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IMPACTS AND RISKS FROM DIFFERENT LAND USES IN SAMAR ISLAND FOREST RESERVE[1]

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IMPACTS AND RISKS FROM DIFFERENT LAND USES IN SAMAR ISLAND FOREST RESERVE[1]

by

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EXECUTIVE SUMMARY

Abstract

A typical risk assessment process was applied to identify and evaluate the different impacts and risks associated with forestry and mineral development options in the Samar Island Forest Reserve (SIFR).

For forest management options, it is estimated that the low timber stock volume of the Dipterocarp forest cannot presently support a large-scale commercial logging operation. Nevertheless, timber poaching and the extraction of non-forest products, like rattan, will likely persist until the resources are depleted. The specific environmental impacts from such extraction cannot be further ascertained, as the extent and location of the operation were not known at present. On the other hand, the risks from agro-forestry and forest plantations are considered manageable provided appropriate silvicultural practices are employed.

The mineral development options that would significantly affect SIFR are Concord bauxite mining and Bagacay copper-pyrite mining. Both are situated within Taft watershed and are located 10-km apart from each other.

Concord mining is expected to be a shallow open-pit mine with little overburden or spoil. It requires the stripping of about 620-ha of Dipterocarp forest, including its topsoil, soil microorganisms, and soil fertility. It is also highly probable that the mining operation will disturb the terrestrial ecosystem including wildlife, particularly the rare and endangered species of the Philippine Eagle that is believed to be nesting in the Taft forest area. Since the mine-disturbed land is expected to be withdrawn from other land uses, it becomes a visual intrusion to the surrounding areas due to its unsightly excavations and exposed areas. While the risk of ordinary floods is low or remote, the likelihood of flash floods attributable to Concord mining ranges from high to low. The soil loss associated with Concord mining is projected at 650 tons to 164,176 tons annually while the dust suspended is about 248 kg hourly. Red Mud (milling by-product) may leak and contaminate the Taft River and destroy the aquatic life unless proper environmental controls are practiced.

The Bagacay copper-pyrite mine is expected to be a deep open pit with overburden or spoil materials. About 324 ha of Dipterocarp forest will likely be removed, affecting the soil, groundwater and wildlife (including the Philippine Eagle) within and around the mine area. It may generate about 340 tons to 85,795 tons of soil annually to the Taft River. Its flashflood contribution ranges from 0.308 MCM to 1.231 MCM on a given day of heavy rainfall. Acid Mine Drainage is highly possible due to the abundance of acid-producing pyrite in the mine site. However, the abundance of limestone deposits can neutralize the acidity as it is formed. Nonetheless, the dissolved copper remains an environmental problem in the Taft River, which now exceeds the DENR standard for Class C/D waters. The exposed mining area will also generate dust estimated at about 129.6 kg hourly.

Samar is visited by tropical cyclones at a rate of about 1.44 cyclones every year with the months of November and December receiving the highest number of cyclone passage.

Damages due to cyclones are relatively low as compared to Leyte. No disastrous landslides were located for the last 10 years (1990-1999) while two earthquakes were experienced in Samar during the same period with P49 million damages. Overall, the effects of natural hazards are manageable and the risk can be reduced if proper precautions were taken in the planning and implementation of projects.

As far as the public is concerned, TLA timber harvesting and mining are the most unpopular economic activities in the SIFR, both in terms of risk and desirability. On the other end of the spectrum are non-extractive activities (residential/community build-up, infrastructure development and ecotourism),which are deemed fairly acceptable and least risky activities by the survey respondents within and outside the SIFR. In the middle of these extremes are small-scale extractive activities such as timber poaching, kaingin, quarrying, communal mining, hunting wildlife, gravel and sand extraction, collection of stalactites and stalagmites, and gathering of rattan and minor forest products.

These findings are not conclusive but should be considered as provisional and indicative. Many uncertainties and inadequacy of data prevented a complete quantitative risk assessment, apart from time constraint that constricted its scope. Instead, a qualitative framework is suggested in this study, which can aid in Multi- Criteria Analysis. Moreover, as the risk assessment process is iterative in nature, the results can be refined as more studies and models are made and validated in SIFR.

Finally, the government is not to be deterred by such uncertainties that frequently attended natural resource management, and should pursue the 'precautionary approach' as one of the principles of sustainable development, in the implementation of risk mitigation measures.

IMPACTS AND RISKS FROM DIFFERENT LAND USES IN SAMAR ISLAND FOREST RESERVE

1. INTRODUCTION

1.1 Overview

The Samar Island Biodiversity Study (SAMBIO) is a USAID-funded project that complements the current multicultural effort to preserve and conserve the biodiversity of Samar Island Forest Reserve (SIFR). According to its Inception Report (REECS 1999), the overall objective of SAMBIO is to conduct a comparative economic and institutional assessment of the different management options for SIFR so as to provide a scientific basis for informed decision making by all stakeholders. In essence, the study is an attempt to harmonize the apparently-conflicting goals of biodiversity conservation and the different economic needs of various stakeholders.

This main concern of conflicting land-uses is not unfounded. Many considered Samar Island as the last bastion of biological diversity in this part of the world. Samar is rich in not only flora and fauna (many of which are globally significant) but timber and mineral resources as well. However, Samar remains one of the most economically depressed provinces nationwide. The use and development of these natural resources, notably mineral and forestry, can improve their economic lot, if particularly done in a sustainable manner - but there lie many uncertainties and risks.

1.2 Role of Risk Assessment in SAMBIO

The role of environmental risk assessment, as a component of the SAMBIO, is in the identification and evaluation of possible impacts and risks associated with preferred forestry and mineral development activities as management options in the SIFR. By understanding and including the different risk factors in the different management options of the SIFR, like typhoons, floods and landslides, the study aims to reduce the level of uncertainty thus enabling greater capability to achieve biodiversity conservation and sustainable economic development. By incorporating the probable adverse consequences of a particular management option in the decision, a more efficient and equitable outcome may be achieved

1.3 Scope and Limitation of Risk Assessment

Risks are described in terms of the range of possible adverse consequences that a management option may generate and the probability distribution across consequences (Freeman 1992). On the other hand, uncertainties can be categorized in three types (Carpenter 1995): First, the unknowable responses or true surprises that can not be eliminated or reduced, but whose magnitude and relative importance can be estimated (e.g. major earthquake or volcanic eruptions). Second, the uncertainties arising from lack of ecologic understanding and principles on which dependable predictive models can be constructed. This type of uncertainty requires difficult and long term research. Third, poor

data quality or errors arising from making an incorrect decision based on data that inaccurately estimate the true state of nature. Reliable biophysical and socio-economic data are central in decision making, and this study has to take into consideration these three types.

This study is an ***ex-ante*** evaluation directed on the risks and uncertainties associated with two groups of management options — mineral and forest resource development. These options are timber harvesting, agro-forestry, plantation forest, rattan harvesting, bauxite mining, copper/pyrite mining, coal mining, and quarrying.

The probable negative impacts of these management alternatives on human safety, bio-physical stability, and resource use are taken into account in the study but owing to paucity of data in all management options, particularly on the frequency of occurrence, the quantification of risk that is needed in BCA (Benefit-Cost Analysis) can not be completed. Instead, qualitative description of risk is undertaken, which may aid in MCA (Multiple-Criteria Analysis).

2. ASSESSMENT FRAMEWORK AND METHODOLOGY

2.1 General Framework

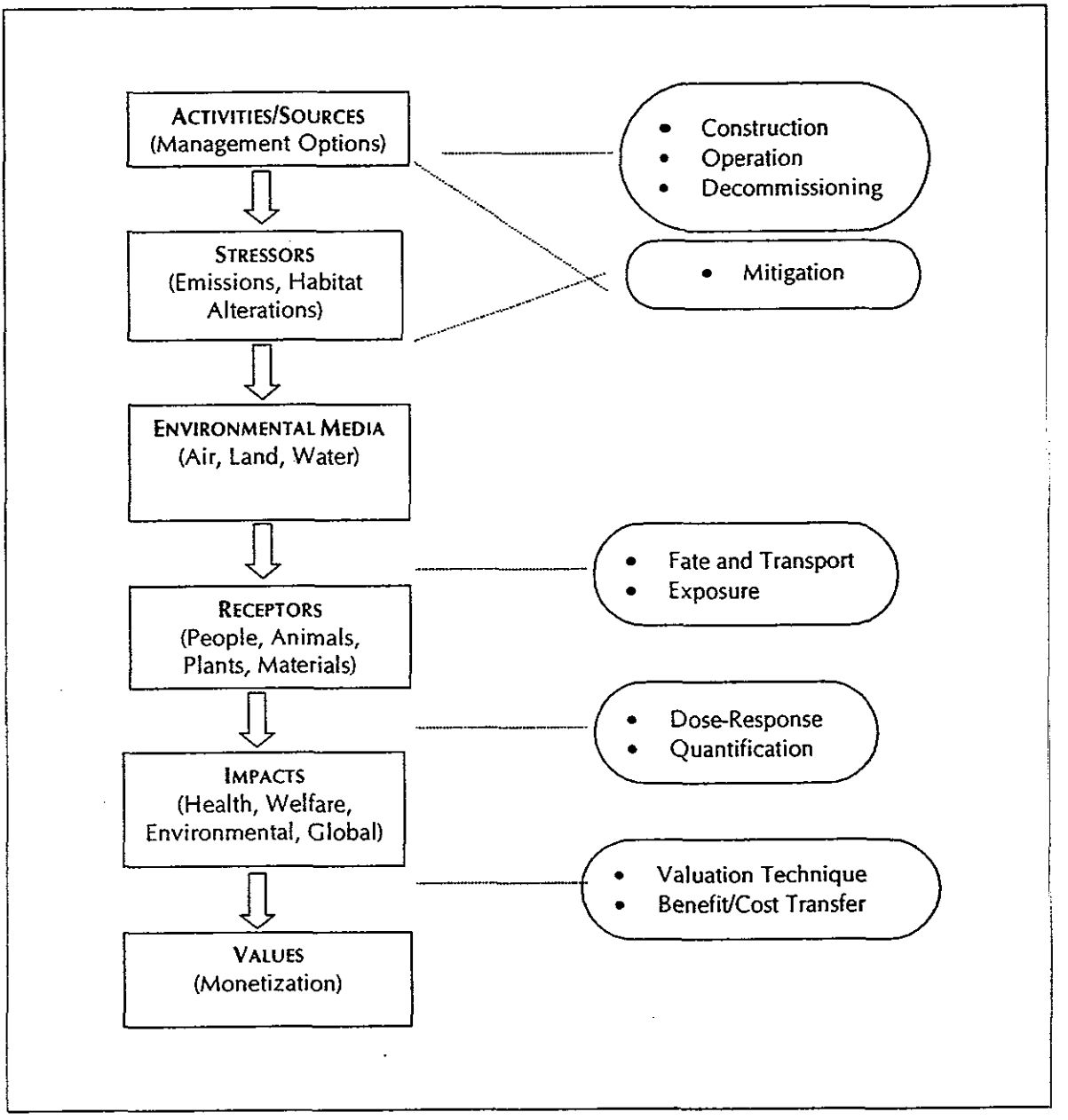
The general framework and approach first adopted to identify and quantify environmental impacts is based mainly from the ADB Workbook (1996) on 'Environmental Evaluation of Environmental Impacts'.

Figure 1 demonstrates how a management option is linked to impacts, risks and economic values. It also introduces some of the standard terms used in Environmental Impact Assessment (EIA).

The ***activities or sources*** refer to the management options that can affect the environment either during the construction/establishment or operation phase. ***Stressors*** are physical, chemical and biological agents that can affect people and/or the environment. They are also used to denote the types and levels of pollutant emissions or habitat alterations. Mitigation refers to avoiding or minimizing increases in environmental stressor levels. It can also occur at the activity level.

The ***environmental media*** (that is, air, water and land), through which stressors pass, are subject to chemical transformation (***fate***) and/or physical dispersion (***transport***) before the ***receptors*** (people, flora, fauna and materials) are affected by them. ***Exposure*** refers to the level of a stressor faced by receptors, what the stressor is, and the duration of exposure.

