment and thus reduce velocity of debris flow to prevent disaster, there are many purposes that can be integrated into sabo facilities nowadays, for example intake structures for agriculture irrigation. More over, with the broader and more complicated problems concerning sediment related disaster and thus sediment control, the Sabo system also covers controlling sediment in the off-stream areas.

In understanding the WATSAP, the message to be implemented in the mitigation of sediment related disaster management would cover the following key words: decentralization, regional autonomy, intergovernmental data sharing network, data framework on a sustainable basis, stakeholder involvement, and self-financing. These key words become the spirit in implementing the four concepts of the ISDM as the followings.

1. Establishing integrated Sediment–related Disaster Mitigation Guidelines through model areas,
2. Human Resources Development,
3. Establishing Disaster Information System, and
4. Establishing Local Organization for Disaster Mitigation.

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[1] Source: http://www.kimpraswil.go.id/

*6.1 Establishing integrated sediment related disaster mitigation guidelines through model areas.*

In establishing a national guideline for integrated sediment related disaster mitigation, a four model areas has been selected; Mt. Merapi area, Mt. Agung area, West Sumatra area, and Central Sulawesi Area. These four models were selected based on their different physical characteristics of sediment types, which are expected to represent all types of sediment material causing disasters in Indonesia.

In Mt. Merapi of Central Java, and Mt. Agung in Bali the disaster is mainly due to volcanic debris flow. While in Mt. Merapi some civil structures are to be made, in Mt. Agung the mitigation requires also slope stabilization by vegetation to prevent erosion. In West Sumatra, the type of disaster is a non-volcanic debris flow comprising large boulders. The mitigation would require specific method and consequently specific type of structures. In Central Sulawesi (Celebes), the disaster is caused by mudflow and sometimes debris flow of non-volcanic activities in the area prone to slope failures.

Not only technical aspects, the method of disaster mitigation also based on indigenous knowledge, social, and economical condition of the related areas. For a comprehensive understanding of the model areas, the following activities are conducted (Haryono, 2002).

1. Data collection on social and economical condition as well as technical data of the prone areas and the surroundings.
2. Meeting with local community to collect their indigenous knowledge on disaster mitigation.
3. Designing of procedure for avoiding the disaster.
4. Designing of mitigation structure and mitigation procedure with a comprehensive involvement of the community.
5. Involvement of community in all steps of activities from the design to the implementation as well as the maintenance.
6. Establishing a management system of sediment related disaster mitigation with and for the community.
7. Developing a guidance for integrated sediment related disaster mitigation for the community.

*6.2 Human Resources Development*

This concept of Human Resources Development in this ISDM Project is implemented in three levels. The first level is emphasized in interaction with communities in model areas. However, in order to establish permanent institution for mitigation of sediment-related disaster, training in the ISDM concept including technology involved is conducted with the provincial and district government staffs being the participants. This is implemented in the form of on the job training.

The second, the ISDM Project invites other provincial and district government staffs to attend short period trainings in Sabo Technical Centre, Yogyakarta. The training includes technical aspects and procedure for implementation of ISDM. This effort is meant to disseminate awareness of vulnerability of local condition to sediment related disaster, how to mitigate, and the institution required to be established for the management of the mitigation.

The third level is implemented with the cooperation between DGWR and Gadjahmada University of Yogyakarta. In this cooperation, DGWR staffs are educated in the Master Program for Management of Disaster Mitigation.

*6.3 Establishing Disaster Information System*

The Disaster Information System is aimed at national level coverage information of sediment related disaster potential and occurrence. In the establishment of the system the following activities are implemented (Haryono, 2002).

1. A campaign on data collection with related and concerned institution.
2. Development of a data base system.
3. Development of the data base management and maintenance system.
4. Development of a homepage for dissemination of information and interactive activities in data collection.
5. Provision of technical advice in the management of disaster mitigation.

*6.4 Establishing Local Organization for Disaster Mitigation.*

This concept at the moment is implemented in the model areas. However, in order to sustain this activity, a national campaign shall be made to disseminate the ISDM all over the country.

## 7. NATIONAL SABO STRATEGY

The ISDM project is limited with time and budget constraints. Further effort shall be made for the success of national wide sediment related disaster mitigation management. It has been described in the previous paragraphs that the problem for maintaining this effort is continuous financial support for the construction of disaster mitigation infrastructures, and for the maintenance. Other problem, still concerning sustainability is the low quality of life of the people. Improvement of quality of life will prevent people activities that may endanger the structures; for example, excessive sand mining and forest cutting.

We can involve politicians in overcoming the financial problem. The politicians shall urge and support the government in budgeting the construction of infrastructures for disaster mitigation. Other party concerning financial support involves the government who understand the problem and the necessity of the infrastructure and other activities concerning disaster mitigation. Last but not least financial support is also the concern of local community. Campaign within the community is important to conduct low cost activity to protect them selves.

