

Study on the Crisis Management Warning System in the Maintenance and Management of Floodgate—A Development Study on the Proactive Management Concept of Flood Prevention and Its Application

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ABSTRACT

After hundred years of operation, the farming irrigation and drainage business makes major contributions to the development of Taiwan economy. Especially under the special circumstances of climate and topography, the farming irrigation and drainage facilities are the most important infrastructures in Taiwan. The investments of the farming irrigation and drainage infrastructures have established a solid foundation for rapid growth of agricultural production as well as industrial and commercial activities.

Floodgate is one of those control facilities, relies on the maintenance and management in peacetime. It plays not only an important role in flood control but also related to people's life and property in flood. Therefore, how to maintain and manage the floodgate is an imperative subject for us to study. The maintenance and management of the floodgate that built by Taiwan's central government to avoid river flood and sea surge, has been entrusted to the private companies gradually from 2000.

Due to the change of global and local business environments, the farming irrigation and drainage business is facing the challenge of transformation. Owing to its well been established organizational structure, the Farming Irrigation Association (FIA) is still one of the best choices to be entrusted to maintain and manage the floodgate. Since the essence of maintenance and management of floodgate is crisis management of flood prevention, it is suitable for crisis management mechanism of disaster prevention.

This paper is a pioneering study to integrate "urban environmental planning" and "information management of disaster prevention" systematically and inter-disciplinarily. Accordingly, this paper initially presents a proactive management concept of flood prevention afterward.

Keywords: the Farming Irrigation Association (FIA), the Maintenance and management of floodgate, Crisis management, Flood warning system, Geography Information System (GIS), Proactive management of flood prevention

1. BACKGROUND

Farming irrigation and drainage business is heavily related to people's livelihood. For a long time, the Farming Irrigation Association (FIA) has been developed to a huge organization in Taiwan with very successful techniques in farming irrigation and water allocation.

The history of farming irrigation in Taiwan has been over four hundred years. After Taiwan's retrocession, the Government of the Republic of China moving to Taiwan, for food supply and the stabilization of economy, the farming irrigation and drainage business had been constructed more positively. The investments of the irrigation and drainage infrastructures

have established a solid foundation for rapid growth of agricultural production as well as industrial and commercial activities. Undoubtedly, the irrigation and drainage business relates with civil life and national growth closely, and has made major contributions to Taiwan's economic development.

Due to the rapid changes in social structure and the coming of technology era, agricultural outputs have been on the decrease. However, the financial situation of government is getting worse in recent years, it seems hopeless to have more share putting in flood control. Under the limited subsidies from government, the FIA is now facing dramatic changes in agricultural economic structure.

2. OPERATION ENVIRONMENT OF THE FIA HAS BEEN CHANGED

The history for farming irrigation development in Taiwan has exceeded 300 years as of the present days. Developing activities under foreign administration existed prior to the Ming and Ching Dynasties. More organizations and systems were established during the period of Japanese colonial era. During the period of 60 years since World War II, the FIA has experienced many reorganizations and transformations.

But owing to the rapid changes in social structure and the coming of technology era, the operation environment of the FIA has been totally changed. Especially the coming affiliation of Taiwan into the World Trade Organization (WTO) has been crucially impacted the agricultural sector and the farming irrigation business as well. Therefore, the FIA System (including 17 local irrigation associations presently in Taiwan) has been forced to adjust its strategic thinking of operation and method of management to fit the new running environment. Such as the improvement of irrigation and drainage facilities for more food production, efficiency of water use should be improved to save water that may be transferred to other sectors for financial compensation; and, the FIA System should also play a role in regional flood management, protection for environment and national land resources for getting more social support, etc..

Furthermore, in order to deal with the highly changeable agriculture structure, the FIA should broaden its financial resources and decrease its expenditure. And, most of all, while the FIA faces the trend of internationalization and liberalization, the diversification of running business has become the main path toward surviving and developing, and even uplifting the FIA's competitiveness.