Figure 1
Steps Leading to Valuation of Environmental Impacts and Risks (Modified from ADB 1966)



Impacts refer to the positive or negative chemical or biophysical consequences expected in a receptor after a change in exposure to stressors. (This study concentrates only on the negative impacts). Changes in impacts are typically quantified through dose-response relationship (that is, a quantified decrease in exposure [dose] to a pollutant may be associated with a reduced risk [response] of infant mortality). Impacts are categorized in terms of human health, welfare, environmental resources and global impacts.

Quantified impacts and risks on receptors are assigned appropriate monetary ***values*** using economic valuation techniques.

The identified stressors and impacts (potential and actual) will be listed and subjected to screening to determine the most relevant for quantification. The screening criteria used were drawn from ADB (1996) workbook, to wit:

1. Is the impact internal or mitigated?
2. Is the impact relatively small?
3. Is the impact too uncertain or sensitive for an objective assessment?
4. Can a quantitative assessment be completed?

Table 1 illustrates a sample of Stakeholder-Valuation Matrix (partly adapting Hamilton and Snedaker 1984), which could be helpful in charting and categorizing the impacts of mining (or logging) and in linking these impacts to the valuation process.

Table 1
Potential Negative Impacts of Mining

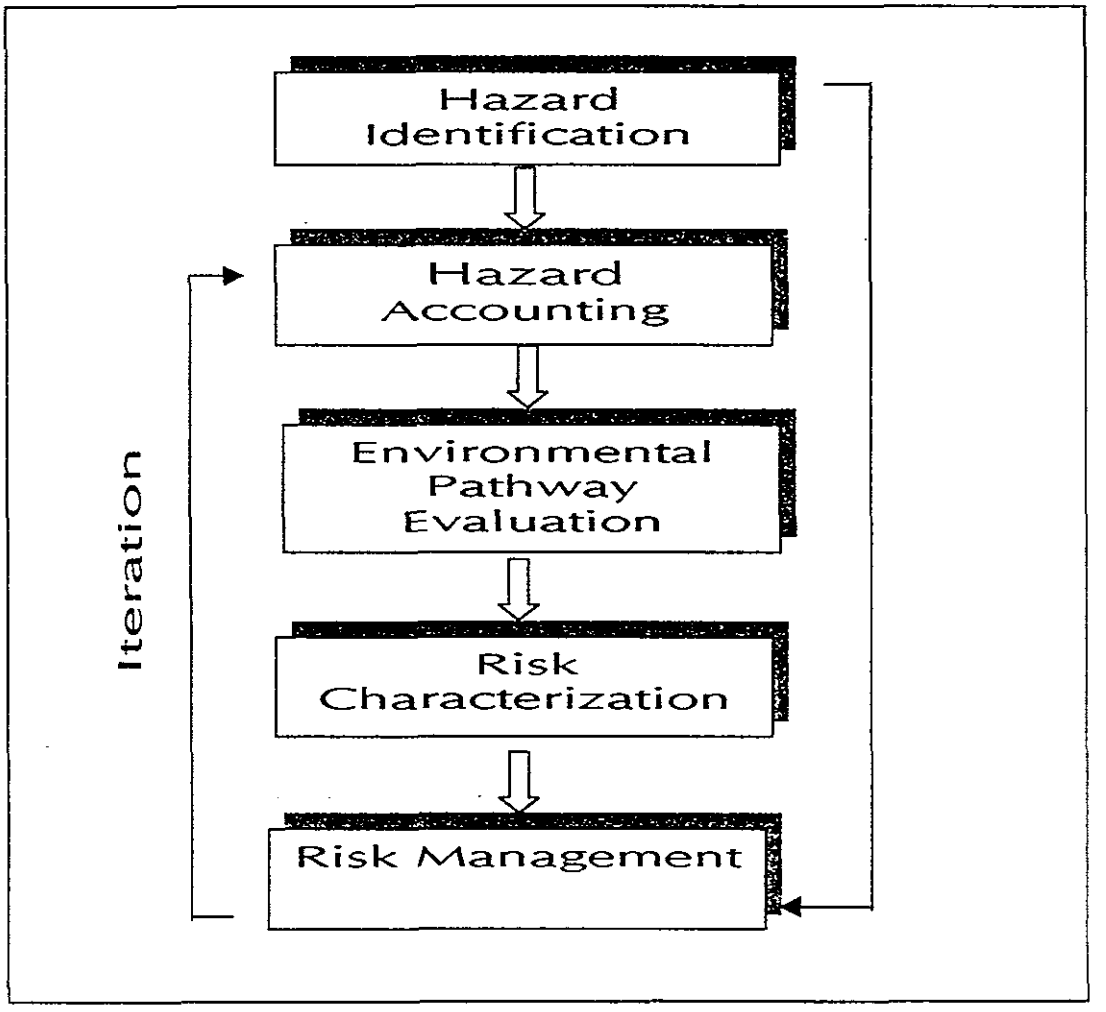
Valuation	STAKEHOLDERS	
	On-site	**Off-site**
Market-based	• Risk of capital/bankruptcy • Damage to property caused by mining activities.	• Reduced farm and fisheries productivity. • Damage to property caused by mining activities.
Non-market	• Risks to life, health and safety in the mine site ▪ Temporary increase in turbidity, soil erosion, dusts and pollutants within the mine site ▪ Contamination of groundwater/freshwater. ▪ Loss of flora and fauna/biodiversity due to destruction of natural habitat	• Risks to life, health and safety ▪ Temporary increase in turbidity, soil erosion, dusts and pollutants ▪ Contamination of groundwater/freshwater. • Loss of flora and fauna/biodiversity due to destruction of natural habitat.

2.2 *Risk Assessment Process*

While there are different types of risk analysis, this study attempts to focus on physical risk (physical conditions hazards) to human health, human welfare and environmental resources that may be caused by logging or mining in SIFR. Risk assessment is essential in this study because of the element of uncertainty, which can occur in any part or stage of the proposed projects.

The process of environmental risk assessment is shown in **Figure 2.**

Figure 2
The Process of Risk Assessment (Smith et al 1988 cited in ADB 1990)



ADB (1990) describes the risk assessment as follows: ***Hazard identification*** lists the possible sources of harm. ***Hazard accounting*** defines the boundary of the problem corresponding to the management questions, technology to be used and biophysical consideration. ***Pathway evaluation*** studies the linkages between initiating events or initial conditions and the eventual impacts on human health and welfare or ecosystems. ***Risk characterization*** is the expression of risk to individuals, to populations, and to other impacted targets – in as quantitative terms as possible. ***Risk management*** is the selection and implementation of risk-reduction actions. An iteration to hazard accounting can refine the assessment.

According to Kaplan and Garrick (1981):, an environmental risk assessment has to address three questions:

1. *What can go wrong with the project?* — the possible negative impacts; the adverse consequences and damages to human health/welfare, environment or equipment that may be reasonably expected from the project.

2. *What is the range of magnitude of these adverse consequences?* — the severity of damage; the number of persons/population affected, geographical area, monetary damage, equipment downtime, etc.

3. *How likely are these adverse consequences?* — their frequency of occurrence, historical or empirical evidence available on their likelihood or failure rates, etc.

The first two questions are considered in hazard identification, hazard accounting and pathway evaluation (if not considered in impact assessment), while the third question is taken into account in hazard characterization.

2.3 Pre-determination of possible forest and mining development activities

Before impact and risk assessment can proceed, there is a need to determine the possible schemes of forest and mining development that may be undertaken in the SIFR, concerning available resources as per inventory data. This process should include the estimation of the spatial extent of areas to be disturbed, off-site and on-site.

2.4 Public perceptions of risks from forestry and mining activities

People's attitudes toward risks and their behaviors in response to them are strongly influenced by how they perceive and understand the risks from various hazards (Covello, Menkes and Mumpower 1986). Despite the importance of this topic in risk management, there are no published data on public perception of risks in Samar Island from resource extractive activities like mining and logging. Included in the economic survey is a questionnaire (***APPENDIX A***) that attempts to find out the public preference on various risks for analytical purposes. Unfortunately, only two questions were considered during the actual survey, and the findings are presented by Rosales (2000, this project).

2.5 Primary Data Gathering

In addition to the primary data gathered from forest resource assessment, watershed assessment and mineral resource assessment that the risk assessment may use, this study also collected grab samples of stream water, through the assistance of DENR-EMB Region VIII, from pre-determined mineral sites located at:

	Location	Mineral Resource
1.	San Jose de Buan	Manganese Ore
2.	Paranas, Samar	Limestone
3.	Bagacay, Hinabangan, Samar	Pyrite Ore & Copper Ore
4.	Concord, Hinabangan, Samar	Bauxite Clay
5.	Taft, Eastern Samar	Coal
6.	General McArthur, Eastern Samar	Chromite Ore
7.	Borongan, Eastern Samar	Nickel Ore

In-situ analysis was conducted for the physical characteristics (temperature, pH, turbidity) using the Horiba water quality checker equipment while samples for chemical analysis were preserved and treated before these were dispatched to the Pollution Research and Laboratory Services of the DENR-EMB Region VIII (Tacloban City) for laboratory analysis (Barra and de la Cruz 2000).

The parameters and results of the analyses are presented in ***ANNEX A***.

2.6 Secondary Data Gathering

The risk assessment component will also rely on secondary data relevant to the issues of mining and timber harvesting. Thus, the study includes extensive review of literature, collation of data and documents from relevant government agencies like PAGASA (Philippine Atmospheric Geophysical and Astronomical Services Administration), NDCC (National Disaster Coordinating Council), DENR (Department of Environment and Natural Resources), and other sources. The information derived may also be useful in the economic evaluation proper.

3. REVIEW OF LITERATURE

The Philippine tropical forests have been recognized for their multiple uses and benefits. Timber, rattan, food, fuel, forage, wildlife, recreation, water, and minerals are some of the well-known products and services that can be derived from forest areas. However, the impacts and risks associated with the generation of such products are not just as known and understood, particularly at the micro-level. This chapter will attempt to collate studies and documents relevant to each particular forest use. Natural hazards such as floods, drought, sedimentation and landslides will be given focus and perspective. However, data on the probability of occurrence of such events for each forestland use, which is needed in risk assessment, were found to be inadequate owing to incomplete information and very little studies relevant to this field.

3.1 Timber Production

Nationwide, timber harvesting has been the predominant forestry activity for several decades although log production declined since the 1970s. In 1998, TLA (Timber License Agreement) areas produced 48% of log production or 252,744 cubic meters; IFMA (Industrial Forest Management) areas manifested 36% or 229,000 cubic meters; and the combined production from CBFM (Community Based Forest Management), PLTP (Private Land Timber License) and PFDA (Private Forest Development Agreement) areas account for the remaining 26% (DENR-FMB 1998). Due to suspension of logging operations in Region 7, Samar manifested no timber production since 1992.

In natural, uneven-aged dipterocarp forests, selective logging system is still the prescribed harvesting or silvicultural method, notwithstanding its numerous deficiencies as noted by Utleg (1973), Revilla (1978), Tomboc (1978), Reyes (1983), all cited in Uebelhör et al (1990), which accentuate on the failure in its implementation. Political will of the government is viewed as a critical factor in the poor enforcement of rules and regulations (Uebelhör et al 1990). As the government tightened its control, delinquent timber licenses were either terminated or suspended. The number of existing TLA holders has now been reduced to 21 (FMB 1998) but there is no conclusive and comprehensive evaluation to date

as to the appropriateness of the selective logging system, if correctly implemented as planned, in different soil and climatic sites in the country. But in many tropical countries, no economic method of sustained timber yield for slow growing dipterocarp forest has been developed for over half a century of logging in natural forests (Pereira 1989).

A recent study revealed that total wastes (felling residuals and yarding damages) were more than 90 cu. m. per ha or 0.75 cu. m. waste for each cu. m. / ha harvested (Ueberhör 1989).

In even-aged plantation forests or tree farms, the prescribed harvesting method is clear cutting and shelterwood or selection system (per FAO 64, S-74). There is a dearth of information as to the impacts and risks of clear cutting or shelterwood as practiced in the Philippines. However, Záruba and Mencl (1969) believed that clear cutting should be avoided so as not to disturb the stability of the slope, which can facilitate landslides if water infiltrates the underground cavities and joints.

