京都大学防災研究所年報 第 53 号 B 平成 22 年 6 月
Annuals of Disas. Prev. Res. Inst., Kyoto Univ., No. 53 B, 2010

Assessment of Japanese and Chinese Flood Control Policies

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Synopsis

The flood is one of the world's most dangerous natural disasters that cause immense damage and accounts for a large number of deaths and damage world-wide. Good flood control policies play an extremely important role in preventing frequent floods. It is well known that China has more than 5000 years history and flood control policies and measure have been conducted since the time of Yu the great and his father's reign. Japan's culture is similar to China's but took different approaches to flood control. Under the high speed development of civil engineering technology after 1660, flood control was achieved primarily through the construction of dams, dykes and other structures. However, these structures never fully stopped floods from occurring. In this research, we present an overview of flood control policies, assess the benefit of the different policies, and contribute to a better understanding of flood control.

Keywords: Flood control, Dujiangyan, History, Irrigation, Land use

1. Introduction

Floods are frequent and devastating events worldwide. The Asian continent is much affected by floods, particularly in China, India and Bangladesh. As the occurrence of flood events has become common, flood risk and flood prevention have raised public, political and scientific awareness. In recent years, flooding has become increasingly frequently in China and Japan concurrently within the extreme climate changes under global warming. Flood control in China and Japan aims to control the water for municipal and commercial use while preventing flood disasters. China has a long history of flood control measures from Yu the great and his father's flood control policy (Hao Gu, 2006). Dujiangyan Irrigation System is a good flood control measurement case in the long history of China. Dujiangyan is an irrigation infra-structure built in 256 BC during the Warring States Period of China by the Kingdom of Qin. It is located in the Min River in Sichuan Province, China, near the capital Chengdu. It is still in use today and still irrigates over 5,300 square kilometers of land in the region. Dujiangyan has a flood control system, an urban water supply system and a sediment transport system (Shuyou Cao, et. al., 2009). The flood control history of Japan began with the flood control in Yayoi period. In 1960, there was a big effort to get the evidence of the "Green Dam" hydrologic function as opposed to concrete dams in Japan (Kaoru Takara et al., 2004). The Chinese government changed the flood control policy to use structure measurement and non-structure measurement after the 1998's flood event. According to this back-ground, we need a system assessment of flood control policies and measurements with a historical point-of-view. In this research, we present an historical assessment of flood control policies. This historical assessment will provide some case studies to identify historical, societal, economic, environmental, engineering and hydrological indexes that reflect the impact of flood control policies and find the advantages and disadvantages of the flood control measures.

2. Flood Events in China and Japan

Asian's population and high rate of development make it uniquely vulnerable to high economic loss during flood events. In particular, China with the third and Japan as the second economy country had big effect from the increased flood disaster in recent years.

Flood events have not been stopped in more than 5000 years of Chinese history. The earliest recorded flood disaster was happened around 2000 B.C. As we know, the recent large floods generally happened in the south of China, especially Guangzhou city as a big city on the end of April 2010. Because of this flood event, many flights were canceled, more than 1 million people become homeless and there was a great economy loss. The three floods with the highest death tolls occurred in 1887, 1931, and 1938 during what is known as the black war period of China (Table 1). The death tolls from each of the three flood disasters were over 500,000 people. In the modern era, the death tolls of flood disasters have decreased, but the economic loss has increased, and the main flooding area in China has shifted from the Yellow River basin to the Yangtze River basin as shown in Table 1.

Compared with the China, the Japanese river basins are much smaller and the effect of typhoon is stronger (Nakagawa, H., 1996). The oldest recorded flood event in Japan is called Countries flood and happened around the middle of 6th century. Because of long rainy period, disastrous floods happened once a year during 623 A.D. to 741 A.D. The flood disaster happened in Kyoto and the Barada bank collapsed in 750 A.D. Disastrous floods also occurred in Kinugawa and Aratamakawa in 758 A.D. and 761 A.D. leading to enormous economic loss. The Yodo river flood happened in 772 A.D. and the Barada bank was broken again. During the period from 796 A.D. to 1530 A.D., there were more than 48 flood events in the Kyoto area. Most of 48 flood events, including 19 in Kinki followed a long period of rain. The death and damage of 858, 1231, 1486, and 1530 A.D. floods in the Kyoto area were large. After 1530, floods became much more widespread in Japan. Examples include the 1542 Kamanashikawa flood, 1604 Kantou flood, 1610 Toukaidou flood, 1624 Tonekawa, Arakawa, Chikumakawa flood, 1650 Kyushu Kinki Toukaidou flood, 1681 Takamatsu flood and the 1694 Fujikawa Chikumakawa flood. From 1530 to 1741, countries floods happened more than 100 times, and the deaths in floods were more than ten thousands. In 1742, 2800 people were killed in the Inunomansui flood disaster as shown in Table 1. In 1934, the Muroto Typhoon and in 1959 the Vera Typhoon lead to major floods and more than 3000 people died. In comparison with the paloe-floods in Japan, the recent floods had two characteristics. More recent floods were characterized by frequent large typhoon and record heavy rainfall in a large area.

