Frequency Analysis across the Drowning Prevention of Water Sportsindangerouswaterarea of Taiwan

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ABSTRACT
Located in a subtropical region and surrounded by seas, distributed with rivers and streams in its inland, Taiwan is an ideal island for people to engage in water recreation activities. Thus, seaside and mountain streams in Taiwan have become inexpensive leisure destinations which are often crowed with people each season. However, such beautiful attractions also hide a lurking crisis, especially for people who tend to ignore their own safety. This study was to explore how the Fire Department can effectively reduce drowning accidents and the number of people drowning. This research firstly conducted expert interviews and open questionnaires in order to understand experts comments on the practices New Taipei City Fire Department adopted in the prevention and relief of drowning in dangerous water areas. Next, this study exercised the Delphi method to extract and construct the level facets of drowning prevention and relief work performance of New Taipei City's Fire Department in dangerous waters, then constructed key factor levels of dangerous water drowning prevention and relief work performance through the Analytic Hierarchy Process to analyze and evaluate the relative importance of each guideline. Finally, this study found out the implementation priority of key projects on drowning prevention and relief work in order to identify the key causes affecting the performance of prevention and relief tasks of drowning in dangerous waters.

Keywords: Water Recreation Activities, Drowning Prevention, the Delphi Method, the Analytic Hierarchy Process, Dangerous Waters

I. INTRODUCTION
Located in a subtropical region and surrounded by seas, distributed with rivers and streams in its inland, Taiwan is an ideal island for people to engage in water recreation activities. Thus, seaside and mountain streams in Taiwan have become inexpensive leisure destinations which are often crowded with people each season. However, such beautiful attractions also hide a lurking crisis, especially for people who tend to ignore their own safety. According to the data of Taiwan's accidental injury deaths publicized by the Ministry of Health and Welfare of the Executive Yuan, there were 600 drowning incidents in 2015, and an average of 438 drowning incidents occurring from 2007 to 2016, which indicates that the drowning rate per 100,000 Taiwanese is 1.9. Moreover, according to the school safety statistics by the Ministry of Education, there were a total of 245 students who died by drowning during the period of 2008 to 2015, an average of 49 student drowning deaths per year, and 0.96 drowning mortality rate per 100,000 students. For example, an instant stream surge caused by heavy rain in Pinglin upstream on June 5, 2016 (2016) took five lives among a group of people. When drowning accidents occur in water areas, people will call 119 for help immediately. However, the fire mission mandated by all levels of current government and the level of the Act are unable to effectively prevent people from drowning (Ma, Xu, & Xu, 2010). In addition, due to existing dedicated authority for water safety management in Taiwan, this study hereby described the relevant central and local jurisdictions as follows: 1. Authorities of central jurisdiction: Water Resources Agency, Ministry of Economic Affairs governing the water safety advocacy for the jurisdiction of rivers/water; Council of Agriculture taking charge of the safety promotion of agricultural irrigation in ditches, rivers and canals; National Fire Agency of MOI promoting fire authorities to strengthen their water rescue plan; Tourism Bureau of MOTC handling water safety and rescue drills, advocacy as well as the formulation of Water Recreation Act; Sports Team of Sport Administration, MOE dealing with the prevention of students drowning cases; the National Physical Exercise Team of Sport Administration, MOE establishing a lifeguard system and promoting a project of “Swimming up” and so on. 2. Authorities of local jurisdictions: Tourism Bureau handling for water recreation activity management as well as the

formulation and promulgation of Acts; WCB leading river regulation within its jurisdiction and those commissioned by the Central Departments; Agriculture Bureau dealing with the protection and maintenance of river ecology for fishes; Fire Department taking in charge for water rescue, ambulance and drowning prevention advocacy; The Department of Education promoting school-water activity experience and water safety planning.

Now taking new Taipei City as an example to illustrate this situation, the water ofthis city is vast and the beautiful sceneries of them have become recreational activity places to many people for water playing, swimming and diving. However, the 120 kilometers of coastlines not only have different patterns of rivers and streams with extremely complex water conditions, but are without needed control as well. Among them, several big rivers and major streams, such as Tamsui River, Keelung River and Xindian Creek, DaHan River, BanshiRiver, Peishih Creek, DabaoCreek, Tonho Creek and others of small water territory like Shenkeng Creek, Shung-Xi River, Ne-Liao River etc., are full of potential risk where people tend to neglecttheir own safety, ignore warning signs and lack the sense of risk which is prone to occur drowning accidents when enjoying their recreational activities in those water areas. Since 2008 each Fire Department of Taiwan cities and counties has list “anti-drowning” as one of the six objectives in theirtasks. The cases of drowningwithin New Taipei City’s jurisdiction in 2007 were 28 people; however, under the full support of previous and present Majors along with the efforts of the fire rescue team and the volunteers of civil society, the death rate of drawing in 2012 has dropped to 15 people with a reduction of 46.43 percent, in which the Dabao Creek where people most frequently visited has achieved the best results of “zero” drawing in 2009, 2011 and 2102, respectively. The reduction of drowning accidents in that location is attributed to the performance of water safety joint inspection teams consisting of Fire Department, police and tourism units.

The main purpose of this study was to explore how the Fire Department can effectively reduce drowning accidents and the number of people drowning. This research firstly conducted expert interviews and open questionnaires in order to understand expert comments on the practices New Taipei City Fire Department adopted in the prevention and relief of drowning in dangerous water areas. Next, this study exercised the Delphi method to extract and construct the level facets of drowning prevention and relief work performance of New Taipei City’s Fire Department in dangerous waters, then constructed key factor levels of dangerous water drowning prevention and relief work performance through the Analytic Hierarchy Process to analyze and evaluate the relative importance of each guideline. Finally, this study found out the implementation priority of key projects on drowning prevention and relief work in order to identify the key causes affecting the performance of prevention and relief tasks of drowning in dangerous waters.

1.1. Research Scope

According to drowning accident statistics of the National Fire Agency, MOI which showed that rivers and seashores were ranked as the first and second most prominent locations of such accidents, and in accordance with the student drowning deaths statistics publicized by the Ministry of Education during 2008 to 2016, the number of drowning deaths of students occurring in creeks and rivers reached a high of 93. Thus, from above data it can be learned that creeks were the main water terrain types in which drowning accidents occurred. Therefore, this study set the "creeks" of natural water in New Taipei City as its research subject. The statistics of drowning locations (regions) and causes in New Taipei City between 2008 to 2016 (Fire Bureau of New Taipei City, 2016) showed that, among the creeks in its dangerous water, the most drowning accidents occurred in Dabao Creek of Sanxia District, which is listed as one of the city’s most dangerous waters and has become the focus of media coverage.

