

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

GIS application on the cadmium contaminated area in Mae Sot District, Tak Province was carried out using factors as reported in Chapter 4. Therefore all significant relationships and explanation of a clear picture on related resources are now able to conclude.

The study area in Mae Sot District, Tak Province has been mostly occupied by the forest area and the other landuse include agriculture, residence, river, road, etc. However, the forests have been continuously decreased due to the deforestation meanwhile the agricultural lands have been expanded. Regarding to rainfall within last two decades, the study area is directly impacted by the heavy rain, especially in July; besides, it has a record of the maximum monthly rainfall at 908.2 mm and the maximum daily rainfall at 207.4 mm in 1994. The contaminated areas generally present along the Huai Mae Tao and Huai Mae Ku in which they are significantly related to flooded areas. In addition, sediment flows westward and deposit along these flooded areas.

Based on the data compiled in this study, it can determine cause of contamination which can be divided into 2 major types. The first major cause is considered as the nature of the area in which is controlled by the regional geology and zinc mineralization in the area. The study area is mostly occupied by the Huai Hin Fon Formation that has zinc deposits with Cd-bearing potential. The natural weathering process consequently transports Cd-contained sediments into the contaminated areas. The second cause is related to deforestation and anthropogenic activities in the areas that in turn lead to high erosion of some certain areas, particularly zinc mines and cultivation (especially corn field). These are suspected to be the major activators of contamination. This can point out evidently from cadmium distribution in soil along the Huai Mae Tao which is directly impacted by stream

flowing from the zinc utility and high erosion area. Although, there is no zinc deposit in the Huai Mae Ku, it still shows a high level of cadmium contamination. This is a direct result of the high erosion area appearing in the upstream cultivation.

Transportation of sediments from the zinc deposit area and the high erosion area is occurred by runoff which usually flows from the west highland of Mae Sot to the east floodplain area. This can not only be confirmed by cadmium and zinc distribution in stream sediment which is likely decreasing towards west lowland and alluvial, but also by the levels of cadmium containing in population of Mae Sot District, Tak Province which reported by Tak Hospital (2004) that 2.5% of 6,802 people live in Mae Tao and Mae Ku sub-district have tested results of high cadmium ($>10 \mu\text{g/g}$ Creatinine) input in their bodies. That may indicate that they consume food and water which contain high level of cadmium (Appendix B, Table B-8).

5.2 Recommendations

This study was only dealt with the secondary data obtained from the several agencies; besides, processing and integration of all data used computer program without post-field study to check the results. Moreover, some data had been collected for a long time so it might not be correct and up to date comparing to in the real time. Consequently, the results might be a little bit inconsistent. However, based on the analysis of all information, a few mitigation and remediation plan for the rehabilitation are given.

- For the soil improvement, it is recommend by Namboonruang, Nanglae, and Phadermrod, (2005) that husk ash should be added in to the soil to decrease heavy metal accumulation and minimize the transportation of heavy metals to rice.
- Since consumption of the contaminated food grown in the areas is the main source of excessive cadmium in human bodies and improvement in the soil contamination is very difficult, the production of rice and other crops for human consumption should be avoided. This policy can prevent further accumulation of cadmium in the body of the exposed population. The

production of non-food crops in these areas such as teak is strongly recommended and supported by the government.

- Deforestation and cultivation should be restricted to the certain area; especially, it should not be taken place on the upstream of the contaminated area which may increase erosion.
- According to the management plan of Padaeng Mine, mining area is classified into four part; A, B, C and TSF. The sedimentation ponds in each area are differently designed; however, the first ponds of each area (A₁, B₁, C₁ and TSF₁) have capacity of 60,000 m³, 195,000 m³, 65,000 m³ and 1,150,000 m³, respectively. From the rainfall data of Mae Sot District recorded by Electricity Generating Authority of Thailand (EGAT) the rainfall intensity of return periods of 100, 500 and 1,000 years are 95, 130 and 140 mm/hr, respectively. All of the pond capacities are designed enough for the precipitation in most cases except rainfall intensity is over 130 mm/hr the first sedimentation pond of area A will not be enough. However, this case would not be happened in the next century. According to the data from this study, they present the maximum daily rainfall at 207.4 mm in 1994 that may be assumed as the worse case of 2-hours of precipitation, the rainfall intensity is 103.7mm/hr which is in the range between rainfall intensity of 130 and 140 mm/hr. Consequently, the precipitation of is not exceed the capacity of all sedimentation pond. This can be complied that the sedimentation pond of Padaeng Mine is appropriate for the runoff management.

Finally, some more works would be taken into account for further studies as recommended below:

- Collect more data of chemical analysis which cover the other adjacent area, for example, Huai Nong Khieo in the southern part of Huai Mae Ku. This is aimed to find out the cadmium distribution in the extended area.
- Field investigation in upstream high erosion area of both Huai Mae Tao and Huai Mae Ku should be considered to analyze the initial Cd-bearing sediment and to identify the cause of erosion.

- Since Huai Mae Tao and Huai Mae Ku are directly impacted by the cadmium contamination; therefore, water from both streams should not be used for food crop agriculture purpose. Moreover, irrigation system from other reservoir may not be the good solution for the remediation due to the nature of the area which is zinc deposit. Consequently, the research for the appropriate water resource is necessary.