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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 forpeople 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 expertscomments 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 ofeach 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 ofdrowning in dangerouswaters.

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 crowed with people each season.However, such beautiful attractions also hide a lurking crisis, especially forpeoplewho 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 incidentsoccurring from 2007 to 2016, which indicates that the drowning rate per 100,000 Taiwanesepersonsis about 1.9.Moreover, according to the school safety statistics by the Ministry of Education, there werea 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 a0.96 drowning mortality rate per 100,000 students.For example, an instant stream surge caused by heavy rain in Pinglinupstream on June 5, 2016 (2016) took five lives among a group of people. When drowning accidents occurin 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[1];)

In addition, due tono existing dedicated authority for water safety management in Taiwan, this study hereby describestherelevant central and local jurisdictions authorities as follows: 1. Authorities of central jurisdiction: Water Resources Agency, Ministry of Economic Affairs governing the 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 all 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

[1]Ma, W., Xu, Y., &Xu, X. (2010). Is drowning a serious health problem in Guangdong Province, People's Republic of China? –results from a retrospective populationbased survey, 2004–2005. International Journal of Injury Control and Safety Promotion, 17(2), 103–110. http://dx.doi.org/10.1080/17457300903453120.

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 asTamsui 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 expertscomments 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 ofeachguideline,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 ofdrowningin dangerouswaters.

1.1. Research Scope

According to drowning accident statistics of the National Fire Agency, MOI[3]which showed that rivers and seashoreswereranked 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 occuring in creeks andriversreacheda high of 93.Thus, from above data it can be learned that creeks were the main water terraintypesin which drowning accidentsoccurred. Therefore, this study set the "creeks" of natural water in New Taipei City as itsresearch subject. The statistics of drowning locations (regions) and causes inNew Taipei City between2008 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 watersand has become the focus of media coverage.

Desiptethe full-length of Dabao Creek beingonly22.5 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, therewere10 thousand vehicles enteringper hour atthis Creek with thousands of peopleparticipatingin water activities. Although the density of local lifeguardsis 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 wasabout 100 and there were 3 to 5 drowningdeathsevery 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 atDabao Creek of Sanxia District" reported by Huang Zong-yi and Lin Jun-hongonudn.com (2006) significantly shows the dark sideof 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 1-1 Table of statistics on dangerous water and drowning cases in Dabao Creek

Dangerous water in Dabao Creek	Reason of dangerous water	Causes of drowning incidents	Statistics of annual drowning cases
Water aroundTian-Fo Temples	At depth of about 4-5 meterswithundercurrents and water level drop	Caused by water depth and diving	1 people drowned in each year of 2000, 2005 and 2010
Water in Shishin Bridge	Depth of about 2-3 meters and next to a hinterland	Incautious water playing	1 people drowned in each year of 2001, 2002 and 2007
Water in Cho-Ho Bridge	Water depth of 3-4 meters with fast-flowing	Incautious water playingand adults negligence in children care	A total of 3 persons drowned in 2004 and 2008
Water inKim Min Bridge	Depth of about 4 meters with fast-flowing	Hitting stones when diving or being hooked by fishing nets	One person drowned in each year of 2002, 2008 and 2010.
Water in Kinglong Bridge	Depth of about 2-3 meters with fast-flowing	Incautious water playing	2 persons drowned in 2003
Water in Tongyuan Bridge	Deeper water with manywhirlpooland undercurrent along with large temperature difference	Hitting stones when diving and not familiar with the water nature	A total of 4 persons drowned in 2000, 2001 and 2008
Water in Tongyoung Bridge	Water depth of about 1-2 meters with undercurrent	Not familiar with the water nature	1persons drowned in 2000
Water in Tonglu Bridge	Fast-flowing, many swirls and undercurrents with large temperature difference	Not familiar with the water nature	1persons drowned in 2001
Water in Chinsun Valley	Depth of 3-4 meters with fast-flowing	Not familiar with the water nature	1persons drowned in 2002
Water in Yun-Yuan Valley	Depth of 1-2 meters and many whirlpools and undercurrentsalong with large temperature difference	Hitting stones when diving and not familiar with the water nature	A total of 4 persons drowned in 2001, 2002 and 2010
Water in Ba-shin Bridge	Fast-flowing with ease water under the bridge	Not familiar with the water nature	1persons drowned in 2002
Water in Chinshiu Bridge	Fast-flowing	Falling into the water	1persons drowned in 2004
Water in Bee World	Having a protective infrastructure with water depth of 1-2 meters and whirlpool , undercurrent in downstream	Not familiar with the water nature	A total of 5 persons drowned in 2001, 2004, 32005 and 2008
Water in Xiongkong	Slow water flow at the water depth of 1-2 meters	Not familiar with the water nature	1persons drowned in 2004
Water in Legend of the Mountain	Fast-flowing with large temperature difference	Depth drowned	1persons drowned in 2001