Despite the full-length of Dabao Creek being only 22.5 km, it is still often flocked to by people for water playing on weekends and holidays. The statistics of Sanxia Precinct, New Taipei City Police Department showed that in the pick period during the summer holiday, there were 10 thousand vehicles entering per hour at this Creek with thousands of people participating in water activities. Although the density of local lifeguards is the highest in the world, the drowning accidents of people playing in this water still frequently occur (Lei Qi-wen, LinXiu-long, 2003) 4. The statistics of New Taipei City Police Department indicated that the number of people rescued from Dabao Creek was about 100 and there were 3 to 5 drowning deaths every recent year, which makes this Creek the stream with the most drowning accidents in a single day and a single location within the jurisdiction of New Taipei City. An article entitled "27 drowning incidents in a single day at Dabao Creek of Sanxia District" reported by Huang Zong-yi and Lin Jun-honganudn.com (2006) significantly shows the dark side of this Creek, as shown in table 1-1. Based on the above factors, the Dabao Creek was listed as the main subject of this research.
<table>
<thead>
<tr>
<th>Dangerous water in Dabao Creek</th>
<th>Reason of dangerous water</th>
<th>Causes of drowning incidents</th>
<th>Statistics of annual drowning cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water around Tian-Fo Temples</td>
<td>At depth of about 4-5 meters with undercurrents and water level drop</td>
<td>Caused by water depth and diving</td>
<td>1 people drowned in each year of 2000, 2005 and 2010</td>
</tr>
<tr>
<td>Water in Shishin Bridge</td>
<td>Depth of about 2-3 meters and next to a hinterland</td>
<td>Incautious water playing</td>
<td>1 people drowned in each year of 2001, 2002 and 2007</td>
</tr>
<tr>
<td>Water in Cho-Ho Bridge</td>
<td>Water depth of 3-4 meters with fast-flowing</td>
<td>Incautious water playing and adults negligence in children care</td>
<td>A total of 3 persons drowned in 2004 and 2008</td>
</tr>
<tr>
<td>Water in Kim Min Bridge</td>
<td>Depth of about 4 meters with fast-flowing</td>
<td>Hitting stones when diving or being hooked by fishing nets</td>
<td>One person drowned in each year of 2002, 2008 and 2010</td>
</tr>
<tr>
<td>Water in Kinglong Bridge</td>
<td>Depth of about 2-3 meters with fast-flowing</td>
<td>Incautious water playing</td>
<td>2 persons drowned in 2003</td>
</tr>
<tr>
<td>Water in Tongyuan Bridge</td>
<td>Deeper water with many whirlpools and undercurrent along with large temperature difference</td>
<td>Hitting stones when diving and not familiar with the water nature</td>
<td>A total of 4 persons drowned in 2000, 2001 and 2008</td>
</tr>
<tr>
<td>Water in Tongyoung Bridge</td>
<td>Water depth of about 1-2 meters with undercurrent</td>
<td>Not familiar with the water nature</td>
<td>1 persons drowned in 2000</td>
</tr>
<tr>
<td>Water in Tonglu Bridge</td>
<td>Fast-flowing, many swirls and undercurrents with large temperature difference</td>
<td>Not familiar with the water nature</td>
<td>1 persons drowned in 2001</td>
</tr>
<tr>
<td>Water in Chinsun Valley</td>
<td>Depth of 3-4 meters with fast-flowing</td>
<td>Not familiar with the water nature</td>
<td>1 persons drowned in 2002</td>
</tr>
<tr>
<td>Water in Yun-Yuan Valley</td>
<td>Depth of 1-2 meters and many whirlpools and undercurrents along with large temperature difference</td>
<td>Hitting stones when diving and not familiar with the water nature</td>
<td>A total of 4 persons drowned in 2001, 2002 and 2010</td>
</tr>
<tr>
<td>Water in Ba-shin Bridge</td>
<td>Fast-flowing with ease water under the bridge</td>
<td>Not familiar with the water nature</td>
<td>1 persons drowned in 2002</td>
</tr>
<tr>
<td>Water in Chinshiu Bridge</td>
<td>Fast-flowing</td>
<td>Falling into the water</td>
<td>1 persons drowned in 2004</td>
</tr>
<tr>
<td>Water in Bee World</td>
<td>Having a protective infrastructure with water depth of 1-2 meters and whirlpool, undercurrent in downstream</td>
<td>Not familiar with the water nature</td>
<td>A total of 5 persons drowned in 2001, 2004, 32005 and 2008</td>
</tr>
<tr>
<td>Water in Xiongkong</td>
<td>Slow water flow at the water depth of 1-2 meters</td>
<td>Not familiar with the water nature</td>
<td>1 persons drowned in 2004</td>
</tr>
<tr>
<td>Water in Legend of the Mountain</td>
<td>Fast-flowing with large temperature difference</td>
<td>Depth drowned</td>
<td>1 persons drowned in 2001</td>
</tr>
</tbody>
</table>

Source: New Taipei City Fire Department and the Author’s compiled data

1.2. Study limitations

Taking into account of the different properties, terrains, locations and characteristics of water in each county and city, this study had the following limitations:

a. Only focusing on the Dabao Creek area in Sanxia District of New Taipei City as the study subject.
b. Only targeting on the responsibility division of jurisdiction governed by each Department of New Taipei City.
c. The design range of this study’s questionnaire
was drawn on the issue of drowning Prevention and Relief Work of Dabao Creek area in Sanxia District of New Taipei City

II. LITERATURE REVIEW

2.1 The analysis of drowning theory

2.1.1. Definition of drowning accident

Accidental injury defined by the US National Security Council is as follows: "Accidental injury refers to the occurrence of a series of events which generally results in injury, death or property damage". Therefore, accident injuries include many types with a wide range and generally be divided into the following three categories. The first category is natural disasters: such as typhoons, floods, earthquakes, thunder lightning, tsunamis and accidental injuries due to other natural phenomena; the second category is man-made disasters: such as car accidents, falls, drowning, fires which are occurred intentionally or inadvertently; the third category is disasters caused by physical environments: such as injuries caused by building collapse, fire wire and sports equipment damaged. According to the above definition, drowning belongs to the second category.

The occurrence of drowning accidents mostly belongs to man-made disasters, which means accidents that are caused by human factors. Whereas from the medical point of view, the results of drowning should be reclassified as: mortality, morbidity, and non-disease. According to the explanation from the American Heart Association (2005), the drowning process begins with the drowning persons’ respiratory track being submerged in liquid, followed by the victims spontaneously holding their breathing which will then incur involuntary larynospasm due to the liquid present in the respiratory oropharynx and throat. In the meantime, as the submerged victims soften to breathe air, it results in their own oxygen depletion along with the incapability to expel the carbon dioxide as well. At this time, the breath speed of submerged persons will become very fast, yet no air is exchanged due to victims’ throats being obstructed or damaged. However, when the oxygen level in arteries have dropped, the victims’ throat spasms and obstruction will be relieved which causes them rapidly to breathe liquid, where the swallowed amount of liquid will vary with the drowning condition. Under such conditions, if the lungs of victims fail to ventilate immediately or are unable to start spontaneously breathing, air generally will lack of effective recovery act, many organs of the submerged persons will lose function which tends to lead to their death, and it is classified as a submersion or drowning phenomenon (Chen Yingxin, 2004).

Scholars and experts attending the seminar held by World Health Organization (WHO) seminar in 2002 all agreed to adopt the new definition for submersion accidents, that is: submersion is a process in which the respiratory system suffers damage when a body is immersed in or into the liquid (Dorp, Knape& Bieren, 2002). The drowning situation of submersion accidents referred to in this study can be defined as people’s deaths caused by drowning which leads their respiratory dysfunction. Drowning is one of the leading causes of death in the world

Zhong Yu Ting (2004) indicated that: "a body submerging in the water and surviving more than 24 hours or experiencing distress symptoms associated with swimming and being alive after on-site first aid and care taken by hospital is called submersion, while drowning is defined as a body submerged in water and being pronounced dead within 24 hours after on-site first aid and hospital treatment".

From a medical point of view, the process of submersion is that of a person who loses action ability due to various reasons (such as ingesting water, fatigue, hypothermia, injury, failure to fight the water current, hindered by debris in the water, or disorientation etc.), so that generates a panic state, ineffective breathing, buoyancy reduction, exhaustion and submersion, which ultimately leads to drowning. In summary, the main cause of drowning is due to ingesting water into the lungs after submersion (or because of throat muscle spasms that result in airway closure) which causes suffocation and further leads brain hypoxia, then followed by loss of consciousness and cardiac arrest, and finally death.

2.2. Factors of drowning accidents

Domestic studies on the factors of drowning in the past were rare. Despite such important factors able to be explored through the experiences of people who have been submerged, the investigation is still difficult to carry out due to either the person actually drowning or being reluctant to talk. Therefore, the researcher tried to explore the risk factors related to drowning by interviewing lifeguards with rescue experiences in submersion in dangerous water within the setting of a life-saving station. Apart from analytic experiences from lifeguards concerned, there was also a lot of press coverage related to the causes that lead to people drowning, such as the analysis reported by Li Ying Feng (2003) after interviewing the then leader of the San-Yin rescue team of Red Cross. The reasons for Dabao Creek’s dangerous water that so easily causes submersion are due to a great bed gap, slippery stones, a lot of undercurrent, large temperature difference and, more importantly, that people tend to jump into the water without warming-up first or not wear swimming clothes. Some even wear jeans into the water which heavily increases weight that hinders the action of legs. In
addition, careless diving behavior is also prone to occurring accidents. According to statistics, about 90% of drowned people were wearing trousers.

Another newspaper report on the causes analysis of annual drowning incidents indicated that water playing after drinking tends to cause stomach cramps which is prone to cause unfortunate drowning (Chen, 2006) 12. Previous studies showed that there is a difference among the occurrence of drowning incidents in terms of individual basic characteristics, that is, the drowning incidence of men is higher than that of women, at a ratio of about 14:1 (Pedden & Mcgee, 2003) 13. Furthermore, there is also a difference of drowning opportunity between male and female at different age groups and such difference will significantly increase with age accordingly, particularly for those older than 10 years. This variation might be closely related to the different types and frequency of water activities which males and females would engage in (Dietz & Baker, 1974) 15. According to statistics, male are more likely to be drowned than women (Pedden & Mcgee, 2003) 16 due to male tend to be exposed in deeper water environment (occupational or recreational purposes) along with higher alcohol consumption and prone to engage in more risky activities (Howland, 1996) 17. As for other factors such as location, time, season, area also have a certain extent of effect on the occurrence of drowning incidents (O’Carroll, 1988) 18.

