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ORIGINAL ARTICLE

Finding Risky Environmental Zones due to Flooding In Uma Uya Project

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ABSTRACT

In this paper, using flood risky zones the worst possible places to effect the water quality due to flooding were found in Uma Uya project. The risky zones of the project is achieved and presented.
Uma Uma project is a multipurpose project. Uma Oya is a major tributary of Mahaweli Ganga originating from Nuwara Eliya. The Oya traverses Welimada and Kandaketiya in Badulla district. Its confluence with Mahaweli Ganga is just above the Rantabe reservoir. Flood is a natural process that can happen at any time in a wide variety of locations. Flooding from the sea and from rivers is probably best known but prolonged, intense and localized rainfall can also cause sewer flooding, overland flow and groundwater flooding. Flooding has significant impacts on water pollution and its quality, it can threaten users lives, and the environment. As it can be seen from results the main risky zones are located at high levels of the site. It is clear from results that about %25 of the site zones involved in high risky flood. While, about %50 and %25 of zones are low risky zones and no risky zones, respectively. Thus, water pollution in such zones are dangerous.

Key Words: Uma Uya**,** Flood, Risk controlling, water pollution

Introduction

Pollution is the introduction of contaminants into a natural environment that causes instability, disorder, harm or discomfort to the ecosystem i.e. physical systems or living organisms [19,1]. Pollution can take the form of chemical substances or energy, such as noise, heat, or light. Pollutants, the elements of pollution, can be foreign substances or energies [2], or naturally occurring; when naturally occurring, they are considered contaminants when they exceed natural levels [3,14]. Pollution is often classed as point source or no point source pollution.

Generally, risk controlling is the process of measuring, or assessing risk and then developing strategies to manage the risk. It is followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events [15] or to maximize the realization of opportunities. Risks can come from uncertainty in project failures, accidents, natural causes and disasters [16,17]. Once risks have been identified and assessed, all techniques to manage the risk fall into one or more of four major categories: Avoidance, Reduction, Sharing and Retention [10].

Megaprojects are extremely large scale investment projects. Megaprojects include bridges, tunnels, airports, power plants, dams, etc. Megaprojects have been shown to be particularly risky in terms of finance, safety, and social and environmental impacts. Risk management is therefore particularly pertinent for megaprojects and special methods and special education have been developed for such risk management using different methods such as information technology [13,7,8,9].

Flooding has significant impacts on human activities, it can threaten workers' lives, their work and the environment. The health, social, economic and environmental impacts of flooding can be

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significant and have a wide community impact [5,11].

The frequency, pattern and severity of flooding are expected to increase as a result of climate change. Development can also exacerbate the problems of flooding by accelerating and increasing surface water runoff, altering watercourses and removing floodplain storage [20].

Flooding is one of the most important problems that can harm site mobilization. That's why it should be identified in a large project such as dam construction. Uma uya project is a multipurpose project which is held in Srilanka. Uma Oya is a major tributary of Mahaweli Ganga originating from Nuwara Eliya. The Oya traverses Welimada and Kandaketiya in Badulla district. Its confluence with Mahaweli Ganga is just above the Rantabe reservoir. In this paper, the Uma Uya project's major risky zones involved in flooding are identified and presented to reduce the site mobilization risks.

The aims of this paper is to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate facilities in areas at risk of flooding, and to direct facilities away from site areas at highest risk.

Materials and methods

Risk Management:

Risk management is very often applied in engineering, but all sciences have risk management. In ideal risk management, a prioritization process is followed whereby the risks with the greatest loss and the greatest probability of occurring are handled first, and risks with lower probability of occurrence and lower loss are handled later [6].

In practice the process can be very difficult, and balancing between risks with a high probability of occurrence but lower loss vs. a risk with high loss but lower probability of occurrence can often be mishandled. There are different methods to control a project risk as follows [18,4,13]:

A. Risk Avoidance:

Includes not performing an activity that could carry risk. An example would be finding risky zones with heavy metals materials. Avoidance may seem the answer to all risks, but sometimes avoiding risks also means losing out on the potential gain that accepting (retaining) the risk may have allowed.

B. Risk Reduction:

Involves methods that reduce the severity of the loss. This method may cause a greater loss by choosing a wrong reduction method and therefore may not be suitable.

C. Risk Retention:

Involves accepting the loss when it occurs. True self insurance falls in this category. Risk retention is a viable strategy for small risks where the cost of insuring against the risk would be greater over time than the total losses sustained. All risks that are not avoided or transferred are retained by default. This includes risks that are so large or catastrophic that they either cannot be insured against or the premiums would be infeasible. Also any amounts of potential loss (risk) over the amount insured is retained risk. This may also be acceptable if the chance of a very large loss is small or if the cost to insure for greater coverage amounts is so great it would hinder the goals of the organization too much.