Table 1 Recent flood events in China and Japan

China			Japan		
Flood Event	Number of death (person)	Economic loss	Flood Event	Number of death	Economic loss (JPY)
1931 China	2,500,000–3,700,000		1742 Inunomansui	2,800	
1887 Yellow river	900,000–2,000,000		1885 Yodo river		
1938 Yellow river	500,000–700,000		1910 Kantou	900	
1935 Yangtze river	145,000	10.0billion CNY	1934 Muroto Typhoon	3066	
1954 Yangtze river	30,000		1938 Hanshin	600	
1998 Yangtze river	3,656	135.4billion CNY	1959 Vera Typhoon	5098	
2009 South China	95	150.0billion JPY	1982 Nagasaki	299	3000 billion

They are also characterized by the change in the relationship between the flooding area and damage caused by the flood. Area of inundation has been reduced according to the development of flood control policy, but damage density has increased five times because of the rapid growth of the economy and the increasing centralization of population.

There are three factors that lead the frequent flood disaster in Japan.

[1] Steep Elevation

Japan's geography is characterized by the relatively narrow islands with steep mountain ridges running down the center making the rivers short and steep in elevation.

[2] High precipitation

The mean rainfall in Japan is approximately 1,700 mm – larger that is higher than the world average of 970 mm (Kazuya Inoue, 2007).

[3] Large, swift floods

Because the areas of the river basins are small, the rivers are short and steep in elevation, and precipitation is high, the floods in Japan start and end comparatively quickly. Flood intensity in Japan is much higher than the world average flood discharge per unit area.

3. Overview of the development history of flood control polices in China and Japan

Following the history of flood events, the governments and researchers of China and Japan are continually improving the flood control policies from the ancient time to present. We found that the flood control technology and policies were vastly improved during periods in which the governments attached importance to reviewing the flood control history in the two countries. An overview of the flood control history will be given in this part.

Flood control history in China began with Yu the great and his father Gun some 4000 years ago. According to the great flood in China, Yu assigned by King Shun was successful in leading the people to control the flood by dredging new channels instead of his father's building dikes. Looking at Chinese history, it is clear that a good leader of the country attached importance to flood control so as to develop flood prevention technology and educate many flood control specialists. "A good leader for the country must first eliminate five victims. In the five victims, flood disaster is taking the first place." said by Guan Zhong(725 BC-645 BC). He encouraged the king of Qi country to pay attention to floods and created many theories according to the environmental conditions and "For the character of water, lead it from high to low." (Hao Gu 2006). Sun Shuao (630 BC -593 BC) in Chu country was an advocate for agricultural water supply which was achieved by building new channels and the artificial lake Quebei that also as storage for the flood season. The “12 Channels quoted from Zhang river” Hao Gu (2006) was constructed by Ximen Bao(445BC-396BC) who is an ancient Chinese government minister and court advisor to Marquis Wen of Wei during the Warring States. Qin Shi Huang as the leader of Qin Country created Qin Dynasty unified the six countries in 221 BC. He trusted on that the development of agriculture could lead the country to prosperity and power. He thought that the water supply and flood control were of primary importance for the development of agriculture.

Li Bing and his father were famous for flood control and were responsible for the design and construction of the Dujiangyan Irrigation System remains in use after 2000 years. "In the positive site to take water, in the side site to irresolute sand" is a part of Li Bing`s flood control theory used in the Dujiangyan Irrigation System. The goal of this system was to reach the flood control aim of "Dividing the flood to reduce the disaster, drawing water to irrigate fields".