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 asfollows:"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 rangeandcangenerally 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 categoryisdisasters caused by physical environments: such as injuries caused by building collapse, fire wire and sports equipment damageetc.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[6], the results of drowning should be reclassified as: mortality, morbidity, and non-disease. According to the explanation from theAmerican Heart Association (2005)[7], the drowning process begins with the drowning persons' respiratorytrackbeing submerged in liquid, followed by the victimspontaneouslyholding their breathing which will then incur involuntary larynospasm due to the liquid present in the respiratory oropharynx and throat. In the meantime, as the submergedvictimsoften fail to breathe air, it results in theirownoxygen 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'throatsbeing obstructed or damaged. However, when the oxygen level in arteries have dropped, the victims' throat spasms and obstruction will be relieved which causes themrapidlybreathe 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 breathingairas well the lack of effective recovery act, many organs of the submerged persons will lose function which tends to lead to their death, and it isclassifiedasa submersion or drowning phenomenon (Chen Yingxin, 2004) [8].

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&Bierens, 2002)[9]. 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)[10]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-sitefist-aid andhospital 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 injestingwater, 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, whichulitmately leads to drowning. In summary, the main causeof drowning is due toinjestingwater into the lungs after submersion (or because of throat muscle spasms that result in airway closure) which causes suffocation and furtherleads brain hypoxia, then followed by loss of consciousness and cardiac arrest, and finallydeath.

2.2. Factors of drowning accidents

Domestic studies on the factors of drowning in the past were rare. Despite such important factors able tobe explored through the experiences of people who have been submerged, the investigation is still difficult to carry out due to either the person actually drowningor being reluctant to talk. Therefore, the researcher tried to explore the risk factors related to drowning by interviewing lifeguards withrescue experiences in submersion indangerouswaters within the setting ofalife-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)[11]after interviewing the then leader of the San-Yin rescue team of Red Cross. The reasons forDabao 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 occurringaccidents. According to statistics, about 90% of drowned people were wearingtrousers.

Another newspaper report on the causes analysisofannual drowning incidents indicated that water playing after drinking tends to causestomach 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 drowningincidence of men is higher than that of women, at aratio of about 14:1 (Peden&Mcgee, 2003)[13].Futhermore, 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 10years. 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 (Peden&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]suggestsseveral main reasons as follows: no attention to the safety of children, insufficient knowledge of water waves, not payingattention to slipperyareas,ignorant braveness 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 (Wellings&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 andinjuriesbyWang (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 risking 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 alcoholwhich 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 theDabao 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 temperaturedifference 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 accidentallyfell 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 ofDabao Creek according to the analytic report of Li (2002)[29].

The spectacular and clear stream of Dabao Creek looks like a graceful and quiet river with natural and original characteristicsis 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.