Illegal logging, commercial logging, and timber poaching are often blamed for the occurrence of floods, droughts, erosion, and landslides. It is important at the outset to put this issue in the right perspective. Floods, droughts, erosion and landslides are naturally occurring. Pereira (1989) observed that, with very rare exceptions, such as the failure of major engineering structures, floods are not caused by human activities but by exceptional atmospheric disturbance: convergence of flow of moist air concentrate vast amounts of water vapor and cause its precipitation. However, he also pointed out that the misuse of the land could greatly increase the severity of floods and the damage caused while good use of the land employing well established techniques of forestry, agriculture and civil engineering can substantially mitigate flood hazards *but it cannot prevent floods*. The same line of argument holds true for drought and erosion/sedimentation, which are the inescapable features of the wet tropics. *The Philippine Strategy for Improved Watershed Resources Management* (WRDP-WMIC 1998) likewise debunked the myth that *water shortages are all due to watershed degradation*, as these are caused by low rainfall associated with El Niño phenomenon, increased water demands and high system losses from water supply delivery. Another misconception is *that logging will automatically lead to flooding and a decline in water supplies*; when logging is correctly practiced, flooding and water yield decline do not happen as can be seen in the forest that are on its second or third cutting cycles. ***Table 2*** shows the comparative erosion rates of the various cover crop systems (Wiersum 1984).

Table 2
Soil Erosion Rates (t/ha/year) Under Tropical Forest and Various Tree Crop Systems

Vegetative Type	Minimal	Median	Maximal
*Multistoried tree gardens (4/4)**	0.01	0.06	0.14
Natural forests (18/27)	0.03	0.30	6.16
Shifting cultivation, fallow period (6/14)	0.05	0.15	7.4
Shifting cultivation, cropping period (7/22)	0.40	2.78	70.05
Forest plantations, undisturbed (14/20)	0.02	0.58	6.2
Forest plantations, burned litter removed (7/7)	5.92	53.40	104.80
Tree crops with cover crop/mulch (9/17)	0.10	0.75	5.60
Tree crops, clean weeded (10/17)	1.20	47.60	182.90
Taungya cultivation (2/6)	0.63	5.23	17.37

* *(x/y) x = number of locations; y = number of treatments/observation*
Source: Wiersum (1984) cited in PCARRD (1991).

3.2 Non-Timber Forest Production

Based on 1998 *Philippine Forestry Statistics* (DENR-FMB), unsplit rattan and almaciga resin production decreased by 46 and 38 percent, respectively, while bamboo and nipa shingles rose by 175 and 38 percent, respectively from previous years. Eastern Samar, with no registered rattan cutting contracts, produced 122,000 lineal meters of unsplit rattan, equivalent to 1.17% of the national production.

There is inadequate literature on the impacts and risks associated with non-timber products harvesting from the forests. However, it is believed that these are minor and temporary, if undertaken according to the pertinent rules and regulations.

3.3 Agroforestry

The concept of agroforestry refers to a *"land use system whereby agricultural crops, forest trees and/or livestock/animals are deliberately raised on the same unit of land either sequentially or simultaneously and applies practices which are economically viable, technologically feasible and ecologically sustainable and compatible with the cultural patterns of the local population"* (PCARRD 1991).

This system, practiced since time immemorial but was abandoned in favor of nonsustainable agriculture in steep lands, is being revived by the government and private sector to counter land degradation while increasing the productivity of the agroecosystem, in terms of minimizing soil erosion, surface runoff, nutrient loss, landslides, pests and diseases and the amelioration of soil fertility, soil physical properties and microclimate (PCARRD 1991).

Paningbatan (1987) as cited in PCARRD (1991) estimated that the annual erosion could be as high as 115 tons/ha in unprotected plowed land but negligible under forest. He reported

that the soil losses for forest, tea plantations and vegetable gardens are 0.245, 4.88 and 7.32 cubic meters/ha/year or an equivalent ratio of 1:20:30.

Gintings (1988) also cited in PCARRD (1991) obtained the least surface runoff and erosion under shrubland, secondary forest and coffee plantation, while highest under tree bare fallow and abandoned kaingin farms in Mt. Makiling (***Table 3***).

Table 3
Soil Erosion and Surface Runoff Under Different Types of Forest Land Use*

VARIABLE	Bare fallow	Abandoned Kaingin	Cultivated Upland	Coffee Plantation	Secondary Forest	Shrubland
Runoff (mm)	91.5[a]	44.5[b]	31.5[c]	17.7[c]	15.2[c]	9.1[c]
Runoff (% of total rainfall)	7.8[a]	3.8[b]	2.7[c]	1.5[c]	1.3[c]	1.8[c]
Erosion (t/ha)	63.8a	26.2[b]	8.4[c]	0.67[c]	0.26[c]	0.06[c]
Slope range (%)	21-23	48-51	50-51	46-48	45-47	50.00

[a,b,c] *Means in the same row which bear different letters are significantly different at 5% level.*

* *Mt. Makiling, June to November 1987.*

Source: Gintings (1988) cited in PCARRD (1991).

A recent study made by Ayson et al (1997) in Ilocos Norte from January to December 1996 obtained the least runoff and sediment yield from agroforestry than from yemane or buri plantation (***Table 4***).

Table 4
Surface Runoff and Sediment Yield

Land Use	Surface Runoff (mm)	Sediment Yield (t/ha/year)
Yemane	3.9a	2.6a
Buri	2.49a	1.09b
Reforestation (mixed)	2.66ab	0.75bc
Agroforestry (alley cropping)	1.75b	0.41c
Significance	**	**
CV(%)	15.11	12.73

All means followed by the same letter are not significantly different at 0.01

Source: Ayson et al (1997)

3.4 Community Settlement and Shifting Cultivation (Kaingin)

Human occupation of a watershed area need not result in degradation of soil and water resources, even under the tropical climate extremes (Pereira 1989). The Ifugao rice terraces have persisted for over 2000 years. However, the considerable influx of people into the uplands during the 1900s resulted in a host of environmental problems. Kaingin system of

clearing and burning forests for agriculture has become a way of life for thousands of people driven by an urgent need for food, lack of available land, lack of employment opportunities and increasing population pressure (UNDP-FAO 1983). They are clearing and reclearing the same land to exhaustion before selecting new sites to clear again for subsistence farming. With poor and diminishing yields (40-50% less than the production of traditional farmers in non-irrigated areas), this process develops into a socio-economic phenomenon that virtually locks the upland settlers into the vicious cycle of poverty and land degradation. It is estimated that about 2.3 million hectares of forestland were cleared by some 80,000 to 120,000 kainginero families (Repetto 1988).

UNDP-FAO (1983) summarized and described the effects of kaingin: forest destruction, forest fires without control; breakdown of watershed management; loss of production; reduction of forest benefits; increase of protection problems; soil destruction and erosion problems; poor agricultural yields; diminishing water resources; and constraints in the socio-economic development, particularly on the wood demands. Specifically, the report also cited the estimates made by BFD (Bureau of Forest Development) that a kainginero family (of 6) would destroy 33 cubic meters/hectare of commercial timber on a period of 12 years.

However, not all kaingins are destructive and not sustainable (otherwise it would be a sweeping accusation). To say that the kaingineros *are to blame for watershed degradation* is another false technical assumption that *The Philippine Strategy for Improved Watershed Resources Management* is trying to dispel (WRDP-WMIC 1998).

Bayotlang (1986) as cited in Paningbatan (1990) obtained, using erosion plots, soil erosion loss of 61, 10 and 8 t/ha/year for bare fallow, corn monoculture, and corn-peanut or mungbean, respectively.

Cruz et al (1987), also cited in Paningbatan (1990) reported that the replacement cost of nutrient per ton of soil loss in some of our watersheds consists of 2.36 kg of urea, 0.8 kg of solophos and 0.56 kg of muriate of potash.

Paningbatan (1990) also referred to the work of David (1987) on the sheet and soil erosion losses of various land uses in Pantabangan under different slope ranges (***Table 5***).

Table 5
Erosion Losses Per Land Use In Tons/ Ha/Year

Land Use	Slope Range (%) 0-3	3-8	8-15	15-25	25-40	40	Average (all slopes)
Primary Forest				0.86		2.25	2.22
Secondary forest		0.41				7.03	6.95
Open grasslands		10.01	25.72	141.70	139.95	264.03	210.72
Irrigated Paddy	0.18				8.82		0.45
Rainfed paddy	0.20	0.81		5.56		25.26	0.64
Savannah					120.85	238.99	194.83
Kaingin				290.95	374.88	586.51	507.89
Diversified crops				177.77	264.03		220.90
River wash	10.17					989.97	418.39
Residential	3.68			169.30	161.17	333.48	103.70
Average (all land uses)	0.48	2.60	25.72	141.33	140.45	113.40	108.70

Source: David 1987. Validation of the Pantabangan Watershed Management and Erosion Control Project. Upland Resource Policy Program Technical Series No.87-2: Makati. PIDS

Delos Angeles and Bennagen (1991) averaged the soil erosion rates from different studies, and valued the soil losses for a hypothetical 100-ha area using the nutrient replacement cost approach (***Table 6***).

Table 6
Average Soil Losses For Different Land Uses

Land Use	Average Soil Loss (in tons/ha/year)	Area (in ha)	Fertilizer equivalent, (in Thousand Pesos)*
Grassland/ pastureland	267.8	15	160.7
Upland agriculture	112.8	10	45.1
Open grassland	79.6	15	47.8
Fruit trees	22.1	10	8.8
Trees, shrubs, grasses	12.5	10	5.0
Secondary forest	3	20	2.4
Paddy rice, irrigated	2.3	10	0.9
Gmelina, ipil-ipil, coffee and grass	1	10	0.4
Total	**n.a.**	**100**	**271.1**

*at 1985 pesos: P40 per ton of soil loss; for application urea, solophos and muriate of potash
Source: Delos Angeles and Bennagen (1991); Table 27,p27.

Francisco (1994) studied the gross erosion, among others, for all the regions in the Philippines using the weighted average of 61.8 tons/ha/yr for agricultural land use, 173.7 tons/ha/yr for open grassland and grassland/pastureland, and 3.0 tons/ha/yr for woodlands. For Region VIII-Eastern Visayas (Leyte and Samar), the average erosion rate is 76.35 tons/ha/yr, which is slightly lower than the national average of 80.62 tons/ha/yr. This is also equivalent to an average depth of soil loss of 0.61 cm/ha/yr, and it will take an average of 196 years to deplete the soil depth of 118 cm in Region VIII areas.

The economic effects of sedimentation on tourism in Bacuit Bay, Palawan are estimated at U$428,000 in terms of loss in revenue from one tourist resort (Hudson and Dixon 1988 as cited in Ebarvia 1994). If applied to 65 diving stations around the country, the total damage would amount to U$27.82 million or P593.54 million (U$ = P21.335 1998 exchange rate).

The cost of damage to reservoirs from sedimentation is estimated at P57.7 million based on the cost of the decrease in the service life of four reservoirs at 10 per cent discount rate (Ebarvia 1994).

3.5 Mining and Quarrying

Mining operations often affect the surrounding communities. A case study of the growth of Atlas Consolidated Mining and Development Corporation in Cebu shows a gradual displacement of farmers, who mostly migrated out of town, within a span of 11 years (McAndrew 1983, cited in Tadem 1990). Mine wastes impounded in tailings dam poses environmental and safety hazards to the local communities. Tadem (1990) noted the adverse effects of these wastes: (a) mine tailings from three mining firms affected 3,782 hectares of farmlands in La Union in 1980 and reduced the harvest by about 20 cavans/ha/year; (b) pollutants (cyanide, mercury, fine sands) from the mines in Benguet affected about 75,000 hectares of farmlands in Pangasinan and La Union, reducing the rice harvests between 5 and 40 per cent yearly with the damage in the two provinces estimated at P388 million/year; and (c) mine tailings dumped directly to the sea, such as those of Atlas Mining, destroying marine life.