Zheng Guo, a hydraulic engineer born at the end of the Warring States period was assigned by Qin Shi Huang to build Zhengguo Canal north of Xian, Shangxi Province at the end of the Han dynasty. Emperor Wu of Han (156BC-87BC) had an important realization about flood disasters and personally conducted the levee breach closure of Huanghe River. Under his supervision, flood control and irrigation greatly expanded and several specialists emerged such as Zheng Danshi, Zhuang Xiong, Shima Qian and Bai Gong. Cao Canal, Longshou Canal, Liupu Canal and Bai Canal were constructed according to the specialists' suggestion. Constructed in the middle ages, Cao Canal was a very important canal and, for the first time, combined food transportation, flood prevention, and irrigation system (Fig.1). Wang Jing created the "Weir Flow" method to repair Junyi Canal at the Yellow River in the end of the Eastern Han Dynasty. Jiang Shidu in Tang Dynasty was as a officer in one county, and he did his best to control flood in that county. He reopened the Pinglu Canal at Hebei province in 705AD and dug out drains that were used to divide floods at Shangxi province in 714AD. The Tang Dynasty, a feudal society and economic powerhouse, depended on the fast development of agriculture. To facilitate the fast development of agriculture, the government made an irrigation law called Shuibushi (The Laws by the Water Conservancy Department) (Hao Gu 2006) and also considered flood control as a part of checking the officers. In this irrigation law, it includes field irrigation management, channel repair and management, dyke repair and management and so on.

The Song Dynasty was the second strongest economic dynasty and also paid a lot of attention to flood control. Fan Zhongyan was a specialist on flood control in the Song dynasty. He built Fangongdi which is a dyke focused on the flood from the sea and he also considered the water management of Lake Tai, Jiangshu province. Su Shi was one of Eight Great Men of Letters of the Tang and Song Dynasties focused on urban floods and lake management. He constructed Sudi dyke that is used to prevent urban floods at Xuzhou and Sudi dyke that is designed to promote good lake management around Xihu Lake. A complete law on irrigation and water conservation called "Irrigation Constraints" was edited by Wang Anshi and published by the government of Song in 1069AD. In the "Irrigation Constraints", it said that the officers are encouraged and supported to develop irrigation and water conservancy, to improve the condition of abandoned land, plans of repairing irrigation are required to report to the government, and the date, budget and maintenance of flood prevention and irrigation program are needed.

The oldest part of the Grand Canal in China dates back to the 5th century BC, although the various sections were finally combined during the Sui Dynasty. The Grand Canal is also known as the Beijing-Hangzhou Grand Canal which is the longest canal or artificial river in the world. It starts at Beijing, winds through Tianjing, Hebei, Shangdong, Jiangshu and Zhejiang to Hangzhou city. Because the capital was changed to Beijing during the Yuan Dynasty, it completed connecting Beijing and Hangzhou and called the canal the Beijing-Hangzhou Grand Canal after the construction in that period. From the Yuan Dynasty, canals were built to combine flood prevention, irrigation and transportation. Guo Shoujing led the construction of the Beijing-Hangzhou Grand Canal from Shangdong to Beijing, and he improved the measuring technology for flood control. During the Ming Dynasty and during the Beijing-Hangzhou Grand Canal’s construction, Bai Ying, a farmer and irrigation specialist suggested the construction of the Gangchengba Dam and Daichunba Dam to control the water so as to keep enough water for boat transportation. Pan Jixun was famous for managing floods on the Yellow River by using “Use water to trash solid in the river bed, reduce the flood”. Xu Guangqi (1562-1633) a catholic created “Field self water conservancy system” theory for flood control and irrigation.

In the Qing Dynasty, Emperor Kangxi and Qianlong thought the flood control and irrigation is the most important thing for the country. In the modern ages from 1840 to 1900, Jia Shumei “Bricks Dam” and Wu Dazheng “Reinforce the shoal, Protect Dam” were the best flood control practices. Before 1949, China was in the wars period and the efforts of flood control were almost stopped. After the People Republic of China was established in 1949, the flood control policies and measures were dependent on civil engineer to raise dykes and construct dams.

With the 1998 China flood happened at the Yangtze River, the government had an important realization that the current flood control policies depended on the structure measure that cannot reduce the death and damage during flood disasters. Because much human activity occurs in the river basin area, it led to much land use change in that area. According to the 1998 flood event, the new flood control policies combined structure measures and non-structure measures. These policies were published by the Chinese government to adapt to the future floods. In the structure measure of the new flood control policies, it includes “To construct the Three Gorges Dam”. Specially, the non-structure measure considers four parts, changing land use, welfare law, moving out prone zone and environmental protection. In the part of changing land use, it includes the changing from agricultural land to lake, agriculture land to forest and urban land to lake.

Fig.1 Development history of flood control in China

In flood control history, some points were found such as the start place of flood control was in the Yellow River called the mother river that is the birth place of the Chinese nation. Some evidence was shown in flood control of Yu the great and his father Gun. The flood control always included irrigation as an important part for agriculture (Chunming Zhao et al., 2005).