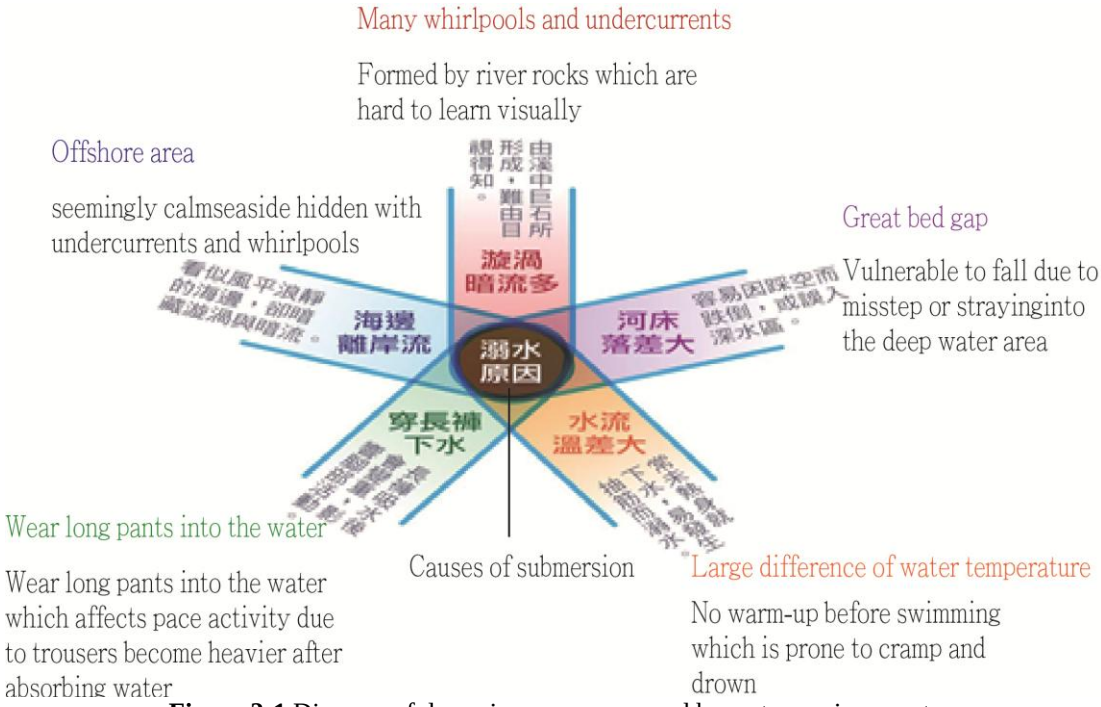

Figure 2-1 Diagram of drowning reasons caused by water environment

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)[30].Orlowski &Szpilman (2001) [31]pointed out that signs must be carefullyplannedandconsidered, 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 dabblers' 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) [32]also pointed out that the supervision and inspection for security management in stream and creekareas also need to be strengthened, as well as to increase the quantityof safety barriers and improve the colors and locations of warningsigns. 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 peopleimmediately.However, in addition to potential dangers of natural water, there aremoredangers caused by dabblers 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 diagramFigure 2-2 showing the characteristic of each factor that could result in submersion accidents.