3. MAINTENANCE AND MANAGEMENT OF THE FLOODGATE IS AN CRUCIAL ISSUE OF FLOOD PREVENTION AND MANAGEMENT

Because of the geographic location of Taiwan is on subtropical monsoon zone, typhoons and storms occur frequently during summer and fall. They always cause severe flooding, landslide, and debris-flow in the midstream and downstream of rivers. This makes the flood damage increasing exponentially in recent years. As a result, the investment for flood control needs to be raised.

Besides, most of Taiwan's basins have been over-developed which makes flood danger of urban areas in the downstream of river increasingly. All of these have threatened people's life, properties and important public facilities seriously. In recent years, the Xangsane (象神)

typhoon and the Nari (納莉) typhoon, for example, have caused huge damages of citizen's life and properties in Taipei metropolis region. It thus needs to set up sorts of flood control facilities.

Floodgate is one of those control facilities, relies on the maintenance and management in peacetime. It plays not only an important role in flood control but also related to people's life and property in flood. Therefore, how to maintain and manage the floodgate is an imperative topic for us to study. The maintenance and management of the floodgate that built by Taiwan's central government to avoid river flood and sea surge, has been entrusted to the private companies gradually from 2000.

Due to the change of local and global business environments, the farming irrigation and drainage business is facing the challenge of transformation. Owing to its well been established organizational structure, the FIA is still one of the best choices to be entrusted to maintain and manage the floodgate.

Over the past years, whenever there were heavy typhoons and storms, flood disaster always caused vast of damages in Taiwan. Such losses are mostly owing to the lacking of the information about potential hazard and the real-time warning system for the low-lying areas. So how to do our best to prevent the damage occurred by typhoons and storms was one the most important job up to now.

Since the essence of maintenance and management of floodgate is crisis management of flood prevention, it is suitable for crisis management mechanism of disaster prevention. To analyze the essence of disaster can be managed from two sides. One is how to understand disaster phenomena that is the characteristic of disaster. The other is how to respond to disaster that is the issue of disaster management.

4. INTEGRATION OF THE FLOOD WARNING SYSTEM AND GEOGRAPHY INFORMATAION SYSTEM IS CORE AND ESSENTIAL TO FLOOD PREVENTION AND MANAGEMENT

First of all, when a typhoon attacks, floodgates must be closed in time to secure the lives and properties inside the levees. Generally speaking, the local governments rely on information provided by the Central Weather Bureau (CWB) to determine the right timing for closing floodgates. Then they will inform the local FIA to close floodgates.

Typhoons and storms have the ability to instantly damage or destroy the lives and properties and then disappear immediately. Due to the time pressure caused by the characteristic of "instant or abrupt risk" and "hit and run", a "flood warning system" must be developed to make the best of time and respond to quick attack by a flood. As a matter of fact, a "flood warning system" is core and essential to the modern hydraulic works. Hydrologic / flood routing were usually used to calculate and predict the water level in stream. Establishing the flood forecasting and early warning system pay much attention by now to prevent and minimize the damage caused by flood. In other words, a flood disaster is hard to prevent but beforehand preparation can reduce its effect. And it is worth further studying how to utilize the device effectively so as to establish the flood precaution function.

The warning river stage along the river plays an important role in the operation before floodwater overtops levees or flooding walls. However, the FIA is still using traditional

management information systems (MIS) to maintain and manage the floodgate without considering spatial information of natural environment and human activities, nor interrelationships among floodgates, rivers and other waterway networks. It can't fit nowadays and thus causes a new idea that covering a wider range called "flood decision support system" been derived from the traditional way of MIS.

The flood decision support system must forecast the locations of flood area, flood depth, flood duration, and calculate flood damages in the floodplain whenever heavy rainfall happens and provide sufficient time for decision making to mitigate the flood damages. Hydraulic parameters such as side flow, water level, discharge, average velocity and cross section of specific stream, manning coefficient, eddy viscosity coefficient have being used as the input to solve this water level forecasting problem.

Moreover, sorts of hydrologic and physiographic data are essential and of great importance to the authoritative agencies of watershed management. Collection, maintenance, and management of such huge data sets is no easy task, not to mention integrating these data in an effective way for the purpose of hydrologic simulation and design. Consequently, it must combine the forecasting and precaution related models and geography information system (GIS) to provide sufficient time for flood warning and decision-making. With rapid advances in GIS technologies, the spatial data and instant flood warning message can be integrated into a flood information system to estimate the risk degree and simulate the scenario of flood. However, the advance of hydrology and related technology can provide more spatially detailed flood information acquired now.