Many important factors lead to drowning accidents. Chang (2005) 19 suggests several main reasons as follows: no attention to the safety of children, insufficient knowledge of water waves, not paying attention to slippery areas, ignorant bravery and aggression of adolescents, superstition and malignant panic. The risk factors in question could also be investigated from following aspects, such as demographics; changes of time and place; location and environmental; drug or alcohol; lack of adult supervision; swimming ability (Wells&Macdowall, 2000) 20. In exploring the risk factors of drowning occurred in creeks of New Taipei City, Wang (2004) 21 indicated that factors such as unable to swim, unfamiliar with the characteristics of the water, nervous swimming, diving behavior, swim in the vicinity of whirlpool undercurrent, odd body language and behavior, and unfamiliar with the snorkeling equipment, etc. are likely to cause drowning accident.

The investigation on reasons causing adolescent drowning accidents and injuries by Wang (2000) 22 showed that it could be understood from several factors of individuals, water, environments and other aspects. Rebecca & Harvey (2001) 23 pointed out that the factors contributing to drowning accidents can be divided into three main factors. Firstly, social and situational factors: such as alcohol, social groups and peer influence; secondly, the environment or exposure factors: such as the water playing time and climatic conditions; thirdly, personal factors: personality, health condition, swimming skills, experience, water safety awareness, hazard detection and evaluation, etc. The study hereby listed aforesaid factors causing submersion as follows:

2.2.1 Individual behavioral factor

Factors like risk behavior (such as diving), body’s alcohol content, diseases, negligence, ignorant brave, mischief, warm-up, physical and watercraft condition, fell, head bump, winding materials in water etc., are significantly related to submersion accident (Wang, 2001) 24. Beeck et al, 2005 25. Drinking is a particularly and unpredictably risk factor to submersion. In the United States, there are about 25% to 50% of drunken adolescents and adults drowned. Alcohol is a risk factor to dabblers due to it can affect people’s balance, coordination and judgment and, furthermore, its effect tends to be easily enhanced after being exposed to sun and heat (Howland et al., 1996) 26. Many submersion persons were found with high concentration of alcohol which usually affects people’s judgment, results in hypothermia and hypoglycemia that are likely to lead to the drowning accident.

Submerging people are likely occur other external traumas, such as head injury, loss of consciousness, or limb paralysis caused by cervical spine fracture due to diving submersion. In addition, people with some chronic disease might generate sudden deterioration of their disease when swimming, such as heart attack, stroke, confusion due to hypoglycemia, muscle spasm, epilepsy ... etc. resulting in temporary disability, or normal people’s physical discomfort (such as cold ...) weakness of physical strength, loss of temperature and other conditions which lead to drowned events (William, 1997) 27. Only a few drawing cases were caused by accidental fell into the water, unfamiliar with the water nature or natural disasters such as flash floods. After review up drowning incidents among the general population, it can be learned that such accident can be prevented as long as there is fully preparation in advance.

2.2.2. Risk factors of water

Although the Dabao Creek of New Taipei City is not deep, it hides an undercurrent below the calm water surface, and a lot of swirls in its water areas along with sharp stones, large bed gap and temperature difference as well as slippery stones under water. People who lose their vigilance while swimming in dangerous water tend to give away their lives carelessly. Lin (2006) 28 reported "At around 4 o’clock in the afternoon, a 15-year-old young people accidentally fell into water from the waterfall near
Yuanyang Valley who was almost washed away by the rushing water, but fortunately rescued by rescue personnel.... “Regretfully, there are still a lot of drowning cases occurred in dangerous water of Dabao Creek according to the analytic report of Li (2002). The spectacular and clear stream of Dabao Creek looks like a graceful and quiet river with natural and original characteristics is actually full of risks that lead people to neglect the hazardous properties of natural water which sometimes renders this Creek a “death valley” which devours many precious lives every year. All in all, thunderstorms, coastal currents swirl, rising tide, big waves and undercurrents in the depth of water, swirl, large river bed gap, hidden stone slide are all fetal factors causing drowning as shown in Figure 2-1, to which people must pay attention when dabbling.

Figure 2-1 Diagram of drowning reasons caused by water environment

2.2.3 Factors of environmental safety

Signs, lifeguards, sound equipment and areas open or not are important safety factors of water scene environment (Wang, 2000). Orlowski & Szpilman (2001) pointed out that signs must be carefully planned and considered, in particular whether there is a standardization for such signs. Warning words, symbols and colors must be applied and shall rely on experts to assist in the analysis of existing signs, to provide recommendations for furnish and content as well as to increase dabbler’s attention. Besides, the arrangement of appropriate, qualified, trained and equipped lifeguard in water scene is an effective measure to prevent drowning.

Lei and Lin (2003) also pointed out that the supervision and inspection for security management in stream and creek areas also need to be strengthened, as well as to increase the quantity of safety barriers and improve the colors and locations of warnings signs. Another important safety factor in dangerous water is the setting of life-saving piles accompanied with rescue pole, lifebuoy and rope which enable lifeguards to rescue people immediately. However, in addition to potential dangers of natural water, there are more dangers caused by dabbler’s wrong judgments; or the natural and original risks of water which is not suitable for water activities and must be prevented through control measures. Thus, people engaging in water activities shall be able to reduce damages caused by submersion through appropriate evaluation and prediction in advance as well as evaluate each risk so that to establish a measure to deal with damage occurrence. Since the maintenance of dabbler’s safety is the critical factor in control measures and safety management for water recreational activities, it should be classified as the main topic to be investigated.

Following is the diagram (referred fishbone diagram Figure 2-2) showing the characteristics of each factor that could result in submersion accidents.
2.2.4. The control measures for water recreation

The research of National Penghu University of Science and Technology (2005) pointed out, except permitting the water recreation activities, the government agencies shall, for the purposes of maintaining safety, ecology or other public interests, provide methods to control activities, that is, prohibiting certain kind or level activity in certain specific area, such as prohibiting swimming or other water recreation activities in a specific stream or creek. Water management authorities shall use dichotomy in zoning declaration so as to enable the public to learn that some activities in certain area is prohibited or even illegal; another way is to declare that only special activities are allowed or legal in designated areas. Except the way of declaration, it also needs a sound system, dedicated enforcement authorities, through detailed planning in order to achieve a significant effect of such management tasks.

In fact, as there are not many water recreation areas with high risk which must be prohibited in Taiwan, therefore, the management authority usually requires to use a variety of restriction means to make water recreation activities at an acceptable level in order to reduce possible conflict among all sorts of recreations or the impact on the environment. Restriction methods adopted by water recreation management include controlling the time or space, the equipment, the number of participants or the skill of performers. The use of those approaches can be mixed and take into account of the compatibility of each activity in order to achieve the best results. Control measures about water recreation activities can be divided as follows:

- **Space control** refers to the management and control of the designated water region, in which different area divisions can be created and assigned for respective usage as well as specify the allowed, prohibited or restricted activities in each area, in case the region is much more complex. For example, activity like swimming and dabbling can be planned in a safety region, while water with higher risk could restrict people to enter in order to avoid dangerous accident.

- **Time Control**

  The management is not fixed; instead, it can also be managed through Time. The shortest control cycle can be set to a certain time of a day, such as beach can be full-day open and closed at night in summer. In addition, as water recreation activities are deeply influenced by the weather, poor weather conditions should be timely warned and, when relevant authorities receiving worsen weather information, the water activities shall be prohibited. With respect to issue of biological conservation, since some creeks in a fixed period might be particularly suitable for specific fish’s reproduction, thus, water recreation activities shall restrict to be conducted. Another condition is that whenever there is any man-made or natural disaster occurred in water activities, it must be notified and controlled, because heavy rain due to unstable weather in the mountain tend to cause creek water level to elevate rapid that often cause people trapped events. In the case of environmental pollution, oil

- **Total quantity control**

  Total quantity refers the limitation of the total number of people in an area so as to not to exceed the carrying capacity of the local environment. The competent authority may limit the maximum daily number of people in recreational water in order to protect the environment, or restrict the numbers of people simultaneously engaging in regional activities.
in order to achieve total quantity control.