D. Risk Transfer:

Means causing another party to accept the risk, typically by contract. Insurance is one type of risk transfer. Other times it may involve contract language that transfers a risk to another party without the payment of an insurance premium. Liability among construction or other contractors is very often transferred this way.

Some ways of managing risk fall into multiple categories. Risk retention pools are technically retaining the risk for the group, but spreading it over the whole group involves transfer among individual members of the group.

Uma Uya Project:

The drainage area of Uma Oya is about 700 sq.kms. Studies for the development of water resources of Uma Oya have been made from time to time mainly for the purpose of hydro power development in the Mahaweli basin. From the early planning stage of the Mahaweli Development Programme, several proposals for the development and utilisation of water resources of the Uma Oya basin have been made by United States Operations Mission (USOM) and the Canadian Hunting Survey Corporation (CHSC) as early as 1959. Later UNDP/FAO Master Plan studies (1968/1969) for accelerated Mahaweli programme proposed the construction of the Upper and Lower Uma Oya reservoirs.

Later the "Master Plan for the Electricity Supply in Sri Lanka" carried out by the Lahmeyer International Company in Germany during 1988-1989 identified three-stage development in Uma Oya to generate hydro power. Subsequently the concept of three stage development of the Master Plan Study was reviewed in 1989 by a panel of experts from

Germany and recommended a two-stage plan.

The Government of Sri Lanka launched the accelerated water resources program of Mahaweli Ganga in 1978 with a view to increase the production of food and power and to alleviate unemployment. However no attention was paid to the development of Hambantota, Monaragala and Ampara districts. While large extents of suitable land are available in these districts, the lack of adequate water resources acted as a major constraint for development. The need to augment water resources of the area became a vita when pursuing a development policy based on irrigated agriculture as the fundamental economic activity. Among identified possibilities, the trans basin diversion of water from the upper catchment of the Uma Oya into the Kirindi Oya basin appeared to be one such option.

In view of that, a pre-feasibility study of the Uma Oya Multi-purpose Project (Trans basin option) was carried out by the Central Engineering Consultancy Bureau (CECB) in 1991. While looking for various possibilities for augmenting irrigation water supplies to this dry zone region, the CECB conceived a multi-purpose scheme for the development of the Uma Oya water resources as an alternative to the in-basin hydro power development. According to this concept, water from the Uma Oya would be diverted through a 24 km tunnel to the upper Kirindi Oya basin to augment the Kirindi Oya flow and in the process generate a large quantity of electrical energy per annum, utilizing the drop of about 550 mg in a single-stage power development.

The latest study of the Uma Oya basin is the trans-basin scheme prepared by SNC Lavalin Inc.(Canada) in 2000. This study was aimed at a comprehensive evaluation and assessment of the best scheme, from in-basin and trans-basin alternatives which have previously been studied. The consultant, SNC-LAVALIN, recommended the trans basin diversion option based on the conditions prevailing at that time.

The proposal in a nutshell is to construct a medium high dam across Uma Oya and a small dam across Mahatotila Oya, which is a tributary of Uma Oya with its confluence at Etampitiya. It is proposed to divert 192 mcm of water annually through a 23.2 km long tunnel to a underground power house at Randeniya on the right bank of Kirindi Oya, The installed capacity of the power house is 90 MW to produce 312 GWh of electrical energy. The water released from the power house will be used to supplement Handapanagala and Lunugamvehera Reservoirs in addition to 5000 ha of new land cultivated in Wellawaya, Buttala areas in Monaragala district. The total cost of the project in year 2000 was Rs.16,000 million.

The key issue regarding the development scenarios discussed for the development of water resources of Uma Oya is the assessment of water availability of Uma Oya by different consultants at different times. According to Lahmeyer International the flow at the Welimada stream gauging site which is slightly upstream of the diversion site was estimated as 258 MCM. The NEDECO Hydrological Crash Program(HCP) in 1980-1984 ,had the principal objective to review the status. According to NEDECO study the annual average flow at the dam sites, which intercepts 254 sq.kms of Uma Oya catchment can be interpreted as 188 MCM and the NEDECO also had expressed their concerns over the poor quality of historical data at the river gauging site in the Uma Oya. The pre feasibility study carried out by the CECB in 1991 reported 277 MCM of annual flow. According to the more recent study by SNC-LAVALIN Inc the water availability at the proposed site was estimated as 228 MCM of annual flow. The most recent review of the water availability by the Ministry of Irrigation was 211 MCM.