Briones and Lagunilla (1992) undertook a socioeconomic analysis of the environmental impacts of open pit mining operations in Benguet and found that the clear winners are the mining company, mine workers and contractors, while the direct losers are the on-site small-scale miners and ball mill owners. The subsistence farmers downstream of the mining site are indirectly affected due to water pollution and a decrease of water for irrigation, which reduced their yield by 15 cavans/ha per cropping. They described and summarized the negative off-site and on-site impacts in a matrix (***Table 7***).

Table 7
Adverse Impact-Matrix Of Open Pit Mining Operations

	On-site	Off-site
Marketed	• Ball mill operations (lost income) – P7,000/month/operator • House/farm improvements (removed) — P20 million • Relocation and rehabilitation • Agricultural production loss • Lost income from pocket mining — P3 million/month	• Decreased fish catch from polluted water bodies • Decreased farm productivity— 15 cavans/ha/cropping loss
Non-marketed	• Vegetation loss • Dust • Noise • Water pollution • Health hazards for toxic wastes • Landscape change •	• Contamination of lower water systems • Health hazards form pollutants • Adverse publicity

Source : Briones and Lagunilla 1992

Recently in Marinduque, the Marcopper Mining Corporation tailings dam collapsed in March 1996. The mine tailings flooded a major river system (Boac River) rendering it biologically dead. Bennagen (1998) estimated that the environmental damages *over a 10-year period in terms of direct use values of the river and coastal waters affected by the tailings spill amounted to P180 million under the "with short-term rehabilitation" scenario and P162 million under the "with long-term rehabilitation" scenario.*

Quarrying of gravel and sands also wreak havoc on the environment. With the devolution of quarrying permit issuances to the local government units (under 5 hectares) in pursuance with the Local Government Code, illegal quarrying has proliferated from Batanes to Tawi-Tawi, to the protest and consternation of the local residents. Even the historical Biak-na-Bato Park (Datingginoo 2000) and the world-renowned Chocolate Hills (Dejarisco and Fuentes 1996) were not spared, with unquantified adverse consequences. In Eastern Samar, the white-sand beach in Mercedez was also subjected to illegal extraction (Cayubit 1998). Residents feared that quarrying undermines the foundation of their bridges, weirs, dams and dikes, and ruins their shorelines and riverbanks. Their lives and livelihood are likewise threatened.

Unfortunately, studies on the specific impacts of quarrying are wanting.

Ebarvia (1994) estimated the damage to health arising from water pollution (all sources) in 1988 at the national level is P61.55, broken down as follows: P17.09 million for mandays lost, P41.07 million for medication cost and P3.39 million as social cost. The foregone earnings due to premature death resulting from water pollution are estimated at P242.31

million at 15 percent discount rate. The total health cost (increased incidence of water-related diseases) for 1988 amounts to P393.85 million.

Based on the survey conducted from 1983-1985 (Santos et al 1985, as cited in Ebarvia 1994), water pollution affected about 47,116 hectares of irrigated areas. Mine tailings impaired 10,087 hectares and 9,136 hectares of irrigated areas during the wet and dry seasons, respectively. Soil erosion and sedimentation degraded 14,514 hectares and 6,775 hectares of irrigated areas during the wet and dry seasons, respectively. Ebarvia (1994) estimated damage cost to agricultural production which amounted to P425.1 million, based on 2.64 mt/ha average palay production and the 1988 palay price of P3,412 per mt.

A follow-up study made by Segayo (2000) used the foregone palay production due to water pollution and sedimentation in estimating the damage to irrigation systems. At 1997 prices, mine tailings caused an estimated loss of P15.6 billion and P24.7 billion during the wet and dry seasons, respectively. On the other hand, soil erosion posted a palay production loss of P23.1 billion and P18.5 billion during the wet and dry seasons, respectively. The pollution-affected areas are summarized below (***Table 8***).

Table 8
Irrigated Areas Affected by Pollution,1997

Sources of Pollution	Irrigated Areas Affected (ha)		% Attributable to Pollution	
	Wet Season	Dry Season	Wet Season	Dry Season
Mine Tailings	9,600	8,738	13.28	18.05
Soil erosion and sedimentation	14,191	6,549	19.63	13.53
Others: piggery, chemical plants, food processing, salt intrusion, schistosomiasis	4,931	4,176	6.81	8.63
Total	**28,722**	**19,463**	**39.72**	**40.21**

Source : Segayo 2000

4. RESULTS AND DISCUSSIONS

4.1 Forest Management Options

4.1.1 Timber Harvesting

Based on the Forest Resources Assessment undertaken by Carandang (2000, this Project), the average harvestable volume is 29.03 cu. m. per hectare using 20x20 plots (***Table 9***). It must be mentioned here that the old growth forests, as noted during the field survey, have less harvestable volume (10.04 cu.m./ha) than second growth forests (30.17 cu.m./ha). This is contrary to the essence of old growth forest, which should have an average harvestable volume of about 130 cu. m. per hectare. Thus, for the purpose of this study, the forest cover

in Samar is better described as second growth forest, which can either be a closed-canopy forest or open-canopy forest. The presumed old growth forests could be the closed-canopy forests considering their total volume and the number of trees per hectare as compared to what were labeled as second growth forests. This 'reclassification' removes one prohibition (no logging or mining in old growth forest) under current rules and regulations. Nonetheless, logging moratorium is still enforced in Samar.

Table 9
Vegetative Cover and Timber Stock Per Hectare

Transect	Vegetative Cover	Number of Tree (bole/ha)	Total Volume (cu. m./ha)	Harvestable Volume (cu. m./ha)
Transect 1	Second Growth Forest	164.00	275.30	59.50
Transect 2	Second Growth Forest	245.91	118.32	16.11
Transect 2	Old Growth Forest	227.22	103.82	10.66
Transect 2	All	237.50	111.80	13.66
Transect 3	Second Growth Forest	221.25	162.48	14.91
Transect 3	Old Growth Forest	325.00	324.32	9.43
Transect 3	All	239.56	191.04	13.94
Average	Second Growth Forest (43/59)	210.39	185.36	30.17
Average	Old Growth Forest (16/59)	276.11	214.07	10.04
Average	**All**	**213.69**	**192.71**	**29.03**

(Source: Based on Carandang 2000)

The low average harvestable volume of timber (29.03 cu.m./ha) indicates that large-scale commercial logging operation under Timber License Agreement (there are 2 suspended TLAs in Samar) or some other form, is not financially nor economically viable at present. However, this will not deter small-scale cutting or poaching of trees, considering the strong demand for wood and the subsistence need of the local populace, which are mostly living below the poverty line. The likelihood of overharvest under these circumstances ranges from low to high depending on how these factors (wood demand and population pressure) interplay. In turn, overharvest threatens, in varying degree, the biodiversity, terrestrial ecosystems and the future use of the resources as the forest cover is reduced and degraded into unsustainable condition. Moreover, timber harvesting will likely engender a change or conversion of the forest area to other land uses like shifting cultivation (kaingin) and community build up, which can reduce forest cover more than timber harvesting itself.

Existing land uses like agriculture, eco-tourism, minor forest products gathering, will also be adversely affected depending on the location and extent of the timber harvesting activities. No spatial evaluation of risk from timber harvesting could be performed (e.g. area and population to be affected, magnitude of damage), owing to inadequate information on the extent and specific location of possible timber harvesting operation, as a management option.

Other critical stressors identified are sedimentation and soil erosion, which are extensively assessed by Cruz (2000, this project).

4.1.2 Non-Timber Forest Products Extraction

Non-timber products like rattan, bamboo and almaciga resin are highly susceptible to overharvesting due to lax monitoring and law enforcement. As the harvest (of rattan) continues without the corresponding permit (DENR-FMB 1998) and deliberate replanting, it is only a matter of time before the supply of such product in Samar is depleted. The negative impact of illegal and improper cutting on biodiversity and ecosystems is made worse by the apparent lack of management or mismanagement of these resources.

For almaciga resin, it is estimated that the population density of almaciga trees ranges from 0.31 bole/ha to 1.03 bole/ha based on the occurrence of almaciga in Transect 1 and Transect 3, respectively (***Table 9***). The low average density of almaciga trees may preclude commercial tapping of resin, but not necessarily the preservation of said species. Moreover, almaciga (*Agathis philippinensis*) is listed in CITES (Convention on International Trade of Endangered Species) as an endangered tree species.

Overall, there are insufficient data on the extent and location of non-timber forest products extraction in Samar, existing and proposed, which are needed for further risk accounting and characterization.

4.1.3 Agro-Forestry and Plantation Forest

The impacts of agro-forestry and plantation forest are mostly considered positive, in terms of reducing soil erosion and sedimentation (see Cruz 2000), preventing overharvest and flooding, and increasing the productivity of forest land (see Carandang 2000).

As long as proper silvicultural practices are observed, such as appropriate application of fertilizer or pesticide, avoidance of monoculture (single species planting), adoption of proper scientific steps if new species will be introduced, and the determination/enforcement of sustainable harvest rate, the adverse consequences of agro-forestry and plantation forest is minimal or negligible.

4.2 Mineral Development Options

This study focuses on two mining options—bauxite and copper-pyrite mining— as these are situated within the SIFR and will certainly cause impact on its environment.

4.2.1 Bauxite Mining

Location and Extent of Mining Operation

According to Mendoza (2000, this project), the possible bauxite mining operations in Samar Island are summarized in ***Table 10.*** (Please refer to the attached Map) The mining method to be employed is open pit mining without the use of explosives. Red mud, dusts and gas emissions are considered as the significant environmental stressors.

Table 10
Possible Bauxite Mining Operation in Samar Island

Location	Coordinates	Area Affected by Mining (in ha)*
1. Onong, Salcedo, E.Samar	11° 26"00'N- 125°28"45'E	200
2. Palomorag, Mercedes, E. Samar	11° 12"30'N- 125°13"45'E	200
3. Campayong, Guiuan, E. Samar	11° 01"30'N- 125°44"00'E	200
4. Concord, Hinabangan, W. Samar	11° 45"00'N- 125°12"00'E	620

* include mining area, milling area, tailings disposal area
(Source: excerpt taken from Mendoza 2000)

The Concord site in the municipality of Hinabangan is of particular importance to SIFR. The three other sites are outside the SIFR area, and excluded for risk analysis as their impact to SIFR is deemed negligible or low.

Impact and Risk from Concord Bauxite Mining

The impacts and risks associated with bauxite mining in Concord are summarized in ***Table 11***.

The establishment of open pit initially entails the removal of existing vegetative cover within the 620-ha mining site consisting mainly of second growth Dipterocarp forest with a stumpage value of P54 million (P3,000/cu. m. x 20.03 cu.m. /ha), dotted by a number of endangered plant species like almaciga (*A. philippinensis*) and yakal (*Shorea astylosa*). This disrupts the terrestrial ecosystem, affecting the natural processes like forest regeneration and nutrient cycling. There is a moderate possibility that the flora within the 5-km radius from the mining site (7,234 ha, excluding the mine site area) is likely to be affected by vegetation clearing, while there is a low probability that the flora outside the 5-km radius but within the 20-km radius from the mine site will be adversely affected. This is based on the approach adopted by UNEP-DENR Philippine Biodiversity Country Study (1996).

Table 11
Summary of Impacts and Risks Associated with Concord Bauxite Mining

Impact Category	Likelihood of Impact (Risk)		
	High	Moderate	Low
Terrestrial Ecosystems/ Biodiversity	Vegetation clearing within the mine area (620 ha)	About 7,234 ha of second growth forest	About 118,000 ha of second growth forest and agricultural lands
Wildlife	Wildlife, particularly the Philippine Eagle, is affected	Wildlife, particularly the Philippine Eagle, is affected	Wildlife, particularly the Philippine Eagle, is affected
Groundwater		Excavation affects the groundwater table in and around the mine site	
Resource Use	The mine area is withdrawn from other land uses	The use of surrounding areas (7,234 ha) is impaired	
Aesthetic value	Reduction of the aesthetic value of mine site and immediate vicinities	Visual intrusion for the immediate vicinities (7,234 ha)	
Surface water/ Floods	Flashflood in areas along Taft River (½ meter rise in normal stream water level)	Flashflood in areas along Taft River (1 meter rise in normal stream water level)	Flashflood in areas along Taft River (1.5-2 meter rise in normal stream water level); Ordinary flooding along the Taft River
Erosion	Increase of 4 tons/ha in soil loss		
Public health and safety	Dust (PM10) affects the workers who will work in the mine site	Dust (PM10) affects the people living within the vicinity of the cleared area	

Mining also disturbs the natural habitat of wildlife, particularly the rare and endangered species of the Philippine Eagle (*Pithecopaga jefferyi*), which is believed to be nesting within the 20 km radius from the mining site. Inadequate information on the behavior and breeding habits of the Philippine Eagle in the wild increases the range of uncertainty (from high to low) as to the magnitude of impact of mining and other activities to the survival and sustainability of said species.