Zhang (1994) 35 pointed out that the principles of security maintenance planning for water recreation activities as follows: 1. open and closed time of water activity site; 2. the safety maintenance equipment and facilities of water activity site; 3. the capacity of the water site; 4. the numbers of safeguards in the site of water activity; 5. the risk and safety evaluation for the environment of water activity site; 6. the weather and water condition of water activity site. The water safety maintenance of sites can be planned and established by government agencies or by passive factors. The focus of such work shall consider the necessity for the implementation of security maintenance which is up to whether there is water activity or not.

2.2.5. Water recreation safety management

People who intend to engage in outdoor natural water recreation, such as dabbling, swimming or diving in stream, river or sea, shall be well prepared in advance at the premise of acknowledging that there is no way to change the environment. Since water activities have a certain degree of risk, it is very important of having sufficient safety knowledge in advance. The definition of Dougherty (1998) on “outdoor water recreation safety” could be interpreted as: the use of learned knowledge to minimize the risk, yet still can get a sense of pleasure, satisfaction, physical and mental self practice at the time of participating in outdoor water recreation activities.

Therefore, there are four basic elements of self-management prior to engaging in water recreational activities: 1. Plan: preconceiving the content of outdoor water activities to be engaging, potential dangers, best measures to manage those dangerous activities and any available safety facility or warning sign? 2. Training: being well prepared in advance to enable one’s own physical condition to be in the best condition to meet the demands required by the environment of recreation activity participation. Prevent from engaging in any such activities in poor physical condition in order to avoid any accident; 3. Exercise: strengthening own skills in order to engage in activities successfully. Training shall focus on imparting knowledge, developing skills so as to achieve a particular task; 4. Alternatives: assuming some possible hypothetical situations that may occur and using past experience to prepare alternatives in advance.

Five tasks for recreational safety management are as follows (Leiqi Wen, Linxu Long, 2003) 37. 1. Good equipment: conducting selection, fitting, maintenance and practice relevant equipment according to previously accumulate outdoor recreation experiences. 2. Good teaching: carefully listening recommendations and guidance advised by expert before, during and after carrying out activities; 3. Sound place: choose an outdoor environment you understand and are able to grasp the situation to engage in activities; 4. Good health care: select a site with resources and functions of first aid, emergency evacuation and medical care in case any injury or disease occurs; 5. Good teamwork: having the same understanding and mutual trust among people who jointly involve in the activities so that to deal with potential dangers faced.

Therefore, how to handle various factors that may affect the safety in the water recreation activities in order to minimize the extent of damage is very important. Chen (1998) 38 classified the tourism management measures into: direct and indirect management measures with the results showed as follows: Themore concepts of environmental conservation and environmental knowledge of tourists, the higher extent of recognition to management measures they have.

An investigation and analysis on safety management in forest recreation area conducted by Huang (1992) 39 revealed that, in addition to install warning signs in dangerous sites, the manager shall also strengthen safety education and provide information to help visitors recognize and prevent the occurrence of dangers. In terms of tourist demand aspect, the labeling of dangerous sites, the warning of dangerous facilities along with facility maintenance and improvement shall be handled in the higher priority.

To meet people’s demand for recreation, many areas with beautiful scene have become the sites for recreation activities, or a major resource of recreational activities.

While possessing high quality of natural environment, these attractions have hidden potential risks. Taking the outdoor water recreation for example, according to a North Carolina study, the most activities associated with drowning are swimming, wading and fishing in sequence (Peterson &Hronek, 1992). The US study found that 50-75% of the drowning cases occurred in natural waters (sea, lakes, rivers, etc.), and the victims comprise of children and adults. In Australia there are 1551 cases of non-boating-related drowning incidents during 1992–1997, of which more than 2 percent drowned while being to rescued (Dietz & Baker, 1974).

Due to that most streams within Taiwanare high in mountain with strong currency with the lack of arrangement in stream bed which is pretty rugged along with the big temperature difference as well as the insufficient safeguard equipment and lifesaving stations, thus, dabblers have to take on self-responsibilities for their own safety. The “Safety of Wild Dabbling” compiled by Sports Administration of Executive Yuan (2003) 42 mentioned that nine out of tenth submersion accident
occurred in wild waters without being managed by dedicated units, in which most of them belonged to dabblers who launched into water on the spur of the moment; whereas accidents happened on those who had planned in advance were less. The scope of wild waters does not include man-made pool, particular creek beds or seawater pool being through artificially arranged, and the dabbling activity does not pure swimming activity which needs to change into a swimming suit and in the waters under the guardianship of lifeguards.

Outdoor dabbling field generally can be divided into four types of coastal, river, lakes and wild reservoir. Water currency in the previous two types are dynamic which may have sea currency, wind waves, torrent and whirlpool phenomena, while water in the later two types are still, which, however, is not safer than the previous two styles due to environmental characteristics (Gutiérrez et al, 2009; Zhao et al, 2008)44. Thus, dabblers must grasp the nature of those water fields so as to maintain activity safety and avoid the occurrence of risk. In accordance with rescue groups of lifeguard stations, streaming dabbling accidents are mostly occurred in school teenagers with characteristics of traveling together, frolicking in the side of stream, wearing long jeans instead of swimming suit and preferring to jump into water directly. Thus, safety management of water field must pay attention on those factors.

2.2.6. Discussion on regulations related to water recreations

For the purpose of safeguarding the safety of the public in water recreations, the competent authority responsible for water recreation activities conducts planning and management for such activities in accordance with the “Regulations Governing Water Recreation Activities” which can be classified into several provisions as follows:

(1) Water recreation activities: refers to the following water activities:

a. Swimming, surfing, diving.

b. The engagement in windsurfing, water skis, parasailing, jet skiing, canoeing, rafting boat, banana boat and other types of instruments.

c. Other water recreation activities publicized by the competent authority.

(2) Management authorities for water recreation activities refer to the following agencies:

a. The particular management authority for water recreation activities located in the Scenic Area and National Park under its jurisdiction.

b. The municipality or county (city) government for water recreation activities not under the jurisdiction of the preceding scope.

c. Penalty imposed by competent authorities in accordance to these regulations only applicable after being publicized.

(3) Notice the restricted activities and areas of waters recreation.

(4) Management for areas of water recreation activities.

The New Taipei City publicized fishing to be one of its water recreation items in accordance with Article 36 of the “Act for the Development of Tourism” and Article 3 of the “Regulations Governing Water Recreation Activities”, respectively, as well as the restriction of fishing range, time and behaviors under its jurisdiction (excluding Yangmingshan National Park, National Scenic areas of Northeast and Yi-Lan Coasts, and Guanyinshan National Scenic area) in accordance with Article 5 of the “Regulations Governing Water Recreation Activities” on Jun 3, 2008, respectively, which were entered into effect on August 1, 2008.

In addition, the City also promulgated an announcement for six categories of water recreation activities including windsurfing, canoeing, water skiing, water cycling, non-powered rubber boats under its jurisdiction (excluding Yangmingshan National Park, National Scenic areas of Northeast and Yi-Lan Coasts, and Guanyinshan National Scenic area) with effect from the day on April 13, 2000 immediately in accordance with Article 9 of the “Regulations Governing Water Recreation Activities”.

On October 1st, 2000, the New Taipei City in accordance with Article 36 of the “Act for the Development of Tourism” and Article 5 and 6 of the “Regulations Governing Water Recreation Activities” to amend the restrictions on range, types and time of Dabao Creek as follows:

(1) The following are recreation areas which are restricted:

   Except Tei-Fou Temple and water areas under Chou-Hou Bridge, Gim Min Bridge, Kim Long Bridge, Tong-Yuan Bridge, Tong-Lu Bridge, Chi-Sun Valley, Yuanyang Valley and Chin-Sui Bridgein Dabao Creek of Sanxia District, only activities of swimming and non-power rubber boating are allowed.

   (B) Subparagraph 5 of Paragraph 2 stipulates the stationary sites and time of rescue personnel in Dabao Creek of Sanxia District like Shinsin Bridge, Wonderland Park, Yuanyang Valley, Zanzu Valley, Pashin Bridge, Bees World, Legend in the Mountain, Chukon Dam.