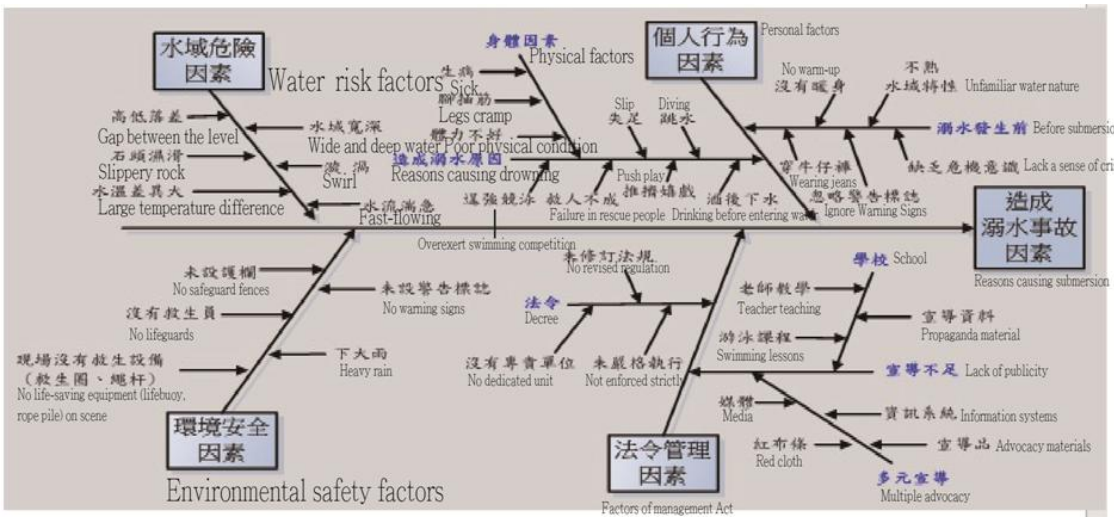

Figure 2-2 Characteristics factors causing submersion accident.
(Source: compiled by this study)

2.2.4. The control measures for water recreation

The research of National Penghu University of Science and Technology (2005) [33] 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 methodsadopted 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 refersthe 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.

2.2.4.2. 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 unstableweather 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

2.2.3.4. Total quantity control

Total quantity refers the limitation of the total number of people in an area so as 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. therisk and safety evaluation for the environment of water activity site; 6. the weather and water conditionof water activity site. The water safety maintenance of sites can be planned and established by government agencies or by passivefactors. 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 demandsrequired 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: strengtheningself own skills in order to engage in activities successfully. Training shallfocus 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 touristmanagement 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)[40];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 Taiwanarehigh 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 " complied by Sports Administration of Executive Yuan (2003)[42] mentioned that nine out of tenth submersion accident

occurredin 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. Discussionon 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 regulationsis 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" andArticle 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 GuanyinshanNational 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"Actfor 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-HouBridge, Gim Min Bridge, Kim Long Bridge, Tong-Yuan Bridge, Tong-Lu Bridge, Chi-Sun Valley, Yuanyang Valley and Chin-Sui BridgeinDaibao 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 rescuepersonnel in Daibao Creek of Sanxia District like Shinsin Bridge, Wonderland Park, YuanyangValley¸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-FouTemple,Gim Min Bridge, Kim Long Bridge, Tong-Yuan Bridge, Tong-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 Daibao 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 todabbleonseashores 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:

Figure 2-3 Relevant factors resulting in submersion accidents

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.
5. Japan Maritime Self-Defense Force of the Ministry of Defense: in charge of maritime homeland defense affairs and salvage business.

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 submersionincidents, theU.S. initially designated police to take in charge for such rescue mission; however, due to the imperfectorganizational system

in the early time, not many submersed people were successfullyrescued.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 thestandard 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 submersionrescue, 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 aloneas 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. Owingtothe 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. Warningrescue: 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 recreationsites. 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[45]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 recoveredquestionnaires were tested by Expert Choice software analysis in order to calculatethe 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:

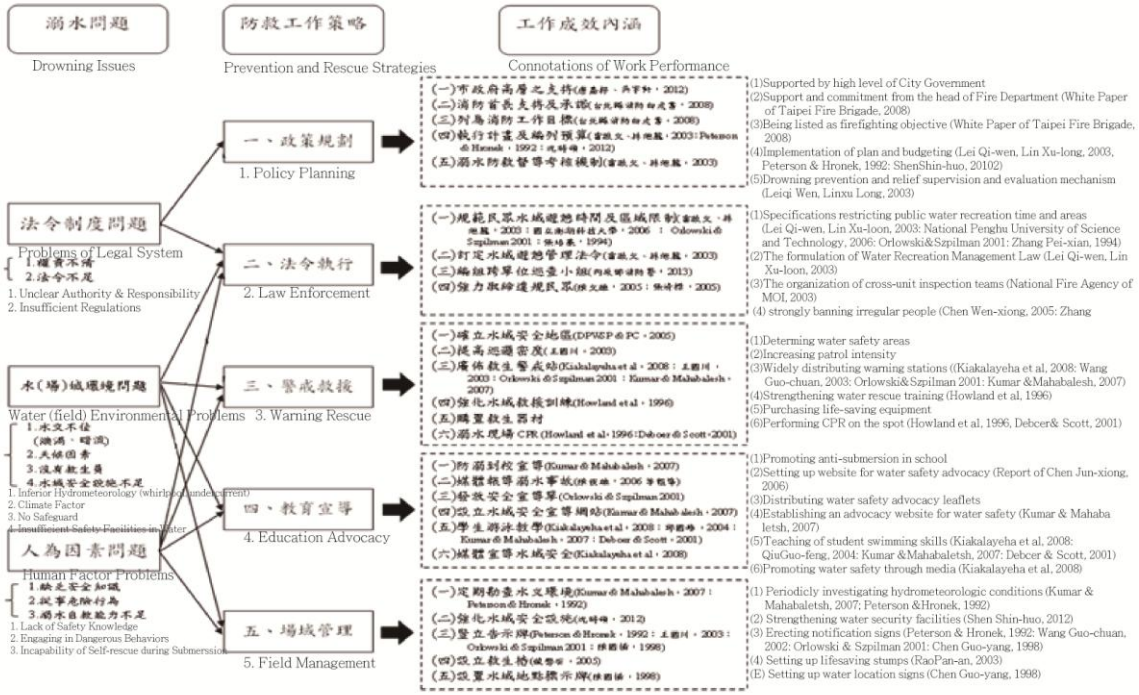

Figure 4-1 Preliminary Study Structure

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 subjectsincluded3 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 actual engage in planning and implementation of rescue task 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 checkswhether 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 intopolicy 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 4-1 Table of weights and sorting of overall performance levels of submersion accident prevention and rescue in risky waters of Fire Department, New Taipei City

First Layer Objective	Second Layer Structure	Perspective of Weight	Perspective of Sorting	Third Layer Factors	Factor Weight	Factor Sorting	Overall Weight	Overall Sorting
Structure of weights and sorting of overall performance levels of submersion accident prevention and rescue in risky waters of Fire Department, New Taipei City	Policy Planning	0.163	3	Supported by high level of City Government	0.067	4	0.011	17
				Support and commitment from head of Fire Department	0.223	2	0.036	8
				Listing as objective of fire prevention task	0.448	1	0.073	4
				Implementing plan and budgeting	0.198	3	0.032	10
				Supervision and evaluation mechanism of submersion rescue	0.063	5	0.010	18
	Law Enforcement	0.471	1	Specifying the restriction of time and areas to the public water recreation	0.500	1	0.235	1
				Setting the water recreation management laws	0.277	2	0.130	2
				Publicizing limit specifications of waters recreations	0.127	3	0.060	7
				Organizing cross-unit inspection teams	0.066	4	0.031	11
				Strongly enforcing public violation	0.031	5	0.015	14
	Warning Rescue	0.262	2	Identifying safe water areas	0.236	3	0.062	6
				Increasing patrol frequency	0.132	4	0.034	9
				Widely spreading life-saving and warningstation	0.239	2	0.063	5
				Strengthening water rescue training	0.339	1	0.089	3
				Purchasing life-saving equipment	0.055	5	0.014	15
	Education Advocacy	0.047	5	Media reports on submersion accidents	0.585	1	0.027	12
				Advocating submersion prevention in schools	0.121	3	0.006	21
				Establishing websites to promote water safety	0.204	2	0.010	20
				Distributing safetypromotion leaflet	0.091	4	0.004	22
	Field Management	0.057	4	Checking and inspecting water environment regularly	0.066	4	0.004	23
				Strengthening water safety facilities	0.172	3	0.010	19
				Erecting signs	0.466	1	0.026	13
				Setting lifesaving piles	0.242	2	0.014	16
				Setting water location nameplates	0.054	5	0.003	24

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 warningstation (weight 0.063),identifying safe water areas(weight 0.062), publicizing limit specifications of waters recreations(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 water safety facilities (weight 0.010),setting websites for water safety advocacy (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 inspectinghydrologicalenvironment (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 forcepeople to prevent from making risky behaviors due to no enforcement power. In addition, owning 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 be 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 submersionaccidents 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, warningrescue, education advocacyand 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 stationswidely, and identifying safe water areas are important. In policy planning, listing submersion accident prevention as task objectiveandimplementation plans and budgeting are also important for prevention and reliefperformances.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 enforcements for people who violate the laws to highlight the government authority and maintain the security of people.