Mine excavation of bauxite clay, which could be shallow with little overburden or spoil, will certainly alter the topographic configuration of the mine site and immediate areas, rendering them unsightly and withdrawn from other land uses (unless these areas will be rehabilitated immediately). The excavation may also affect the quantity and quality of groundwater, but the possibility depends on the depth of the pit and the groundwater level.

Clearing the mine site will definitely expose the soil to various factors such as rainfall, wind and sunlight resulting in the loss of topsoil, soil microorganisms and soil fertility. This will contribute to soil erosion, siltation and pollution of the Taft river system, adversely affecting irrigation and aquatic life.

The Taft watershed is given particular attention because the bauxite mine site is situated therein. ***ANNEX A*** shows the results of the water sampling done, reflecting the benchmark conditions of the river system (sample nos. 7 & 8), which passed DENR standards for Class C/D waters (DAO#34 1990).

The mine operation will strip the vegetation of Taft watershed equivalent to about 1.5% reduction of forest cover for the entire Taft watershed, which is small or insignificant if the totality of the watershed area is considered. This is translated to 1.37% increase (or 5.55 MCM increase), at most, in surface runoff annually according to the estimates made by Cruz (2000) for 10% reduction in forest cover. However, it is also projected that the runoff will decrease by 4.11% (16.64 MCM) annually if the forest cover is further reduced by 20% — a proposition that runs counter to the usual behavior of a watershed: reduction of vegetation leads to an increase in surface runoff.

ANNEX B summarizes the runoff estimates at different scenarios. Assuming these estimates are correct, the risk of ordinary floods (i.e. rise in water level occasioned by average rainfall intensities) associated with bauxite mining operation is small or remote. It will contribute 0.015 MCM of water as surface runoff to the Taft River, without significant rise in water level — as can be gleaned from ***ANNEX C*** (Stream Discharges). (Expanding the mining area will further reduce the risk of ordinary flooding along Taft River due to reduced runoff as estimated by Cruz (2000) using the USLE model).

On the other hand, the magnitude of flashfloods (i.e. abrupt rise in stream water level occasioned by heavy and prolonged precipitation) attributable to bauxite mine sites varies and this can affect the riparian areas. ***ANNEX D*** estimates the volume of stream flow for different runoff coefficients and various heavy rainfall intensities. The maximum possible discharge from the mine site is 2.356 MCM a day, which could contribute to an increase of about 2 meters in stream water level at an average stream velocity of 0.066 m/sec. and about 1 meter above the normal level if the velocity is increased to 0.1 m/sec. However, the likelihood of occurrence of such event is remote (3 in 46 years or an annual frequency of 0.07) (***ANNEX E***). In contrast, the rise of half-meter from the normal water level would be high (annual frequency of 2.17 events) for rainfall below 100 mm/day with runoff of 0.589 MCM. Taft watershed has a population of 26,963 as of 1995, and those located near riverbanks would be vulnerable to damages if these flashfloods occur during the time Concord mining is operational.

Whether or not these possible increases in stream water level will result in the overflow of riverbanks and consequently, the inundation of the community and surrounding area remains uncertain at this point. This would require a more detailed research and study on the specific location of the riparian communities and the topography of neighboring area *vis a vis* the Taft River. However, data from the NDCC (National Disaster Coordinating Council) reveal no incidence of flash flood in Samar Island for the period of 10 years (1990-1999), in contrast to its neighboring island of Leyte that recorded two incidences, one of which is the Ormoc Tragedy in November 1992 that killed about 4,943 people and damaged properties worth P812 million. It is worth mentioning here that the recorded

rainfall at that time was 140 mm taken for a 12-hour period, an event that occurs only once every 50 years in Tacloban City.

As far as soil erosion in Taft watershed is concerned, Cruz (2000) estimated that the total erosion using the USLE (Universal Soil Loss Equation) is 26,255 tons, which is equivalent to 0.64 ton/ha (***ANNEX F***). This is quite low. If the suspended sediment load data of 1.1647 g/liter (Nasayao 2000) for Taft is considered, the computed soil loss is about **16.34** tons/ha annually for an average stream discharge of 585 MCM (see ***ANNEX C***). In contrast, this is high in relation to the tolerable soil erosion rates of 8-15 tons/ha (various sources), but still lower than the average erosion rate of 76.35 tons/ha for Region VIII (Francisco 1994). ***ANNEX F*** shows a comparison of the different soil erosion estimates for Taft watershed under current land uses, which ranges from 0.64 tons/ha to 39.52 tons/ha. The estimate used by Delos Angeles and Bennagen (1991) is nearest to the computed soil loss of 16.34 tons/ha annually.

The stripping of vegetation in the Concord bauxite mining site will definitely enhance soil erosion and sedimentation of Taft river. The soil loss attributable to bauxite mining is estimated in ***ANNEX G***. This ranges from 650 tons or 0.02 tons/ha (2.4%) to 164,176 tons or 4 tons/ha (30.69%) increase in soil loss annually (***ANNEX H***). The highest possible erosion rate resulting from Concord mining is 42.59 tons/ha for Taft watershed, which is still below the Region VIII average of 76.35 tons/ha. Thus, the soil loss due to clearing of the bauxite mining area is low or minimal, albeit imminent (because of high surface runoff). With respect to the tolerable soil erosion rates of 8-15 tons/ha (various references), it is noted that the soil erosion rates, with-and-without Concord mining, varies depending on the model applied.

The Red Mud, as a by-product of milling, may leak from the tailings pond and contaminate the river system. This could be a more serious threat if the volume is large enough to cause damage as in the Marinduque tailings accident. However, with the present state of sediment loading, which is above the level that could cause severe damage to aquatic life (400 mg/l), there may not be much aquatic life downstream of Taft river to be affected. It should be noted in 1989 the Taft River experienced a noticeable degradation in quality, which was blamed on mining activities upstream.

The cleared area (620 ha) will also generate dust of about 248 kg hourly in the surrounding area, based on the emission rate of 0.4 kg/hectare per hour of exposed area as estimated by Beer (1984).

4.2.2 Copper-Pyrite Mining

<u>Location and Extent of Mining Operations</u>

The proposed copper-pyrite mining is located in Bagacay, Hinabangan, Western Samar with coordinates of 11°46'0"N-125°15'0"E covering an area of 324 hectares (Mendoza 2000). It is about 10 km away (horizontal distance) from the proposed Bauxite mining area in Concord and falls within the watershed boundary of Taft just like the Bauxite mine site.

Mendoza prescribes open-pit mining with the use of explosives as the mining method, and identifies tailings disposal and Acid Mine Drainage as the potential environmental problems (2000).

Impact and Risk from Bagacay Copper-Pyrite Mining

The impacts and risks attributable to copper-pyrite mining in Bagacay are tabulated *in* ***Table 11***. The process and likelihood of impact and risk is similar to Concord bauxite mining (section 4.2.1), except the magnitude of impact, which is initially expected to be half less than that of Concord mining by area proportion.

Just as in any open-pit mining, the establishment of the Bagacay mine will certainly require the removal of the remaining vegetative cover of the 324-ha mining area, including their topsoil, soil microorganisms, and soil fertility. This may not be as much as the vegetative cover of Concord area because of the high acidity of the soil that prevents the growth of plants. There is a moderate possibility that the vegetative area within a 5-km radius from the mine site (about 7,530 ha of second growth forest) will be affected, and the probability of affecting the second growth forest outside the 5-km radius is low to negligible.

Like the Concord mining, the Bagacay mining would have the same likelihood of impact to the species of Philippine Eagle that is believed to be nesting within the 20-km radius from the mining site, and to other wildlife within and around the mine area.

It would be reasonable to presume that the open pit would be deep with overburden or spoil — this is one feature that distinguishes it from Concord mining. It is highly possible that the groundwater and drainage system in and around the pit is affected, depending on the depth of the pit. During the years that the mine is operational, the mine area is withdrawn from other beneficial land uses such as forestry, ecotourism, and agriculture. The aesthetic value of said area and immediate vicinities is also definitely reduced.

Table 12
Summary of Impacts and Risks Associated with Copper-Pyrite Mining

	Likelihood of Impact (Risk)		
Impact Category	**High**	**Moderate**	**Low**
Terrestrial Ecosystems/ Biodiversity	Removal of remaining vegetation within the mine area (324 ha)	About 7,530 ha of second growth forest	About 118, 000 ha of second growth forest and agricultural lands
Wildlife	Wildlife, particularly the Philippine Eagle, is affected	Wildlife, particularly the Philippine Eagle, is affected	Wildlife, particularly the Philippine Eagle, is affected
Groundwater	Excavation affects the groundwater and drainage in and around the mine site		
Resource Use	The mine area is withdrawn from other land uses	The use of surrounding areas (7,530 ha) is impaired	
Aesthetic value	Reduction of the aesthetic value of mine site and immediate vicinities	Visual intrusion for the immediate vicinities (7,530 ha)	
Surface water/ Floods	Slight increase in normal stream water level due to heavy rains of not more than 100 mm/day	Flashflood in areas along Taft River (< ½ meter rise in normal stream water level)	Flashflood in areas along Taft River (1 meter rise in normal stream water level); Ordinary flooding along the Taft River
Erosion	Increase of 2 tons/ha in soil loss		
Public health and safety	Dust (PM10) affects the workers who will work in the mine site; About 130 kg of dust is generated from the exposed area	Dust (PM10) affects the people living within the vicinity of the cleared area	
Land Use/ Biodiversity/ Health	Acid Mine Drainage		

ANNEX A described the current conditions of the Cansolabao River, a tributary of Taft River, where the Bagacay mine site will drain (sample nos. 5 & 6). It is noted that the copper content exceeded the DENR standard for Class C/D waters (DAO #34 1990).

Clearing the 324-ha mine area is equivalent to 0.78% forest cover reduction of the whole Taft watershed. This can bring minimal change in surface runoff to the current land use, as shown in ***ANNEX B***. The risk of ordinary flood associated with Bagacay mining is remote; the

probability is lower than that of Concord mining. No significant rise in normal stream water level is expected, as the runoff is lower than the 5.55 MCM benchmark for 10% forest reduction (***ANNEX C***).

ANNEX I estimates the stream discharge from Bagacay mining area for various runoff coefficients and rainfall intensities. The maximum flashflood contribution of the mine area is 1.231 MCM in a given day but the possibility of occurrence is remote (0.07 annual frequency for 301-400mm rainfall) (refer to ***ANNEX E***). This could possibly increase the average stream water level by about 1 meter under normal velocity (see ***ANNEX C***). On the opposite end of the scale, heavy rainfall less than 100 mm is highly possible (annual frequency of 2.07 events) and this will generate 0.308 MCM to the Taft River. Conversely, this indicates only a slight rise in normal stream water level. The likelihood of rainfall ranging from 100 to 200 mm/day from occurring is moderate (annual frequency of 0.89) and this will contribute 0.616 MCM or an increase of half meter above the normal water level.

The soil loss associated with Bagacay mining is estimated in ***ANNEX J*** using four different sets of soil erosion coefficients. The maximum possible erosion rate of Taft River resulting from Bagacay mining is 41.12 tons/ha, which is below the Region VIII average soil erosion rate of 76.35 tons/ha estimated by Francisco (1994). The contribution of Bagacay mining to soil loss ranges from 340 tons (1.29% or 0.01 ton/ha increase) to 85,795 tons (16.04% or 2.09 tons/ha increase) annually (***ANNEX K***). The incremental increase in soil erosion is deemed minimal but the probability of its occurrence is high. With respect to the tolerable soil erosion rates of 8-15 tons/ha (different references), it is noted that the soil erosion rates, 'with-and-without' Bagacay mining, also varies depending on the model applied. As the 'land use averages' estimate used by Delos Angeles and Bennagen (1991) is nearest to the actual sediment load data of 16.34 tons/ha yearly, it is recommended for use as far as Taft watershed is concerned.