   1. July to August: 9:00 to 17:00, Monday to Sunday.

   2. May, June and September: only every Saturday and Sunday, 9:00 to 17:00.

   Tei-Fou Temple, Gim Min Bridge, Kim Long Bridge, Tong-Yuan Bridge, Ting-Yein Bridge: May to September- Saturday and Sunday, 9:00 to 17:00.
Bulletin of prohibition and restriction of water recreation activities in Dabao Creek

Based on the planning and management for water recreation activities provided for in the “Act for the Development of Tourism” and “Regulations Governing Water Recreation Activities”, the Tourism Bureau of New Taipei City first amended and publicized the restricted range, categories and time of Dabao Creek on October 1, 2010, with the content as follows:

1. Restricted areas for water recreational activities.
2. Stationary locations and time of rescue personnel
3. Daibao area of Sanxia District: only swimming is allowed, subject to specific locations with rescue personnel stationed and within the range guarded by pull ropes.

To sum up, although the public have the right to dabble on seashores and in streams, the government, for the purpose of safeguarding people’s lives and in accordance with relevant laws, has prescribed regulations governing the water recreation activities for the public to follow. Factors resulting in submersion accident were counted as man-made behavior, water environment, field management and regulatory system and so on, as shown in Figure 2-3:

III. COMPARATIVE ANALYSIS OF WORLDWIDE WATER SAFETY MANAGEMENT

3.1 Analysis of current status of Japan water safety management

Despite the grim situations in terms of personnel and financial resources in both Government and local public organizations, the results of Japan's Industry–Government-Academia cooperation in water activities is very successful and continue to conduct reviews in line with organization system through such cooperation in order to efficiently and effectively implement countermeasures. Related units of the division of powers and responsibilities in waters are as follows:

1. The Consumer Affairs of Cabinet Office: governing review business for the application of nonprofit legal person related to waters rescue organizations.
2. Sports and Youth Bureau of the Ministry of Education, Culture, Sports, Science and Technology in charge of: handling review businesses relating to swimming education and competition of all schools and water rescue educational training courses.
3. Fire Department of the Ministry of Internal Affairs and Communications: handling educational trainings for water disaster rescue and relief as well as support water disaster prevention and relief operations.
4. Japan Coast Guard of Ministry of Land, Infrastructure, Transport and Tourism: handling the safety planning for national coasts and rivers, educational training for waters disaster relief and prevention as well as support water disaster relief businesses.

3.2 Analysis of current status of U.S. water safety management

According to the statistics of American Red Cross, from the early 19th century to the 20th century, there were about 9,000 people drowned every year. With the increasing occurrence of submersion incidents, the U.S. initially designated police to take in charge for such rescue mission; however, due to the imperfect organizational system
in the early time, not many submerged people were successfully rescued. Finally, the Administration decided to hire trained lifeguards with special equipment to participate in water rescue operations. Early rescue training was simple, it only emphasized on personal safety in water. Rescue method was mainly focused on above-water rescue, supplemented with under-water rescue. Until 1964, some institutions in California established the United States Lifeguard Association, which increased the standard of beach lifesaving practice, instilled water rescue safety knowledge to the public, and improved professional level of beach lifeguards throughout the country. Features of US waters safe management are rich content of lifeguard training, significant performance of submersion rescue, modernization of water rescue and medical equipment, and expansion of lifeguard duty scope.

Because American children drowning case happened again and again, the US Waters Safety Advocacy Bureau then targeted on families having swimming pools in Phoenix City to carry out drowning prevention promotion, in which the firefighters produced promotional lists about the safety of dabbling to remind parents not to let children close to swimming pools, ponds, bathtubs with water alone as well as encourage the public to set up protective fences, prepare lifesaving poles, ropes, buoyancy aids in the sites concerned, and call 911 immediately encountering a case of submersion. In the meantime, similar to our country, the Bureau also encourage people to learn cardiopulmonary resuscitation (CPR) and, if people do not know how to operate CPR, the 911 phone receivers can also transfer their calls to the nursing staff to provide instruction of on-line first aid.

3.3 Comparative Analysis of Water Safety Management among Taiwan, Japan and the United States

The analysis of water safety management among Taiwan, Japan and the United States showed that, despite there is different national condition among these three countries, each country has commonly listed school students’ water safety education as a priority as well as pays relative emphasis on the implementation and prevention approaches is this aspect. Owing to the complexity of details in “policy planning”, “implementation of the Act “and” Field Management “, about submersion, the research only focused on sections of warning rescue and education advocacy to deduce a comparison as follows:

1. Warning rescue: the above information showed that each country has different competent authority to take in charge of water management. In Taiwan, it is responsible by government agency, but in the U.S. such function is responsible by U.S. Water Life Saving Association which conducts supervision to water recreation sites. Therefore, it is a practical way to jointly perform submersion prevention and warning missions through the cooperation and authorization between official and civil organizations which also can save the budget expenditures of government entities.

2. Education advocacy: in this aspect, Japan and Taiwan pay more emphasis on submersion-prevention advocacy, such as Taiwan’s Ministry of Education promote such education to students and teachers through each level of schools, while Fire Department in each County/City promote such advocacy to the public through various occasions and opportunities. Whereas in the US, except the submersion prevention education promoted by government agencies on individual website, the feature of its system is lifeguards stationed on sites who are dispatched by non-government organizations will take the initiative to conduct anti-submersing education to the public.

IV. METHODS

4.1 The concept of performance evaluation for submersion prevention and relief work

1. Definition of performance evaluation: an assessment for the effectiveness of the program implementation based on the comparison of results of original budget or estimation. However, owning to the public sector has no profit motive and lacks of objective market data such as turnover, profitability and market share; it has a certain difficulty in the definition of performance evaluation.

2. The purpose of the effectiveness evaluation: in terms of rational perspective, the purpose is to seek answers about policy feasibility, implementation and results, impact of the implementation and other issues in order to serve as basis for policy amendment or plan expansion, continuation or termination through data collection and analysis

4.2. Methods applied on performance evaluation for submersion prevention and relief work

This study adopted three stages to establish factors of performance in submersion prevention and relief work in Fire Department of New Taipei City. The first phase was to review relevant literature and to carry out open-depth interviews by expert questionnaire in order to draw hierarchical structure. The second stages used the Delphi questionnaire of Delphi method to aggregate expert opinions on the assessment factors, and proposed recommendations to establish hierarchical structure. Finally, an Analytic Hierarchy Process was adopted to sort the
weights.

The present study used "analytic hierarchy process" (AHP) developed by American scholar Saaty in 1971 to evaluate factors of each level deducted from the literature review of this research in order to understand that, under the uncertainties of factors along with a plurality of assessment guidelines on decision issues, what is the most important factor which has to be urgently executed. Therefore, this study designed, distributed and statically analyzed results obtained from questionnaire which was created base on AHP. In this stage, the relative importance of each factor among the indexes were evaluated through Delphi expert assessment and the consistence of recovered questionnaires were tested by Expert Choice software analysis in order to calculate the critical assessment factor of success index as well as to sort the weight sequence and analyze the importance degree of weights through geometric mean. Furthermore, an additional manpower and budgetary resources were invested to aid the assessment and analysis for the comparison of the submersion people and relevant man power cost before and after the implementation of relevant policies associated with submersion rescue so as to understand the performance in this aspect.

After referring the aforementioned domestic and abroad literature review as well as basing on the researcher practical experience, this study initially aggregated objective and effective performance factors of submersion accident rescue in risky waters of the Fire Department of New Taipei City as well as conducted the measurement for weights in order to construct index analysis structure of its rescue performance, as shown in Figure 4-1:

![Figure 4-1 Preliminary Study Structure](image)

4.3 Research subjects and questionnaire distribution

This research targeted on experts and scholars who understand the domestic water safety experience, lifesaving coach who actually implement prevention and rescue tasks in Daibao Creek, and heads of relevant department of New Taipei City to carry out survey through questionnaire developed on the basis of Delphi method and analytic hierarchy process.

In this study, the implementation of the questionnaire for the experience of experts and scholars understand the security and internal waters of the practical implementation of lifesaving coach Prevention and Relief Work of Great Panther Creek and north of the new municipal government departments in charge of the Bureau of the questionnaire and AHP Delphi method of investigation.