According to the remains of drains and embankments, the flood control history in Japan came from the Yayoi period (300BC-300AD). The real flood control efforts were started during the Kofun period. Under the Union political power of Royal prerogative of Yamato was established at Kinai and the floods happened in Yodo and Yamato rivers, Horie canal of Nanba which drained flood from Kawauchi lake to Kawauchi bay was excavated, and in order to fix the Yodo river channel the Mamuta bank was constructed. The Tsu temple ruins in Okayama city is on behalf of the flood control technology of this period. During the early part of the 8th century, Ritsuyo country paid attention to flood control. In Ritsuyo, Kokushi and Kunji officers set up efforts for flood control, the water in river and for irrigation is as public water, and the flood prevention measure and the water use are decided by the government. These flood control policies achieved some good effects. Because the power of Ritsuyo country was lost, the construction of drains and reservoirs in the small scale are used for flood control. For a good example, Mannouike reservoir was built by Kukai in this period. Kanshin Sangha was played important roles in this period.

The return of area and systematic flood control happened during the Azuchi–Momoyama period of the Sengoku period. Bunroku bank in the Yodo River constructed by Hideyoshi Toyotomi and Shingen bank built by Shingen Takeda still remain some ruins. The technology of ring dykes appeared at Kisosansen River from the 13th century.

Entering the Edo period, the flood control was becoming large-scale and popularized. The technology of flood control developed very quickly. The famous flood control in the Edo period was to change the river channel (rapids substitution). This river substitution was started at Yahagi River from 1605, and it also was done at Tone River during the 17th century. Hourekichisui flood control event changed the Kisosansen river channels in the middle of the 18th century. In the end of the Edo period, straightening of river channels and setting up flood plains instead of reservoirs were used for flood control (Fig.2).

In the Meiji period, the new government recommended flood control specialists from Europe and other developed countries. As a good example of flood control in early modern times, the flood control measures of the Netherlands called “Low water flood control” were based on securing flow quantity by installing the spur dike in the river channel, aiming at the stability of the duct, and digging up the river bed (Fig.2). The “Low water flood control” cannot prevent floods on its own. In 1896, Kasen Law was created, establishing the principle that directs flood flow to the sea as soon as possible. After that, “High water flood control” designed to straighten the river channel and build the high bank was becoming the main measure of flood control.

In the Showa period, the economy developed in quickly. Under the influence of the U.S., flood control was beginning to integrate the river and construct the multipurpose dam. After the World

War II, the large flood disasters began to be considered with reference to typhoons. In the 1980s, dam construction began to be optimized to give a constant flow to the river, and natural environment while providing flood defense. The Green dam concept that depends on the forest and grass to control the flood also became an important topic. From the 1990s, the natural flood control and some issues outside of flood control and irrigation became important parts of flood control policy (Fig.2). Meanwhile, the new flood control increasingly had to deal with increased flood damage in urban areas.

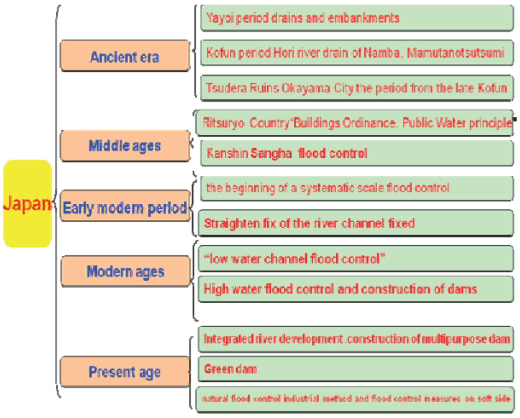

Fig.2 Development history of flood control in Japan

4. Case-study of flood control polices in China and Japan

1. Gun and Yu and the great flood control policy

Gun used dykes to stop floods, because the floods were so big that the dykes can only raise the water. Dykes in that period failed to control the floods although dykes remain a useful way to achieve flood prevention in modern times. Building new channels to lead water to the sea was used by Yu the great instead of dykes. The new channels were able to reduce the level of water and irrigate the fields.

2. Dujiangyan Irrigation System

Dujiangyan, located in the Min River, Sichuan Province, China, is a combined flood control and irrigation system built in 256 BC during the Warring States Period of China by the Kingdom of Qin (Shuyou Cao, et. al., 2009). It is still in use today and still irrigates over 5,300 square kilometers of land in the region.

In the Dujiangyan irrigation system, there are three main constructions.

[1] The main part of this system is Yuzui or Fish Mouth, shown as "A" in Fig.3. It is named for its conical head that is said to resemble the mouth of a fish. It is an important structure that divides the water into inner and outer streams. The division for the inner stream normally is 40% to 60% during floods. It helps the inner stream to carry the river's flow into the irrigation system, and the outer stream drains away the rest, flushing out much of the silt and sediment.