Acid Mine Drainage (AMD) is highly possible due to the abundance of acid-producing pyrite in the mine site. It poses a potentially significant environmental problem when pyrite materials are exposed to air (primary reactant) and oxidized to produce sulfuric acid and metals. Water is the primary medium for the leaching and movement of oxidation products into the ground and surface water systems (Ritchie 1993). AMD not only contaminates ground and surface waters and impairs their beneficial use; it also affects the aquatic ecosystems and riparian communities in downstream environments resulting from acidity and dissolved metals (EA 1997).

On the other hand, Samar has one redeeming quality: the vast presence of limestone deposits ($CACO_3$) — natural carbonates that can neutralize the acidity as it is formed. Data from MGB Region VIII supported this process: water samplings were taken from the Philippine Pyrite Area in Bagacay show pH levels of 2.22-2.96; but the acidity was reduced downstream to pH level 7.14 (in Binaloan). This, however, does not alleviate the problem of dissolved copper in the Taft River, which currently exceeds the DENR standard for Class C/D waters. In general, the problem of AMD in Samar requires a more detailed study, including its prevention and remediation.

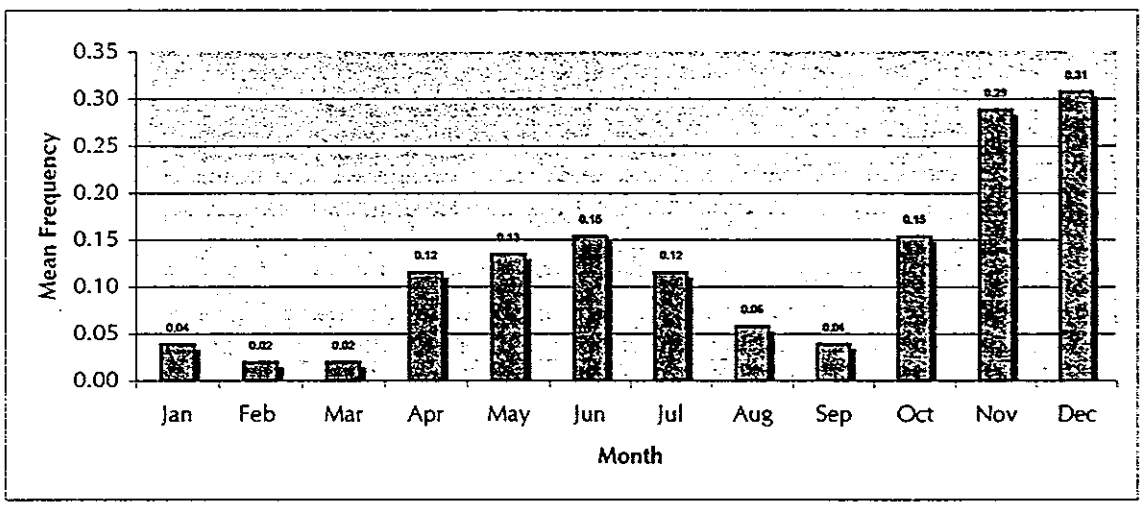
The Bagacay mine may also generate dust of about 129.6 kg hourly in the surrounding area, based on the emission rate of 0.4 kg/hectare per hour of exposed area as estimated by Beer (1984) for a similar open-pit mining situation.

4.3 Influence of Natural Hazards — Typhoons, Landslides and Earthquakes

4.3.1 Tropical Cyclones

PAGASA classified tropical cyclones according to their intensity into three categories: typhoon, tropical storm and tropical depression. There are about 75 tropical cyclones whose centers passed within 100-km radius from Catbalogan, Western Samar within a 52-year period, which average 1.44 tropical cyclones annually (***Annex L***). This is lower than the 457 tropical cyclones crossing the Philippines within the same period, which average 9.0 tropical cyclones yearly. ***FIGURE 3*** presents their mean frequency of occurrence monthly. It must be noted that November and December have the most number of tropical cyclones passage over the area.

Figure 3
Tropical Cyclone Passage in Samar and Their Monthly Mean Frequencies



Over a 10-year period (1990-1999), the National Disaster Coordinating Council (NDCC) recorded 14 typhoons in Region VIII and their damages to lives and properties are presented in Annex M. Samar Island accounts 12.5% of the property damage and 3% fatality as compared to the whole of Region 8. This indicates that Samar is not as susceptible to damages due to tropical cyclones as Leyte.

However, in embarking with large-scale timber harvesting operations or mining operations, proper consideration of the magnitude and frequency of typhoons in the scheduling and planning of the environment-sensitive activities (e.g. earthmoving, clearing of vegetation) is crucial in reducing the risks attendant to such operations.

4.3.2 Landslides and Earthquakes

For a period of 10 years (1990-1999), the NDCC reported no disastrous landslide incident in Samar, as compared to one incident in Leyte; and two incidents of earthquake in Samar with a magnitude of 6.2 and 6.9, which caused damage to infrastructure amounting to P49 million in the provinces of Eastern Samar and Northern Samar.

Although, the probability of landslide occurrence is negligible in Samar, the landslide-prone areas should be investigated in relation to the location and conduct of timber harvesting or mining operations. Activities that can induce landslide and land creep, like clearing of trees in such areas, should be examined well before these are undertaken.

Design of infrastructures, particularly bridges, tailings pond and pit, should take into account the severest magnitude (8 in the Richter scale) and the possibility that an earthquake occurs twice in ten years.

4.4 Risk Perception

The public perception of risk and the acceptability of itemized economic activities, within and outside the SIFR, are averaged in ***ANNEX N*** and ***ANNEX O***, respectively (see also Rosales 2000 for separate discussion on variations among sub-groups of respondents).

There are three risk categories: most risky, moderately risky and least risky activities as perceived by the public, while there are five ratings of acceptability: 1 = most desirable/acceptable; 2 = moderately acceptable; 3 = fairly acceptable; 4 = less acceptable; and 5 = least acceptable. It is noted that there were no responses for the most acceptable (rate 1) and moderately acceptable (rate 2) activities.

The results (***Table 12***) indicate, among others, that large-scale mining and timber harvesting as management options in SIFR are not popular as far as risk and acceptability is concerned. On the other hand, the findings are also an indication of the awareness of the local people on the SIFR resources (not necessarily on the environmental processes) but lack better alternatives for their uses. This does not only require immense IEC (information, education and communication) campaign to improve the perception and perspective of the public but a realistic, holistic and participatory risk management approach that actively involves the stakeholders in all aspects of resource management and biodiversity conservation.

Table 13
Risk and Acceptability Matrix of Economic Activities in SIFR based on SAMBIO Household Survey

Low

	RISK CATEGORY		
ACCEPTABILITY CLASS	Most Risky	Moderately Risky	Least Risky
Least Acceptable	• TLA timber harvesting • Mining/mineral extraction		
Less Acceptable	• Timber Poaching • Kaingin	• Quarrying • Communal mining • Hunting wildlife • Extraction of gravel & sand • Gathering rattan and other minor forest products	• Collection of stalactites and stalagmites
Fairly Acceptable			• Residential/ community build-up • Infrastructure Development (roads, power, etc) • Ecotourism
Moderately Acceptable			
Most Acceptable			

LIKELIHOOD OF OCCURRENCE

Low ← LIKELIHOOD OF OCCURRENCE → High

The matrix also suggests that community build-up/settlements would continue in SIFR if no positive economic policy and programs are implemented to regulate it, including the conversion of forestlands to residential area. While residential/community build-up (settlements) was ranked 'fairly acceptable' and 'least risky' by the respondents, studies show that this perception may not be so. According to "The Philippine Environmental and Natural Resources Accounting Project" main report (ENRAP 1996), the pollution in terms of BOD_5 (biochemical oxygen demand-5 days) comes primarily from households and urban runoffs/settlements (44%) and from degraded uplands (36%). The situation can be aggravated by the presence of mining or forestry operations, which can attract new settlers in search of work or business opportunities as experienced in many such operations (e.g. Anda 1999). The new settlers include not only mine and forestry workers and their families, but also traders and entrepreneurs who seek better economic opportunities and provide goods and services for the new settlers. The residential settlements / community build-up is likely to occur within the 5-km radius area from the mine/forestry sites. Without adequate and planned facilities and basic services like water, electricity, roads, sewerage and solid waste management system, the environmental and economic problems engendered by uncontrolled or unregulated residential settlements/community build-up are often underestimated or ignored, and the results may be disastrous for the community as well as

for the environment. Thus, it is imperative that this matter be considered in the operation plan and budget until the post-project period.

Other non-extractive activities within the same category like infrastructure development and ecotourism are welcome but these are hindered by limited government funds or private capital. As more people are willing to take risks (for themselves, the community or the environment) to benefit from the SIFR resources, the unregulated gathering of rattan and other minor forest products would also persist until the resources are depleted or the market exists. This scenario is also insinuated for other resource extraction activities, but to lesser degrees, such as the collection of stalactites and stalagmites from caves (to the detriment of troglobitic fauna that may be present in such caves), quarrying, communal mining, hunting of wildlife and extraction of gravel and sand.

5. CONCLUSIONS AND RECOMMENDATIONS

The study of impacts and risks associated with forestry and mine development options in Samar Island Forest Reserve resulted in the following provisional findings:

- Commercial logging operations are unlikely to occur at present due to low timber harvestable volume (29.03 cu. m per ha) in the Dipterocarp forest.
- Timber poaching is highly possible due to the strong demand for wood and the subsistence need of the forest communities. Overharvesting may threaten a number of species, as well as engender the conversion of the forest to other land uses. Specific impacts and risks are not determined due to inadequate information on the location and extent of possible activities within the SIFR.
- The risks from agro-forestry and forest plantations are low as long as compliance with appropriate silvicultural practices is ensured.
- The Concord bauxite mining operation will strip the 620-ha area of vegetative cover (mainly Dipterocarp forest), including its topsoil, soil microorganisms, and soil fertility. It affects the natural processes of the forest ecosystem and the wildlife that inhabit it, including species of Philippine Eagle that is believed to be nesting in the Taft area. The risk of ordinary flooding is low but flash floods (with approximately ½ m rise in normal stream level) may occur at a high probability (with an annual frequency of occurrence of 2.17 events). The soil loss from the mine area is about 650 tons to 164,176 tons annually, which does not exceed the average soil loss for Region VIII. Red Mud (a by-product of milling) may leak from the tailings pond and contaminate the Taft River.
- The Bagacay copper-pyrite mine will remove 320 ha of Dipterocarp forest, its topsoil, soil microorganisms and soil fertility. It would affect the forest ecosystems and wildlife in a manner similar to Concord mining but to a lesser magnitude. The possibility of ordinary floods due to the mining operation is low to negligible but the possibility of flashfloods (with approximately ½ rise in normal stream level) is moderate (0.89 event yearly). Soil loss may range from 340 tons to 85,795 tons annually for Bagacay mining, which is lower than Concord mining.
- The influence of natural hazards in forestry and mining operation is manageable provided these are considered in the planning and design of the operation.
- TLA timber harvesting and mining are the least popular economic activities in the SIFR.

These findings are indicative of the immediate area of concern; however, they are not conclusive owing to the paucity of data and the number of uncertainties that attended the conduct of the study, apart from limited time that constrained its scope. These results are provisional and indicative, at best, considering the characteristic of environmental risk assessment process that is iterative in nature. However, this could be refined as more studies and data come in, and as more predictive models are developed and validated in the SIFR. Moreover, this effort leads us to have a more focused area of investigation in the future.