An effort to protect people from disaster is a good campaign for the politicians. What to be campaigned is to make the politicians understand the problems and the mitigation activities required. In order to have strong support, the politician shall create the force strong enough to mobilize fund for this purpose. The politician may force the government for providing the fund, or any other potential sources relevant to protection of people. In many ways, we, who concern on the mitigation of the disasters, shall facilitate a campaign to the politician in order they are well aware of the ISDM. One effort is to invite Governors of the Provinces where the areas are vulnerable to disasters, and facilitate them to form an association for changing information concerning the disaster in their provinces. We can propose that the association is named Indonesia Sabo Association, and further proposing activities on implementation of Sabo system.

It is essential that the staff in the provincial government can support the governor with the information on ISDM and Sabo. There should be a Sabo Unit in every province, which can provide the information on sabo and ISDM. This includes all the technical know how and the procedure for the mitigation management. Sabo units shall collect the information about the disaster in the area and create the networking with other provinces. The sabo unit shall disseminate the information to the community, community organizations, schools and other important institutions in mitigating disaster. The sabo unit would be a unit responsible for giving the advice to the people.

The community is a small entity that shall protect themselves from disaster. Low cost structure, save cultivation method, terraces, greening and the like for preventing sediment related disaster can be made and applied in the community. To achieve the effectiveness of the efforts, and thus to keep the cost low, the community shall arrange the disaster mitigation activities in a well-organized system. Therefore, local organization for ISDM purposes shall be founded.

The ISDM has to aim to the improvement of the community quality of life. The protection of people from disaster is the main objective. However, the utmost use of the properties of the community shall be part of the ISDM as well. Utilization of steep slope for agriculture is possible, however the method and the procedure for the safe and sustainable cultivation shall be provided in the ISDM activities. Sabo structure, sabo dam for example, can be designed not only for regulating the sediment, but based on the discussion with the community, it can be used also for irrigation diversion structure, or an intake of water supply. These facilities will keep the community busy for their works in fulfilling their need to improve their crop production or other productive activities and thus improve their lives. These facilities will also help avoid forest cutting or other activities that endanger the sustainability of ISDM facilities.

## 8. CONCLUSION

High population increase demanding more exploitation of natural resources in Indonesia has increased the occurrence of sediment related disaster. The mitigation of the disaster faces two main problems, difficulties in mobilization of fund and poor quality of life of the people. The latter is essential to maintain the environment and the infrastructure that have been built in favorable condition for disaster prevention.

Mobilization of fund requires all level support from the high level politician to participation of the local people. Indonesian Sabo Association, an association of high level politicians, would be the answer for prime mover enable to urge government and other potential organization to mobilize the fund. On the other hand, local people shall organize themselves to systematically prevent and mitigate the disaster.

In the province, there shall be a Sabo Unit to be the center of information for sediment related disasters concerning the prevention and the mitigation. This unit can also be operational for the design and implementation of the sabo system, depending on the regulation and source of fund.

The improvement of quality of life of a community is essential for sustainability of the environment. Productive agriculture activities or industry may reduce negative activities that may avoid watershed deterioration and damages on facilities built for disaster mitigation. For this purpose it is highly recommended to create additional function of the facilities by incorporating for example intake structures for irrigation or others depending on the demand of the community.

## 9. REFERENCES


Haryono (2002). *Pencegahan Bencana Alam Sedimen (Tanah Longsor dan Letusan Gunung Api).* Seminar Nasional Pengaturan Hukum Mengenai Korban Bencana Alam Akibat Banjir, Tanah Longsor, dan Letusan Gunung Berapi, Universitas Islam Indonesia dan JICA, Yogyakarta, 18 April 2002.

Hasan, Moh. (2002). *Sediment Related Disaster Control (Sabo Work) in Indonesia (Past and Present Policies).* Proceeding of International Symposium on Sediment-Related Issues in South East Asian Region, Directorate general of Water Resources, ISDM Project, Yogyakarta, September 22, 2002.

STC (2002). *Tinjauan Bencana Alam Sedimen di Indonesia.* Sabo Technical Centre, Integrated Sediment-Related Disaster Management Project, Yogyakarta.

Suharto S. and Abdulmadjid M (1971). *Progress Report on the 1971 Population Census of Indonesia,* BPS Statistics, Jakarta Indonesia 1973.

Surbakti, Praptoprijoko and Darmasto, (--). *Indonesia's 2000 Population Census: A Recent National Statistics Activity,* BPS Statistics Indonesia.

White, Gavin (2002). *Watershed Deterioration: Elements for Measuring the Off-sidte Costs of Deforestation (Drafi)*, Rural Development Unit, World Bank Jakarta, Indonesia.


Makassar, Indonesia, December 2002