In view of the above, the reason for this drastic difference in the estimates was a matter of concern. All previous reports on Uma Oya reported unreliable and poor quality of available hydrological data.

It has to be noted that it is not logical to assume that all available water at the dam sites can be diverted due to the downstream water requirements and also due to the rapid fluctuations of water levels in the river caused by flash floods. From detailed studies it was found that from the annual total of 211 MCM of water volume only 130 MCM can be diverted to Kirindi Oya based on the most recent estimate of 211MCM of total water. Based on this, the annual generation of power was estimated as 175 Gwh. This is a reduction of 56 % in comparison to the estimate of 312 Gwh made by the consultant SNC-LAVLIN.

Flood:

Flooding from rivers and coastal waters is a natural process that plays an important role in site mobilization risk controlling. However, flooding threatens construction site and causes substantial damage to property. The effects of weather events can be increased in severity both as a consequence of previous decisions about the location, design and nature of settlement and land use, and as a potential consequence of future climate change. Although flooding cannot be wholly prevented, its impacts can be avoided and reduced through good planning and management.

Climate change over the next few decades is likely to mean milder wetter winters and hotter drier summers will continue to rise. Flooding will leads to increased and new risks of flooding within the lifetime of planned projects.

Positive planning has an important role in helping site mobilization and applying the managers programs on flood risk management. It avoids, reduces and manages flood risk by taking full account in decisions on plans and applications of:

A) Present and future flood risk, involving both the statistical probability of a flood occurring and the scale of its potential consequences, whether inland or on the coast.
B) The wider implications for flood risk of development located outside flood risk areas.

Results and discusion

Uma Uya Project Flood Identifying:

As it is mentioned before, there are four different ways to risk controlling. For the purpose of Uma Uya project flood risk controlling, the first step is finding the risky zones. In other word, the risk controlling is achieved using risk avoidance.

That's why, first of all topographic maps of the risky zones of the Uma Uya project and main rivers position were controlled. Then using maps, risky zones were found and presented. Figure 1 shows the site plan of Uma Uya project. According to the Figure there are 16 different zones. In the project site, Zones 2, 4 and 5 have risky flood zones. Figure 2 shows zones 1 to 6 topography. Also, risky flood zones of the zones are presented in Figure 3 to 5.

As it can be seen from results the main risky zones are located at high levels of the site. It is clear from results that about %25 of the site zones involved in high risky flood. While, about %50 and %25 of zones are low risky zones and no risky zones, respectively. Thus, site mobilization in such zones are dangerous and for flood controlling it is better to mobilize the site in no risky zones and zone numbers 1, 3 and 6 to 16.

Conclusions:

The flood frequently poses challenges in areas of engineering. Flood hazard analysis and mapping can provide useful information for risk controlling. The analysis is used to identify the factors that are related to flood, estimate the relative contribution of factors causing water flows, establish a relation between the factors and flood, and to predict the flood hazard in the site mobilization future based on such a relationship.

Fig. 1: Uma Uya project site plan.

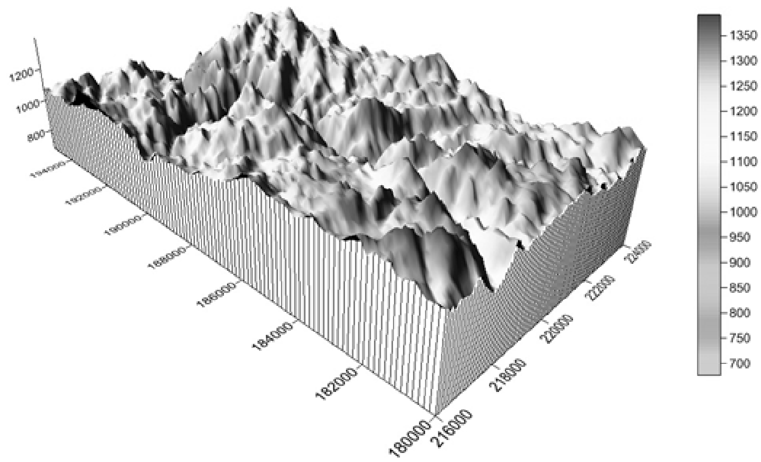

Fig. 2: Zones 1 to 6 topography.