As quantitative risk assessment is not possible at present, a framework (***ANNEX P***) is suggested to be included in the Multi-Criteria Analysis (MCA) to consider risks. In this framework, the stakeholders may qualify and agree to the acceptable levels of risk (as a criterion) attendant to any interventions in the SIFR. The grave risks or threats to biodiversity and environmental degradation can be mitigated to an acceptable level through a number of practices. These risk reduction measures include, but not limited to, rehabilitation of mined-out areas simultaneous with mining operation to minimize the exposed area at a given time; designing of tailings dam and other infrastructures that can withstand the severest earthquakes and typhoons; protection of any remaining old-growth stand through active patrolling and/or fencing; design and implementation of incentive-disincentive schemes to encourage beneficial activities or discourage damaging activities; management zoning of the SIFR according to land use capabilities and limitations; and the proactive involvement of stakeholders in all phases of SIFR management to ensure that decisions will be effectively implemented.

Lastly, amidst uncertainties and inadequacy of information, the government should put in operation the 'precautionary approach' (Principle 15 of the Rio Declaration), which states that:

> *"In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradations."*

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ANNEX A

Water Sampling Results for Possible Mineral Sites

No	River Station	Location	Mineral Resources	Suspended Sediment Load g/lt	Temp deg. C	pH	Turbidity mS/cm	Conductivity mS/cm	Alumina ppm	SO4 %	Cu ppm	Fe ppm	NO3 ppm
1	San Jose River-upstream	San Jose de Buan, N. Samar	Manganese	0.7886	31.2	8.19	1	0.157	<0.6	116	**0.154**	0.528	nil
2	Blanca Aurora River-downstream	Blanca Aurora, San Jorge, W. Samar	Ore		28.4	8.08	16	0.324	<0.6	179	<0.001	0.011	1.130
3	Tinane River-upstream	Casandig, Paranas, W. Samar	Limestone	0.3032	26.4	7.24	10	0.293	<0.6	84	0.020	0.054	2.630
4	Ulot River -downstream	San Isidro, Paranas, W. Samar			26.0	7.70	4	0.321	<0.6	236	<0.001	0.020	1.480
5	Cansolabao River-upstream	Cansolabao, Hinabangan, W. Samar	Copper Ore	0.5448	24.2	7.70	9	0.180	<0.6	161	**0.059**	0.355	0.170
6	Cansolabao River-downstream	Cansolabao, Hinabangan, W. Samar	& Pyrite Ore		25.5	7.67	7	0.277	<0.6	299	**0.137**	1.130	0.556
7	Tubig River- upstream	Concord, Hinabangan, W. Samar	Bauxite Clay	0.3846	24.5	7.50	16	0.267	<0.6	274	0.023	0.009	0.731
8	Taft River-downstream	San Rafael, E. Samar			25.2	7.80	9	0.266	<0.6	218	0.011	0.124	1.420
9	San Rafael River- upstream	San Rafael,Taft, E. Samar	Coal	0.8282	26.4	7.24	10	0.088	<0.6	nil	**0.055**	0.063	0.098
10	Calbiga Creek - downstream	San Rafael,Taft, E. Samar			26.5	7.50	11	0.086	<0.6	141	0.001	0.059	0.039
11	Bigan River- upstream	Gen. McArthur, E. Samar	Chromite Ore	0.6884	27.5	7.80	3	0.156	<0.6	178	0.007	0.200	nil
12	Bigan River- downstream	Gen. McArthur, E. Samar			25.6	7.61	32	0.143	<0.6	122	0.005	0.022	0.439
13	Suribao River - upstream	Binutangan, Borongan, E. Samar	Nickel Ore	1.3255	30.2	8.28	3	0.160	<0.6	144	0.016	0.078	0.078
14	Suribao River - downstream	Banuyo, Borongan, E. Samar			30.8	7.88	3	12.000	<0.6	655	0.010	0.017	0.390
	DENR Standard	Class C-D			3 rise	6.5-8.5			5		0.050	5	10.000

Source: Samples collected and analyzed for SAMBIO by Ilara and dela Cruz (2000) of the DENR-EMB Region VIII.

ANNEX B

Taft Watershed Runoff Estimates

Total Area (ha) = 41,688 Mine Area (%) = 1487

Criteria	Runoff Coeff (%)	Runoff (mm)	Runoff (MCM)	Change (mm)	Change (MCM)	% Change	Daily Change in Discharge (MCM)
Current Land Use	0.365	971.12	404.84				
10% Forest Reduction	0.370	984.43	410.39	13.31	5.55	1.37	0.015
20% Forest Reduction	0.350	931.20	388.20	-39.92	-16.64	-4.11	-0.046
10% Forest Increase	0.480	1,277.08	532.39	305.96	127.55	31.51	0.349
20% Forest Increase	0.490	1,303.71	543.49	332.59	138.65	34.25	0.380
Average Rainfall		2,660.60	1,109.15				

Source: Extracted from Cruz 2000

ANNEX C
Stream Discharges of Taft River

Water level	Stream Depth (m)	Stream Width (m)	Cross-sectional Area (sq.m.)	Stream Velocity (m/sec)	Stream Discharge		
					cu. m/sec	MCM/day	MCM/year
*Average Streamflow	2.13	132	281.16	0.066	18.56	1.60	585
0.5 m depth increase	2.63	154.27	405.73	0.066	26.78	2.31	844
1 m depth increase	3.13	158.27	495.39	0.066	32.70	2.82	1,031
2 m depth increase	4.13	163.45	675.05	0.066	44.55	3.85	1,405
3 m depth increase	5.13	166.65	854.91	0.066	56.42	4.88	1,779
no depth increase	2.13	132.00	281.16	0.100	28.12	2.43	887
0.25 depth increase	2.38	151.68	360.99	0.100	36.10	3.12	1,138
0.5 m depth increase	2.63	154.27	405.73	0.100	40.57	3.51	1,280
1 m depth increase	3.13	158.27	495.39	0.100	49.54	4.28	1,562
2 m depth increase	4.13	163.45	675.05	0.100	67.50	5.83	2,129
3 m depth increase	5.13	166.65	854.91	0.100	85.49	7.39	2,696

*Source: Samples collected and analyzed for SAMBIO by Nasayao (2000)

ANNEX D

Concord Mining Flashflood Estimates (in MCM)

Mine Area (ha) = 620

Max. Daily Rainfall (mm)	Runoff Coefficient (%)*					Adjusted Max. Daily Stream Discharge
	0.6	0.7	0.8	0.9	0.95	
100	0.372	0.434	0.496	0.558	0.589	2.19
200	0.744	0.868	0.992	1.116	1.178	2.78
300	1.116	1.302	1.488	1.674	1.767	3.37
400	1.488	1.736	1.984	2.232	2.356	3.96

* for bare, compacted soil, with 0-30% slopes, clay and silt loam (Coppin and Bradshaw 1982)

ANNEX E

Frequency of Occurrence of Greatest Daily Rainfall in Samar Island (1954-1999)

Greatest 24-hr Rainfall (mm)	No. of Occurrence	Annual Frequency	Likelihood of Occurrence
<100	100	2.17	High
100-200	41	0.89	Moderate
201-300	8	0.17	Low
301-400	3	0.07	Remote but possible
>400	0	0.00	

Source: PAGASA 2000

ANNEX F

Comparative Evaluation of the Different Soil Erosion Estimates for Taft Watershed Under Current Land Uses

Current Land Use	Area (ha)	USLE Estimate (1)		Land Use Averages (2)		Pantabangan Data (3)		Tropical Forest (4)	
		Erosion Rate (tons/ha)	Total Erosion (tons)	Erosion Rate (tons/ha)	Total Erosion (tons)	Erosion Rate (tons/ha)	Total Erosion (tons)	Erosion Rate (tons/ha)	Total Erosion (tons)
Close Canopy Forest	16,032	0.60	9,619	3.00	48,096	2.22	35,591	6.16	98,757
Open Canopy Forest	18,001	0.60	10,800	3.00	54,003	6.95	125,107	6.20	111,606
Cultivated brush and grass land	3,609	1.05	3,772	12.50	45,113	194.83	703,141	182.90	660,086
Cropland w/ coconut	3,438	0.60	2,063	112.80	387,806	220.90	759,454	70.05	240,832
Total	**41,080**	**0.64**	**26,255**	**13.02**	**535,018**	**39.52**	**1,623,294**	**27.05**	**1,111,281**

Sources: (1) Cruz 2000
(2) Delos Angeles and Bennagen 1991
(3) David 1987
(4) Wiersum 1984

Note: Land use descriptions do not exactly match in some categories.

ANNEX G

Comparative Evaluation of the Different Soil Erosion Estimates for Taft Watershed Land Uses with Concord Mining

Land Use	Area (ha)	USLE Estimate (1)		Land Use Averages (2)		Pantabangan Data (3)		Tropical Forest (4)	
		Erosion Rate (tons/ha)	Total Erosion (tons)	Erosion Rate (tons/ha)	Total Erosion (tons)	Erosion Rate (tons/ha)	Total Erosion (tons)	Erosion Rate (tons/ha)	Total Erosion (tons)
Close Canopy Forest	16,032	0.60	9,619	3.00	48,096	2.22	35,591	6.16	98,757
Open Canopy Forest	17,381	0.62	10,800	3.00	52,143	6.95	120,798	6.20	107,762
Cultivated brush and grass land	3,609	1.05	3,772	12.50	45,113	194.83	703,141	182.90	660,086
Cropland w/ coconut	3,438	0.60	2,063	112.80	387,806	220.90	759,454	70.05	240,832
Bare/Open grassland (mine area)	620	1.05	651.00	267.80	166,036.00	210.72	130,646.40	182.90	113,398.00
Total	**41,080**	**0.65**	**26,905**	**17.02**	**699,194**	**42.59**	**1,749,631**	**29.72**	**1,220,835**

Sources: (1) Cruz 2000
(2) Delos Angeles and Bennagen 1991
(3) David 1987
(4) Wiersum 1984

Notes: Land use descriptions do not exactly match in some categories.
Bauxite Mining area = 620 ha.

ANNEX H

Comparative Evaluation of the Different Changes in Soil Erosion Estimates for Taft Watershed With-and-Without Concord Mining

Land Use	USLE Estimate (1)		Land Use Averages (2)		Pantabangan Data (3)		Tropical Forest (4)	
	Erosion Rate (tons/ha)	Total Erosion (tons)	Erosion Rate (tons/ha)	Total Erosion (tons)	Erosion Rate (tons/ha)	Total Erosion (tons)	Erosion Rate (tons/ha)	Total Erosion (tons)
Current Land Use (Annex F)	0.64	26,255	13.02	535,018	39.52	1,623,294	27.05	1,111,281
With Concord Mining (Annex G)	0.65	26,905	17.02	699,194	42.59	1,749,631	29.72	1,220,835
Change	0.02	650	4.00	164,176	3.08	126,337	2.67	109,554
% Change	2.48	2.48	30.69	30.69	7.78	7.78	9.86	9.86

Sources: (1) Cruz 2000
(2) delos Angeles and Bennagen 1991
(3) David 1987
(4) Wiersum 1984

ANNEX I

Bagacay Mining Flashflood Estimates (in MCM)

Mine Area (ha) = 324

Max. Daily Rainfall (mm)	Runoff Coefficient (%) in Mine Area*					Adjusted Max. Daily Floodflow
	0.60	0.70	0.80	0.90	0.95	
100	0.194	0.227	0.259	0.292	0.308	1.91
200	0.389	0.454	0.518	0.583	0.616	2.22
300	0.583	0.680	0.778	0.875	0.923	2.52
400	0.778	0.907	1.037	1.166	1.231	2.83

* for bare, compacted soil, with 0-30% slopes, clay and silt loam (Coppin and Bradshaw 1982)

ANNEX J

Comparative Evaluation of the Different Soil Erosion Estimates for Taft Watershed Land Uses with Bagacay Mining

		USLE Estimate (1)		Land Use Averages (2)		Pantabangan Data (3)		Tropical Forest (4)	
Land Use	Area (ha)	Erosion Rate (tons/ha)	Total Erosion (tons)	Erosion Rate (tons/ha)	Total Erosion (tons)	Erosion Rate (tons/ha)	Total Erosion (tons)	Erosion Rate (tons/ha)	Total Erosion (tons)
Close Canopy Forest	16,032	0.60	9,619	3.00	48,096	2.22	35,591	6.16	98,757
Open Canopy Forest	17,677	0.61	10,800	3.00	53,031	6.95	122,855	6.20	109,597
Cultivated brush and grass land	3,609	1.05	3,772	12.50	45,113	194.83	703,141	182.90	660,086
Cropland w/ coconut	3,438	0.60	2,063	112.80	387,806	220.90	759,454	70.05	240,832
Bare/Open grassland (mine area)	324	1.05	340.20	267.80	86,767.20	210.72	68,273.28	182.90	59,259.60
Total	**41,080**	**0.65**	**26,595**	**15.11**	**620,813**	**41.12**	**1,689,315**	**28.45**	**1,168,532**

Sources: (1) Cruz 2000
(2) Delos Angeles and Bennagen 1991
(3) David 1987
(4) Wiersum 1984

Notes: Land use descriptions do not exactly match in some categories.
Bagacay Mining area = 324 ha.