4.3.1. Study subjects

A total of 18 subjects were selected for interviews and questionnaire filling. These subjects included 3 officials from central units, 2 scholars, 3 experts from rescue groups, 5 lifesaving instructors, 3 personnel from relevant Department of...
New Taipei City (such as tourism bureau, police stations, fire stations) who actually engage in planning and implementation of rescue tasks of Daibao Creek, one from District Office and another one from Village Office.

4.3.2. Questionnaire distribution

For the recovery and improve the efficiency of the questionnaire, this research, in addition to distributing the questionnaire by registered mail, e-mail and fax payment, furthermore joined the online respondents to the second Delphi and AHP questionnaire in YouthWantNetwork (http://www.youthwant.com.tw/) in order to shorten the recovery time as well as to facilitate the responses of experts. Moreover, this study also checks whether experts have received the questionnaire in question and proposed instructions about the questionnaire during the survey period.

4.4. Results

This Chapter summarized the analytic results of the study, in which the effective dimensions of rescue task for submersion incident in risky waters of Daibao Creek performed by Fire Department of New Taipei City were divided into policy planning, laws enforcement, warning rescue, education advocacy and field management, to which experts believed that "laws enforcement" was the most important. Besides, the relative weight of 24 evaluation factors affecting performance under the overall hierarchical structure of this study was sorted in this study, as shown in Table 4-1. Among such weight and sort, the first six items accounted for 65% of the overall weight with the sequencing as follows: restriction the time and areas to the public water recreation, set the water recreation management act, improve patrol density, task objects of life-saving, widespread life-saving warning stations, and establish safe areas.

<table>
<thead>
<tr>
<th>Second Layer Structure</th>
<th>Perspective of Weight</th>
<th>Perspective of Scoring</th>
<th>Third Layer Factors</th>
<th>Factor Weight</th>
<th>Factor Scoring</th>
<th>Overall Weight</th>
<th>Overall Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy Planning</td>
<td>0.183</td>
<td>3</td>
<td>Supported by high level of City Government</td>
<td>0.067</td>
<td>4</td>
<td>0.011</td>
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<td></td>
<td></td>
<td></td>
<td>Support and commitment from head of Fire Department</td>
<td>0.323</td>
<td>2</td>
<td>0.066</td>
<td>8</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Listing as objective of fire prevention task</td>
<td>0.448</td>
<td>1</td>
<td>0.075</td>
<td>4</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Implementing plan and budgeting</td>
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<td>3</td>
<td>0.059</td>
<td>10</td>
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<td></td>
<td></td>
<td></td>
<td>Supervision and evaluation</td>
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<td>5</td>
<td>0.010</td>
<td>18</td>
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<td>Law Enforcement</td>
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<td>0.325</td>
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<td></td>
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<td>0.150</td>
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<td></td>
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<td>Publishing limit specifications of waters recreation</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Organizing cross-unit inspection teams</td>
<td>0.066</td>
<td>4</td>
<td>0.010</td>
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<tr>
<td>Warning Rescue</td>
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<td>Identifying safe water areas</td>
<td>0.356</td>
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<td>0.062</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Increasing patrol frequency</td>
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<td>4</td>
<td>0.049</td>
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<td>Widely spreading life-saving and warning stations</td>
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<td>Strengthening a water rescue training</td>
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<td>Purchasing life-saving equipment</td>
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<td></td>
<td></td>
<td>Media reports on submersion accidents</td>
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<td>Advancing submersion prevention in schools</td>
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<td></td>
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<td>Distributing safety promotion leaflet</td>
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<td>Field Management</td>
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<td>Checking and supporting water recreation users regularly</td>
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<td>4</td>
<td>0.064</td>
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<td></td>
<td>Strengthening water safety facilities</td>
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<td>0.034</td>
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<td></td>
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<td>Ensuring areas</td>
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<td>0.066</td>
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<td></td>
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<td>Setting lifeguard poles</td>
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<td>0.076</td>
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<td></td>
<td></td>
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<td>Setting water location monitors</td>
<td>0.054</td>
<td>2</td>
<td>0.063</td>
<td>14</td>
</tr>
</tbody>
</table>

Further details of the overall sequence of relative importance among those 24 prevention performances are as follows: specifying the restriction of time and areas to the public water recreation (weight 0.235), setting up water recreation management laws (weight 0.130), strengthening water rescue training (weight 0.089), listing as objective of fire prevention task (weight 0.073), widely spreading life-saving and warning stations (weight 0.063), identifying safe water areas (weight 0.062), publicizing limit specifications of waters recreation (weight 0.060), support and commitment from head of Fire Department (weight 0.036), increasing patrol frequency (weight 0.034), implementing plans and budgeting (weight 0.032), organizing cross-unit...
inspection teams (weight 0.031), media reports on submersion accidents (weight 0.027), erecting signs (weight 0.026), strongly enforcing public violation (weight 0.015), purchasing lifesaving equipment (weight 0.014), setting lifesaving pile (weight 0.014), supported by high level of City Government (weight 0.011), strengthen safety inspection or advocacy (weight 0.010), setting websites for water safety advocacy (weight 0.010), supervision and evaluation mechanism of submersion rescue (weight 0.010), submersion prevention at school (weight 0.006), distributing safety advocacy leaflet (weight 0.004), setting water location signs (weight 0.003), and regularly inspecting hydrological environment (weight 0.003). According to the above results, if the prevention and rescue work strategies of submersion accidents in dangerous streams to be carried out by Fire Department in each county and city or other regulatory authority in the future can base on five perspectives of "policy planning", "laws enforcement", "warning rescue", "education advocacy", "field management" as well as each important index, it will be able to perform such tasks effectively.

V. DISCUSSION

Taiwan is an island country, and it has many beautiful and valuable open water resources which have become popular attractions to people for water recreation. However, some waters like Dabou Creek often hide unpredictable risks which also form a major challenge to safety control and management in such resources. Although the civil societies have provided assistance of setting life-saving warning station in dangerous waters, there is no way to force people to prevent from making risky behaviors due to no enforcement power. In addition, owing to that part of rivers and streams are located in remote areas along with the limit man-power of water security and management agencies and civil rescue groups, some counties/cities have not been able to adopt various active action on prevention and relief as the New Taipei City does. Thus, their sporadic submersion prevention measures like random patrols, erect warning signs and limited advocacy have achieved very limited results.

5.1. Constructing the hierarchical structure of rescue performance for submersion accidents in dangerous waters.

The study, using experts depth interviews, Delphi method and analytic hierarchy process, developed the hierarchical structure of rescue performance for submersion accidents in dangerous waters and constructed five perspectives of policy planning, laws enforcement, warning rescue, education advocacy and field management for rescuer performance of submersion accidents. Among them, the laws enforcement is the most effective item in the five major perspectives, particularly setting the water recreation management act, restricting the time and areas to the public water recreation. In the warning rescue, strengthening water rescue training, distributing life-saving warning stations widely, and identifying safe water areas are important. In policy planning, listing submersion accident prevention as task objective and implementation plans and budgeting are also important for prevention and relief performances. On the field management, erecting signs and installing life-saving pile are major performances. As to education advocacy, the major performances are media reports on submersion accidents and setting websites for water safety advocacy.

According to the research’s findings, suggestions advised by experts in the interviews and improvement strategies proposed from the water safety reports of Sports Administration, MOE, this study summarized strategies and methods for current government agencies to sophisticate their rescue tasks of submersion accidents in dangerous waters as follows: water safety Act, water safety education, water safety maintenance, water safety rescue and water safety advocacy.

1. Water safety Act
(1) Enacting and publicizing laws to restrict or prohibit water recreations.

Local county and city governments may in accordance with the “Regulations Governing Water Recreation Activities” issued by the Ministry of Transportation and Communication stipulate suitable announcement based on water characteristics under their own jurisdiction as well as pull the rope for water recreation range and set warning lifeguards stations; notify the public to engage in all sorts of water recreation activities in deep waters or waters with swirls, and undercurrents.

(2) Clear messages of water recreation announcement

Announcement relating to recreational waters shall be specified clearly, and such message shall be fully exposed through public Medias or relevant website to notify the public to avoid dabbling in dangerous water in order to ensure their own safety.

(3) Strengthen the enforcement of violations

County and city governments may organize “Water Safety Joint Inspection Team” from Departments of Tourism, Police and Fire to strengthen water safety inspection or advocacy for waters of being restricted or prohibited as well as strengthen the advices or enforcement for people who violate the laws to highlight the government authority and maintain the security of people.

2. Water safety education
(1) Enhancing students' cognitive of water safety and implement water safety education
Swimming in open water has its own peculiarities, such as submersion accident with the damage extent more serious than general exercises which may cause irreparable tragedy.