3. 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 furtherelaborate 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, strengtheningteachers'knowledge and ability, especially students self-help and emergency response capabilities in the case of submersionand 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 differenthydrometeorology and environments, such as likely swirls and offshore flows etc., and such dangerous situations may easily cause people topanic 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 warningpeople 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 Associationto widely establish life-saving warningstations at dangerous waters in order to assist the report and immediate rescue for submersion accidents. These groups of volunteers should beawareofceremoniesin 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 thedetails 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 capacityof water rescue " on July and August to urge each fire authority to carry out various butnecessarytasks, 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 thedetails 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 accidentoccurs 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 safetyadvocacy shall also be held before the peak season or summer holiday of dabbling. The New Taipei City has produced the advocacy leaflet of "Informer" 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 warningstationwith 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-submersionadvocacy" 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-submersionadvocacy" 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 theircorrect 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:

Figure 2-6 Websites of water safety advocacy

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 studyusedAHPto obtainrelative importance of performance index for each prevention and rescue task of submersion at dangerous watersfromFire 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 achieveeffective 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 submersionaccidents. 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. Providewater 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 Acttorequire 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 firefightersrecruitedwithinthree years andorganizewaterrescue 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 submersionaccidents.

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 warningstations

Given the limited anti-fire manpower, it really has difficulties to implement water safety warning and advice in Dabao Creek which hasa total length of 22.8 kmandalways 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 uplifesaving stationsduringholidaysin Dabao Creek to carry out immediate rescues for submersion accident as well as to advise people to not wear jeans whiledabbling 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 rescue task in Dabou Creek, this study conducted a preliminary SWOT analysis as shown in Table 2-4:

Table 2-4 The SWOT analysis on the rescue task in Dabou Creek

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

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.Itthen evaluated the relative importance of performance index for each prevention and rescue task of submersion recoveryatdangerous waters of the Fire Department of New Taipei City Governmentvia experts, scholars who understand the domestic water safety experience, relevant Departments and Bureaus of New Taipei City whichactually implement prevention and rescue tasks in Daibao Creek, and finallydeduced the priority sequencing of the performance of prevention and rescue tasks in dangerous waters to serve as referencesforeach 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 previousoverall level of weight and sorting presented in this study, restricting and regulating public water recreation time and areas and setting the water recreation management Actaccountedtwo items of five factors from thelaw 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.

ore, to be effectivelypreventingsubmersion accidents from happening, approaches conducted by New Taipei City such as setting the waterrecreationmanagement Act, regulating and restrictingpublic 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 listingsubmersion 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.Recommendationsfromresearch 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' awarenesson 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 forfollow-up research

Owing to insufficiencies and limits of this study, there are still many research directions andquestions to be clarified for future studies which are recommendedand summarized as follows:

1.Expandingthe scope of study: due to time and manpower considerations, the present study only focused on Dabou Creek ofSanxia District asitsresearchscope.Futureresearchers can extensively collect successful strategies onsubmersion 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 canbecombined with the concept of fuzzy theory to determine evaluation criteria or key factors for evaluation and analysis in order to make theprevention and rescue work for submersion accidents more sound.

3. Recommendations forcentral authorities: there is an inconsistency in the concept of launching prevention and rescue works among different entities due to their own varyingbackgrounds.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 hasthe right to dabble in seashores and steams, 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" forrelevant agencies and local governments to follow in terms of penaltyimposingand management. In addition, a law of "Guidance insafety 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. Regardingdisobedientviolators, 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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