ANNEX K

Comparative Evaluation of the Different Changes in Soil Erosion Estimates for Taft Watershed With-and-Without Bagacay Mining

Land Use	USLE Estimate (1)		Land Use Averages (2)		Pantabangan Data (3)		Tropical Forest (4)	
	Erosion Rate (tons/ha)	Total Erosion (tons)	Erosion Rate (tons/ha)	Total Erosion (tons)	Erosion Rate (tons/ha)	Total Erosion (tons)	Erosion Rate (tons/ha)	Total Erosion (tons)
Current Land Use (Annex F)	0.64	26,255	13.02	535,018	39.52	1,623,294	27.05	1,111,281
With Bagacay Mining (Annex J)	0.65	26,595	15.11	620,813	41.12	1,689,315	28.45	1,168,532
Change	0.01	340	2.09	85,795	1.61	66,021	1.39	57,251
% Change	1.29	1.29	16.04	16.04	4.07	4.07	5.15	5.15

Sources: (1) Cruz 2000 (1) Cruz 2000

(2) delos Angeles and Bennagen 1991

(3) David 1987

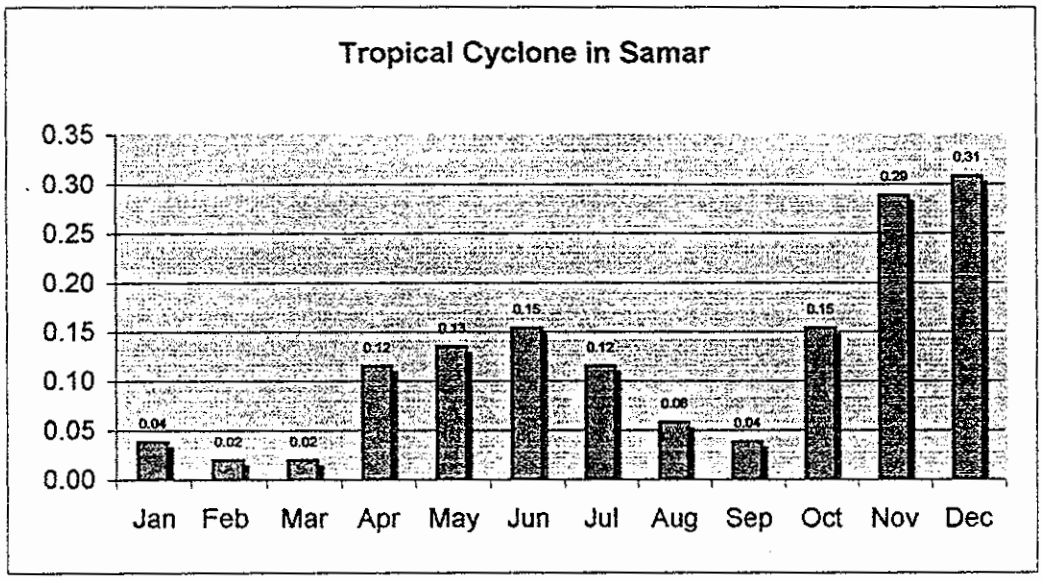
(4) Wiersum 1984

ANNEX L

Tropical Cyclone Passage in Samar (1948-1999)

Month	Tropical Cyclone	Cyclone Mean Frequency	%
Jan	2	0.04	2.67
Feb	1	0.02	1.33
Mar	1	0.02	1.33
Apr	6	0.12	8.00
May	7	0.13	9.33
Jun	8	0.15	10.67
Jul	6	0.12	8.00
Aug	3	0.06	4.00
Sep	2	0.04	2.67
Oct	8	0.15	10.67
Nov	15	0.29	20.00
Dec	16	0.31	21.33
Total	**75.00**	**1.44**	**100.00**

Source: PAGASA 2000



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ANNEX M

Damages from Tropical Cyclones to Samar Island (1990-1999)

	Western Samar	Eastern Samar	Northern Samar	Total (SAMAR)	Yearly Average (SAMAR)	Total (Region 8)	Average (Region 8)
Dead	0	6	4	10	1	357	36
Injured	0	10	2	12	1.2	258	25.8
Missing	0	2	1	3	0.3	849	84.88
Damage to Agric. (PHP million)	79.9	140	27.7	247.6	24.76	1990	199
Damage to Infras (PHP million)	37.2	29.3	97.8	164.3	16.43	1305	130.5
Total Damage to Properties	**117.1**	**169.3**	**125.5**	**411.9**	**41.19**	**3295**	**329.5**

Source: NDCC (2000)

ANNEX N

Average Ranking for Economic Activities in SIFR and Risk Classes

Economic Activity	Average Risk Ranking* (from most to least risky)	Risk Class
TLA timber harvesting	1st	Most Risky Activities
Mining/ mineral extraction	2nd	
Small scale logging/timber poaching	3rd	
Kaingin/shifting cultivation	4th	
Quarrying	5th	Moderately Risky Activities
Communal mining/ small-scale mining	6th	
Collecting / Hunting wildlife	7th	
Extraction of sand and gravel	7th	
Gathering rattan and other minor forest products	8th	
Collection of stalactites and stalagmites	9th	Least Risky Activities
Residential /community built-up	10th	
Infrastructure Development (roads, power, etc)	11th	
Ecotourism	12th	

*Survey results taken from Rosales 2000

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ANNEX O
Average Rates for Economic Activities in SIFR and Acceptability Classes

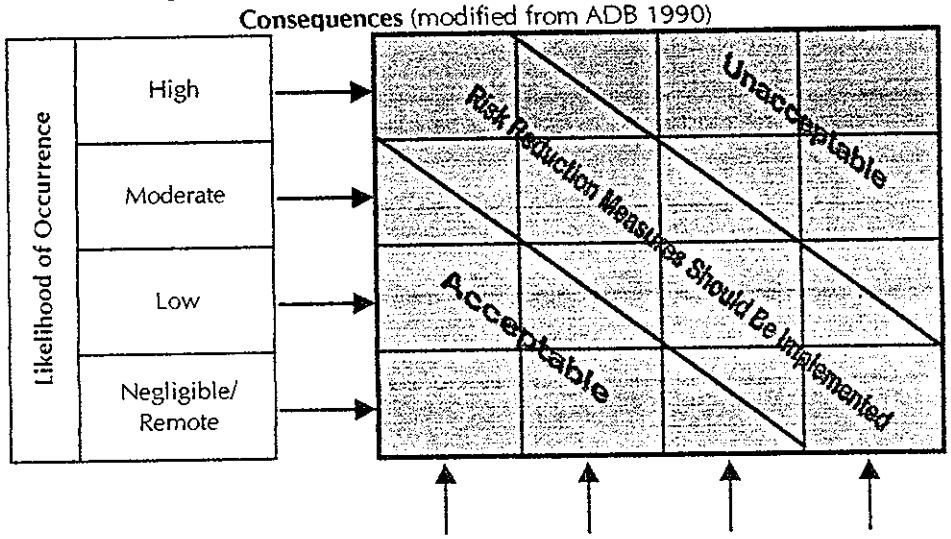
Economic Activity	Average Rate*	Acceptability Class
TLA timber harvesting	4.91	Least Acceptable
Mining/ mineral extraction	4.68	
Quarrying	4.26	
Small scale logging/timber poaching	4.24	
Collection of stalactites and stalagmites	4.14	Less Acceptable
Communal mining/ small scale mining	4.09	
Collecting / Hunting wildlife	3.97	
Kaingin/shifting cultivation	3.95	
Extraction of sand and gravel	3.91	
Gathering rattan and other minor forest products	3.45	
Ecotourism	3.13	Fairly acceptable
Infrastructure Development (roads, power, etc)	3.04	
Residential /community built-up	3.01	

* Note: Rate is rounded off — 1 = most desirable/acceptable; 2 = moderately acceptable; 3 = fairly acceptable; 4 = less acceptable; 5 least acceptable

Source: taken from Rosales 2000

ANNEX P

Risk Categories Based on Their Likelihood of Occurrence and Severity of Consequences (modified from ADB 1990)



Factor/ Criteria	Negligible	Marginal	Critical	Tragedy
Damage to property	<P0.5 million	P0.5 to P50 million	P50 to P500 million	>P500 million
Public health and safety	Minor illness or injury; <1 year lost work time	> 1 year lost work time from illness or injury	Death or severe illness to 1-9 people in the community	Death to 10 or more persons or cause severe injuries/ illnesses to 100 or more persons in the community
Biodiversity/ecosystem damage	Slight, quickly reversible damage to few species/ecosystem parts	Temporary, reversible damage. Reversion to earlier successional stage	Loss of keystone species and widespread habitat destruction	Complete, irreversible and immediate destruction of all life.
GeoPhysical stability	<8 t/ha/year erosion rate	8 to 25 t/ha/year erosion rate	>25 to 80 t/ha/year erosion rate	>85 t/ha/year erosion rate

APPENDIX A

Risk Perception Questionnaire

1) What positive and negative effects do you think will **logging or timber harvesting** here in Samar have on

   a) animal and plant life?

   _____

   _____

   b) the quality of air, water, and soil?

   _____

   _____

   c) the people in the municipality and the province?

   _____

   _____

   d) on you and your household in particular?

   _____

   _____

2) What positive and negative effects do you think will **mining or mineral utilization** here in Samar have on

   a) animal and plant life?

   _____

   _____

   b) the quality of air, water, and soil?

   _____

   _____

   c) the people in the municipality and the province?

   _____

   _____

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d) on you and your household in particular?

_____

_____

3) What positive and negative effects do you think will **swidden agriculture or kaingin** here in Samar have on

a) animal and plant life?

_____

_____

b) the quality of air, water, and soil?

_____

_____

c) the people in the municipality and the province?

_____

_____

d) on you and your household in particular?

_____

_____

4) Please rank, from 1 to 10 (highest to lowest), the activities in the SIFR that you perceive as the greatest threat to you, to other people, and to the environment:

		RANK:
a)	Small scale logging/timber poaching	_____
b)	TLA timber harvesting	_____
c)	Mining/ mineral extraction	_____
d)	Communal mining/ small scale mining	_____
e)	Kaingin/shifting cultivation	_____
f)	Residential /community built-up	_____
g)	Gathering rattan and other minor forest products	_____
h)	Collecting / Hunting wildlife	_____
i)	Ecotourism	_____
j)	Extraction of sand and gravel	_____
k)	Collection of stalactites and stalagmites	_____
l)	Others (please write): _____	_____

5) In your opinion, please rate from 1 to 5 (1 = *most desirable/acceptable*; 2 moderately acceptable; 3 = fairly acceptable; 4 = less acceptable; 5 least acceptable) the acceptability of the following activities in the SIFR:

	RATE:
a) Small scale logging/timber poaching	_____
b) TLA timber harvesting	_____
c) Mining/ mineral extraction	_____
d) Communal mining/ scall scale mining	_____
e) Kaingin/shifting cultivation	_____
f) Residential /community built-up	_____
g) Gathering rattan and other minor forest products	_____
h) Collecting / Hunting wildlife	_____
i) Ecotourism	_____
j) Extraction of sand and gravel	_____
k) Collection of stalactites and stalagmites	_____
l) Others (please write): _____	