Most of the content of School water safety-related advocacy was developed by targeting on submersion accidents occurred annually as well as the analysis of their causes without investigating student awareness of the concept to water security. This study recommended understanding the insufficiency of students understanding in such concepts through further investigation in this field, and further elaborate projects relating to water safety education course in order to enhance students knowledge in various water safety.

To ensure the safety of students, it needs to integrate safety-related knowledge and assemble the teaching courses of water safety in all levels from elementary, junior high and high schools in order to strengthen the teaching in this field so as to enhance student safety in waters. Furthermore, it is suggested to incorporate water safety education into the compulsory education curriculum and compile into a textbook so that to enhance students' awareness of water safety activities.

(1) Strengthen student’s self-help swimming capabilities

Except teaching students how to swim for a certain distances with proper posture and techniques, the purposes and content of each school swim teaching should also focus on gradually enhancing students' self-help-based swim (such as jellyfish drift or drift and other floating abilities), amending swim teach materials, strengthening teacher's knowledge and ability, especially students self-help and emergency response capabilities in the case of submersion and simple land rescue skills such as throw rescue items, life-saving pole etc. so that students will not only learn how to swim, but also possess the ability to help themselves.

(3) Enhancing students’ ability to interpret water condition

The biggest difference incalm and clear open waters is that they might hide different hydrometeorology and environments, such as likely swirls and offshore flows etc., and such dangerous situations may easily cause people panic and result in a submersion tragedy. Therefore, schools at all levels shall enhance students' ability to interpret water condition and understand the possible risks in there while implementing water safety advocacy courses so that they will not dare thrust into the water without preparation as well as keep away from dangerous waters.

3. Water safety maintenance

(A) Strengthening patrols in dangerous waters

To dangerous waters frequently occur submersion accidents, fire agencies of county/ city shall plan patrol routes for submersion prevention, list out key areas for advocacy and dispatch personnel (police, firefighters etc.) to perform anti-submersion patrols in order to strengthen the guard tasks in dangerous waters.

(2) Setting warning signs

It is necessary to increasewaning signs in dangerous waters to warning people about the possible dangerous conditions that they are engaging, and replace or update old, damaged, unidentified or unsuitable signs with new ones.

(3) Labeling the locations of waters

Dangerous waters should be set location nameplates to enable people to report to 119 about the correct place where submersion accident occurs so that to save rescue time of local fire units after receiving such emergency call.

4. Water safety and rescue

(1) Strengthen firefighters rescue training

The Fire authorities of each county and city shall organize torrent rescue training at the same quality as internal standard (RQ1, RQ2, and RQ3) to strengthen the firefighters rescue technique, and design advanced lifesaving planning to cultivate seed instructors to enable firefighters to effectively perform rescue tasks in waters and increasesubmersionrescuerate.

(2) Utilizing lifesaving resources of civil society

The Fire authorities of each county and city shall integrate the volunteer powers of civil societies, such as Red Cross Society of the Republic of China and Chinese Taipei Life Saving Association to widely establish life-saving warning stations at dangerous waters in order to assist the report and immediate rescue for submersion accidents. These groups of volunteers should be aware of ceremonies in recognition of life-saving societies and visit volunteers in station with encouragement and gratitude conducted by the New Taipei City Government which demonstrates the effect of "Limited government resources, infinite civil power."

(C) Enacting and promulgating the details of execution plan about water rescue

To actively enhance submersion rescue actions of fire authorities in each county and city so that to reduce the number of drowning deaths each year, the National Fire Agency, MOI usually issues notification of “Implementation plan to strengthen the capacity of water rescue” on July and August to urge each fire authority to carry out various but necessary tasks, such as more warning during hotter climate periods or asking competent authority to set more warning labels at usually time period. Fire authorities of each city and county should refer to the plan promulgated by Central competent authority to enact and promulgate the details of execution plan about water rescue which are suitable for waters under their own jurisdiction as well as
drowning related budget for submersion prevention and rescue to enable field firefighters to perform and implement.

(4) Strengthening water safety facilities
Each water management authority shall commonly install necessary facilities, such as life-saving piles (lifesaving pole, ring and rope) at dangerous waters, and regularly inspect hydrological environment to understand the characteristics of dangerous waters. Fire authorities shall explore and plan water rescue course to conduct immediate resurge when accident occurs along with the organization of life-saving drills to enable relevant staff to be familiar with the procedures of water rescue.

5. Waters safety advocacy
(A) Promote swimming training and water self-help advocacy
The relevant authorities should drive the public swimming campaign and handle swimming courses for students and people, so that people are not afraid of the water and even become closer to water. In the meantime, relevant water self-help activities and promotion shall also be outreached to increase people swimming capability and self-help concept.

(2) Strengthen advocacy in peak season of dabble
Since the period of June to September every year is the peak season of dabbling, thus, water safety advocacy task shall be strengthened since May through various channels and media, and the inter-ministerial water safety meeting shall also be convened continuously to discuss the direction of strategies and promotion in responding to watersafety. In the meantime, news conference regarding water safety advocacy shall also be held before the peak season or summer holiday of dabbling. The New Taipei City has produced the advocacy leaflet of “Informers” posted in the bulletins of each community building management committees or elevator to remind parents’ attention to the whereabouts of their children. Beside, each fire authorities can also coordinate with women’s fire prevention team to establish submersion propaganda station in dangerous waters and hang red banners in appropriate places to remind the public’s attention on the security of swimming and dabbling.

(C) Multiple anti-submersion propagandas
Planning water safety promotion or warning with understandable messages and promoting through plain or electronic media, mobile phone messaging software (Line, App, etc.), popular social networking sites (such as facebook, twitter, etc.) to strengthen the public water safety knowledge and ability; all waters management authorities should clearly inform the public about which waters have installed with a lifesaving warning station with lifeguards stationed, and strengthen the publication about relevant website to facilitate the public to download water safety related information.

5.2 The combination of submersion security management strategy and the performance of submersion prevention and relief
Combine the strategies of “strengthening anti-submersion advocacy” and “entrenching swimming and water safety courses” relating safety management of submersion accidents with part of prevention and rescue task to strengthen the main point of “education promotion” in schools, families and communities.

1. School education: the main policies in this aspect include “strengthening the anti-submersion advocacy” and “entrenching swimming and water safety courses”, thus schools at all levels should carry out anti-submersion advocacy education in accordance with the following directions:
(1) Training of anti-submersion instructors: schools at all levels should plan trains for anti-submersion instructors and staff and use different timings like morning assembly, class room or outdoor teaching to promote anti-submersion concept to let students build their correct safety awareness about dabbling.
(2) Timings of major advocacy: for example, in the period from May to September each year, two-day weekend, consecutive holidays or the time of submersion case occurrence.
(3) Focus of advocacy content: such as selection of recreation site, not engage in risky behaviors, be vigilant, proper warm-up exercise, and the establishment of self-help concept.

2. Community education: the best way to impress people about anti-submersion concept is using practical case education to call for their attention in water safety. Thus, such education advocacy is necessary to match with news media, Police Broadcasting Service interviews, press release, and other multiple promotional channels.
3. Family concern: New Taipei City Government has produced propaganda posters and widely posted on the bulletins of each disaster prevention informant of the City to remind parents to pay attention to the whereabouts of their children and ask them not to dabble in waters without stationed lifesaving guards.

4. e-communication: the approaches of incorporating e-communication for anti-submersion tasks by the Fire Department of New Taipei City Government as shown in Figure 2-6 below:
5.3 The relative importance of performance index for each prevention and rescue task of submersion at dangerous waters of Fire Department of New Taipei City Government

This study used AHP to obtain relative importance of performance index for each prevention and rescue task of submersion at dangerous waters from Fire Department of New Taipei City Government, and prioritized them in accordance with their degree of importance into five perspectives of "policy planning", "law enforcement", "warning rescue", "education advocacy", "field management" to serve as reference of development focuses of each important indexes for fire agencies and other relevant authorities in their future execution so that to achieve effective rescue duty of submersion accident in dangerous waters.

1. Restriction on time and areas

The announcement in accordance with provisions of Article 5 of the "Regulations Governing Water Recreation Activities" restricts the allowed dabbling month, time and 14 water sites per year as well as dispatches stationed lifesaving personnel during those periods so as to enable people to follow and avoid submersion accidents. This national initiative action effectively regulates public water recreation habits and greatly enhances their safety as long as the public follow the stipulation prescribed by the announcement.