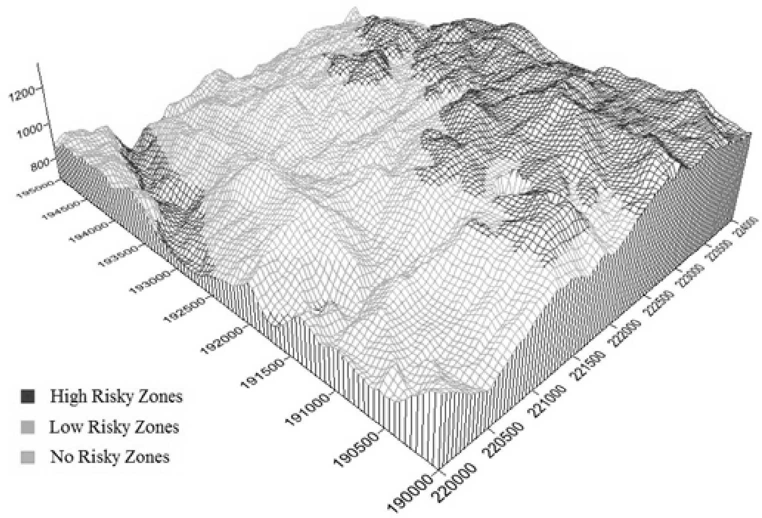

Fig. 3: Zone 2 flood risky zones.

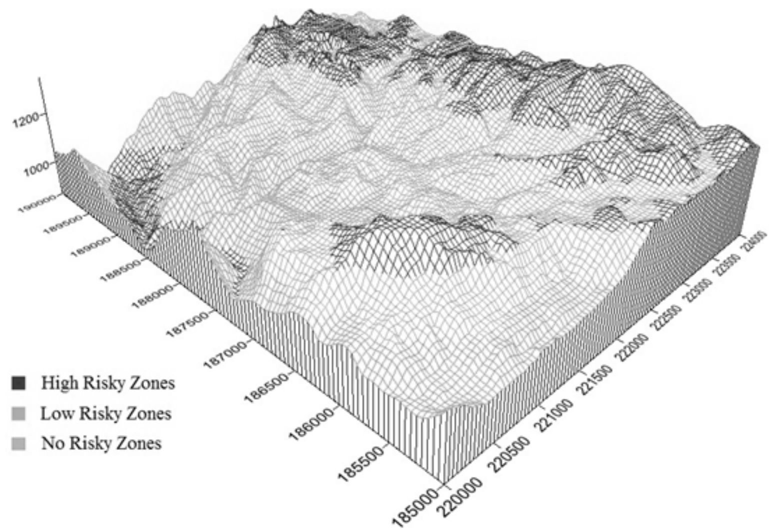

Fig. 4: Zone 4 flood risky zones.

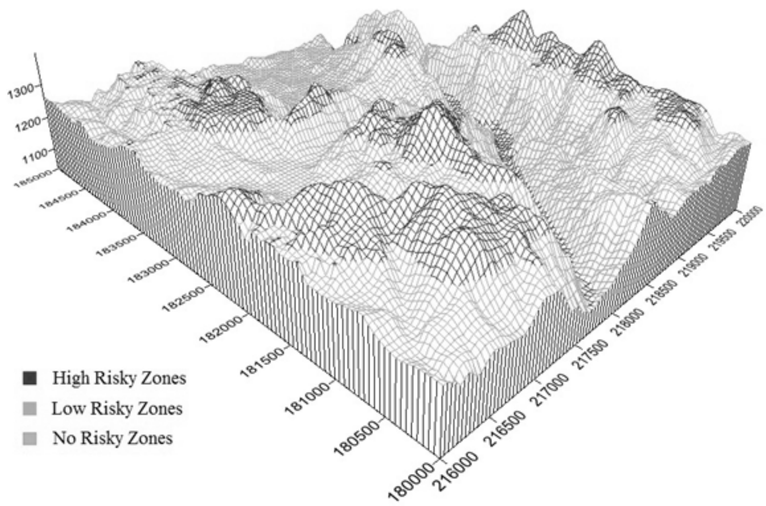

Fig. 5: Zone 5 flood risky zones.

In this paper, using flood risky zones best possible places to arrange the buildings and equipments were found in Uma Uya project. The risky zones of the project is achieved and presented. In addition, results show that:

a. If there is a wrong mobilization the flood risk will be high.
d. It is clear from results that high risky flooding zones for Uma Uya project is about %25. While, low and no risky zones are about %50 and %25, respectively.
c. According to findings we can say that it is dangerous to mobilize Uma Uya project in zones 2, 4 and 5.

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