5.PROACTIVE MANAGEMENT CONCEPT OF FLOOD PREVENTION AND ITS APPLICATION

Owing to the fact that disaster damage is often as a result of human error or carelessness, and can be better controlled or even avoided by recognizing the potential for danger and taking preventative and even "proactive" action. Accordingly, we can expect sorts of effective actions accompanied by disaster management and emergency services to mitigate or minimize catastrophic effects.

Here "proactive" means "acting in advance to deal with an expected difficulty". For an individual, "being proactive" means consciously bringing about positive habit of knowing where one is going in life, having a strong sense of what is important in the long run, and using one's everyday actions to bring this about. As for disaster management, like flood management, "proactive" means to take an approach instead of a reactive approach. Accordingly, this paper initiates a "proactive management" concept of flood prevention.

By reviewing the conceptual framework of "Disaster Management Cycle", "proactive management" proposes the followings:

1. The first rule of "proactive management" is that "source management is better than distal management"
2. A "Disaster Management Cycle" includes four stages: mitigation, preparedness, response and recovery at least.
3. Based on the "precautionary principle", "Mitigation and preparedness are more important than response" is strongly urged.
4. Strategic thinking of "proactive management" emphasizes conscious planning.

5. A thorough strategic planning must be started and developed long before a contingency crisis or emergency, then, execute to achieve the goals, rather than simply to respond to inquiries. In practice, it will just prolong the reaction time before the discovery of a new threat.
6. During normal operations, "proactive management" may seem like a waste of money. One can't really see the value of it as long as everything runs smoothly, but when there are crises or emergencies, it's invaluable.

Then, this paper would like to discuss flood prevention by means of the "proactive management" concept.

First of all, we usually taken engineering methods to deal with flood prevention. But since the function of hydraulic structure has its limit, it must cooperate with non-structure method to disperse the risks and mitigate flood damages. Flood disaster insurance is a good way among these non-structure methods. Some developed countries such as U.S, France, and Japan, have successfully experienced securing the property for the public from catastrophe or disaster by insurance arrangement, together with loss prevention and risk financing. A well-organized insurance program includes a number of natural perils (earthquake, typhoon, flood, ...etc.) coverage within a single policy and system. This paper thus suggested traditional risk financing and insurance arrangement should be combined to develop a comprehensive risk management, and flood disaster insurance program at least, for the loss of natural disasters in Taiwan.

Secondly, although the "National Comprehensive Development Plan" or "National Development Scheme" has set-up "flooding areas" according to "flooding lines" which is measured by hundred years. However, being impacted by earthquakes, the variation of climate, and attacked by typhoons, such as Herb(賀伯), Xangsane(象神), Toraji(桃芝), and Nari(納莉), coming along with flood, the environment has been changed. Now the flood in the river is over the "hundred years flooding lines". Besides, it has also exceeded the range of flood areas set by the "National Comprehensive Development Plan". Those legally built-up residential communities outside the flood areas are now located within lands facing natural disasters.

Moreover, the most important one is our traditional engineering methods to deal with flood prevention also show the deficiency of hazard mitigation in our spatial planning system (including regional planning and urban planning) do not take the flood prevention or waterway resources into consideration. It is a pity. More investigations and planning for waterway resources should be made for the needs in the future. Especially those lowlands within urban areas are usually densely populated regions and centers of industries. So, the land-use pattern is also greatly changed by the inhabitants. For the needs in the future, urban environmental planning should be integrated with measurements of flood prevention. There are several important environmental conditions should be analyzed when developing those lowlands within urban areas, such as the needs of inhabitants, the hydrology, the land-use pattern, the types of the industry, and the related public policy.

Finally to prospect, an integrated emergency/disaster management system must combine with sustainable development to build our safe environment. Also, it is necessary to establish an emergency standard procedure to prevent the flooding and regulate all different government agencies to handle the crisis in Taiwan.

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