2. Provide water recreation management regulations

Despite the establishment of life-saving stations and real time rescue of submersion people conducted by both fire agencies with civil societies, the drowning incidents in Dabou Creek continuously occur one after another. After investigation, it is found that the main reason is due to that no clear provisions to regulate people’s wantonly dabbling behaviors. Therefore, the formulation of water recreation management Act require people to follow certain guidelines and to impose penalties on those who violate the provisions prescribed in such Act will obviously achieve some of the results.

3. Strengthen water rescue training

Fire Department should strengthen trainings for firefighters in water rescue s, especially for new firefighters recruited within three years and organize water rescue drills of disaster communications plan, water rescue, life-saving equipment, boat operation, drowning CPR and hospital route planning in the same time to cope with the emergency rescue to sudden submersion accidents.

4. Listed as the objective of Fire Department

To promote effective management and implementation of anti-submersion work, the Fire Department, in addition to listing “anti-submersion” as the six major objectives, shall place the prevention and rescue task of submersion accidents in Dabou Creek as a focus of the prevention area which annually mobilizes considerable manpower in water safety maintenance at such area.

5. Widely install life-saving warning stations

Given the limited anti-fire manpower, it really has difficulties to implement water safety warning and advice in Dabao Creek which has total length of 22.8 km and always attracts large numbers of people to dabble during the holidays. Therefore, the Fire Department in cooperation with 14 life-saving teams of Red Cross Society of the Republic of China to set up lifesaving stations during holidays in Dabao Creek to carry out immediate rescues for submersion accident as well as to advise people to not wear jeans while dabbling in dangerous waters. Such combination with civil societies is, namely, "Limited government resources, infinite civil power".

6. Identify safe water areas

The Fire Depart shall firstly target on Dabao Creek to conduct risk assessment via inviting relevant units along with experts who are familiar with water areas on water environmental investigation for the classification of safe and dangerous water areas, in order to serve as important planning basis for rescue task development.
The SWOT analysis of Dabou Creek rescue tasks

To solve problems related to the implementation of a preliminary SWOT analysis as shown in Table 2-4:

<table>
<thead>
<tr>
<th>Strength</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>◆ Rich waters and rescue experiences</td>
<td>◆ Insufficiency of current laws</td>
</tr>
<tr>
<td>◆ Excellent instructors in water safety knowledge advocacy</td>
<td>◆ Unclear responsibility among management units</td>
</tr>
<tr>
<td>◆ Disciplined firefighting team</td>
<td></td>
</tr>
<tr>
<td>◆ Full support of heads of authorities</td>
<td></td>
</tr>
<tr>
<td>◆ Cooperate with the most number of volunteers</td>
<td></td>
</tr>
<tr>
<td><strong>Opportunities</strong></td>
<td><strong>Threats</strong></td>
</tr>
<tr>
<td>◆ Create safe water environments</td>
<td>◆ Weak compliance with law requirements and insufficient risk awareness</td>
</tr>
<tr>
<td>◆ Facilitate tourism development</td>
<td>◆ Vast aquatic environment</td>
</tr>
<tr>
<td>◆ Enhance volunteers’ self-worth</td>
<td>◆ Impact to the livelihoods of tourism</td>
</tr>
<tr>
<td>◆ Promote public concerns on water safety</td>
<td>◆ Water safety tasks is impossible to be independently completed by a single</td>
</tr>
<tr>
<td>◆ Establish a complete water safety advocacy mode</td>
<td>department or bureau</td>
</tr>
</tbody>
</table>

**VI. CONCLUSION**

This study firstly achieved consensus and convergence of key performance through open expert opinion surveys, expert in-depth interviews, and the Delphi method. Then evaluated the relative importance of performance index for each prevention and rescue task of submersion recovery at dangerous waters of the Fire Department of New Taipei City Government. Via experts, scholars who understand the domestic water safety experience, relevant Departments and Bureaus of New Taipei City which actually implement prevention and rescue tasks in Daibao Creek, and finally deduced the priority sequencing of the performance of prevention and rescue tasks in dangerous waters to serve as references for each fire authority or other competent agencies with dangerous streams/creeks/rivers in their jurisdiction in the development of management strategies.

Summing up the above, among the eight critical performance factors according to the previous overall level of weight and sorting presented in this study, restricting and regulating public water recreation time and areas and setting the water recreation management Act accounted two items of five factors from the law enforcement perspective. Meanwhile, strengthening water rescue training, listing as the objective of fire prevention, establishing widespread life-saving warning stations, and establishing safe water areas were also effective prevention and rescue tasks in submersion accidents. Therefore, to be effectively preventing submersion accidents from happening, approaches conducted by New Taipei City such as setting the water recreation management Act, regulating and restricting public water recreation time and areas, dividing prohibited and restricted areas in dangerous waters, limiting people to engage in water within specified areas with life-saving stations can be considered as references.

In the meantime, the determination to perform rescue tasks in dangerous waters demands the implementation of patrol works of persuading and advising people not to dabble in dangerous waters, coordinating volunteers of society to widely install life-saving warning stations, and listing submersion prevention work as an objective. These are items which can be strengthened by Fire Authorities and other relevant agencies for submersion-prevention tasks.

2. Study Suggestions

I. Recommendations from research findings

This section summarized the sophisticated strategies and methods of government agencies’ prevention and rescue works of submersion accidents as waters safety Act, water safety education, water safety maintenance, water safety and rescue, and waters safety advocacy, with recommendations as follows:

1. Water safety Act
   (1) Publicizing recreational water regulations
   (2) Announcing and promoting water recreation regulation
   (3) Strengthening the ban for violations

2. Water safety education
   (1) Enhancing students’ awareness of water safety
   (2) Strengthening students’ self-help swimming capability
   (3) Implementing water safety education
   (4) Enhancing students’ ability to interpret water conditions

3. Maintaining water safety
   (1) Strengthening patrols in dangerous waters
(2) Setting warning signs
(3) Labeling water locations
4. Water safety and rescue
(1) Strengthening firefighter rescue training
(2) Using lifesaving resources of civil societies
(3) Providing details for the implementation of rescue plans
(4) Strengthening water safety facilities
5. Water safety advocacy
(1) Promoting swimming training and water self-helping advocacy
(2) Strengthening advocacy during peak dabbling season
(3) Multiple submersion-prevention propaganda

II. Suggestions for follow-up research

Owing to insufficiencies and limits of this study, there are still many research directions and questions to be clarified for future studies which are recommended and summarized as follows:
1. Expanding the scope of study: due to time and manpower considerations, the present study only focused on Dabou Creek of Sanxia District as its research scope. Future researchers can extensively collect successful strategies on submersion accident prevention and rescue performance of other counties and cities to achieve more representative research results.
2. Applying the concept of fuzzy theory: there might be some incomplete parts of dependencies between the hierarchical structure and key factors used in this study. Thus, it is recommended that follow-up research can be combined with the concept of fuzzy theory to determine evaluation criteria or key factors for evaluation and analysis in order to make the prevention and rescue work for submersion accidents more sound.
3. Recommendations for central authorities: there is an inconsistency in the concept of launching prevention and rescue works among different entities due to their own varying backgrounds. Thus, this study suggests that future studies shall focus on relevant competent authorities to propose research recommendations which might provide great help on such work.

Although the public has the right to dabble in seashores and streams, for the purpose of safeguarding people’s lives in submersion accidents, the Ministry of Transportation and Communication has formulated the “Regulations Governing Water Recreation Activities” for relevant agencies and local governments to follow in terms of penalty imposition and management. In addition, a law of “Guidance in safety management for facility maintenance of National Scenic Areas and Water Recreation Activities” is also provided in order to implement safety management for such sites. Regarding waters available for people to dabble in, the water management authorities, Fire Departments of each municipality or county (city) government, relevant Agencies or Bureaus, the Ministry of Transportation and Communication, and the Construction and Planning Agency of MOI shall set up signs at prominent places, label the characteristics of such water terrains, and establish necessary emergency rescue systems. With respect to prohibited waters, signs clearly carrying messages of prohibited water ranges and activities shall be set. Regular patrol tasks shall also be arranged for dangerous waters in order to dissuade people from engaging in dabbling activities at such places. Regarding disobedient violators, the punishment should be imposed strictly so as to urge people to observe the precautions and deter them from future violations.

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