[2] Feishayan or Flying Sand Weir shown as G in Fig.3, is about 200m wide and is designed to direct the water from the inner stream to the outer stream. It cleans the water by drawing out the big sediment to reduce the water level and also ensures against flooding by allowing the flow of the water to drain from the inner to the outer stream. It has replaced Li Bing's original weighted bamboo baskets by with modern reinforced concrete weirs.

[3] Baopingkou or Bottle-Neck Mouth, shown as I in Fig.3, is the final part and main part of this system. It leads the clean water to the irrigation channel. It also works as a check gate, creating the whirlpool flow that carries away the excess water over Flying Sand Weir or the narrow entrance near Bottle-Neck Mouth between Lidui Park (J) and Renzi Dyke (H) (Fig.3) to ensure against flooding.

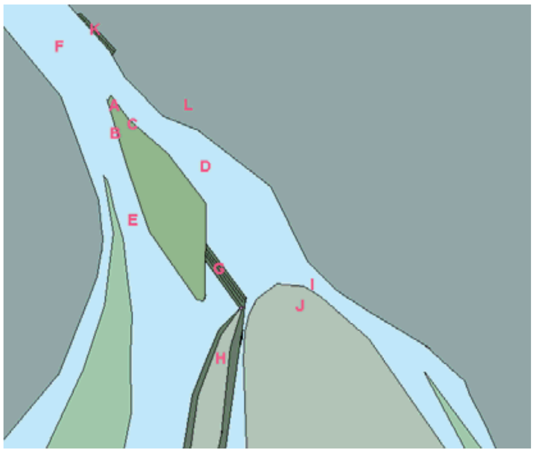

Fig.3 Structure of Dujiangyan irrigation system

A: Fish Mouth. B: Outer River Dike (Jingang Dike). C: Inner River Dike (Jingang Dike). D: Inner River. E:Outer River. F:Mingjiang River. G: Feishayan (Drainage Dam). H: Renzi Dyke. I: Bottle-Neck Mouth. J: Lidui Park. K: Baizhang

Dyke (Dike). L: Erwang Temple.

According to the thoughts of Li Bing and his father, the people summarized its experience in flood control and water usage as: "Harnessing Shoals Deep, Building Dams Lower" or "Keep the weirs low and the sluices deep" (Shuyou Cao et al., 2009). From this system and Li Bing's flood control thought, several good strategies can be identified:

[1] Short and long-term strategy

This system can prevent flood disasters in short-term. If does not require regular repairs although it cannot work in the long term. Li Bing established a major agency guided by one rule that is "Every year the system needs small repairs, every five years need a big repair." This rule helped to manage this system for the long-term.

[2] Combination of flood control and irrigation

Fish Mouth works to "Divide the flow to reduce the flood, draw the water to irrigate the farmland". Bottle-Neck Mouth is an important component that combines flood control and irrigation. As we know, the Lidui Park (J) was connected with Bottle-Neck Mouth (I) by a mountain. Because of this mountain, the flood waters are restricted from flowing. The mountain was cut for drawing the water for irrigation at Bottle-Neck Mouth. The Bottle-Neck Mouth has a mark for controlling the water to prevent flooding during flood season and maintaining water supply for agricultural use.

[3] Co-ordination on Part and whole

When floods are coming, Flying Sand Weir can break so that the water can flow to the outer stream to protect the whole area from flooding.

The headwork structure of ancient Dujiangyan is recognized traditionally as a non-dam intake project. However, historic records show that the division and intake structure actually formed a check-gate dam division system. According to historical records, a temporary low dam and embankment by local natural material that is wood-tripods with bamboo-cages were constructed in ancient times, and used continually in each year's repair until 1974. Bamboo-cages are long sausage-shaped baskets of woven bamboo filled with stones used as a temporary dam under the support of wood-tripods. The structure of bamboo-cages with wooden-tripods is simple and cheap but effective and has been used for over 2000 years.

The new construction of the check-gate at outer stream (Fig.3 - B) not only maintains the stability of the river regime of hydraulic head. The new structure also improves the environment of water diversion and sediment exclusion for this irrigation system.

3. Structure measure and non-structure measure on flood control after 1998.

Since 1998, the Chinese government paid attention to the large flood disasters on the Yangtze River because of the notable human populations. To address the issue, the flood control policies were changed to use structure measure and non-structure measure (Hongtao Wan, 2003).

[1] Structure measure

The construction of the Three Gorges Dam in Yichang city, Hubei Province was discussed by Sun Yat-sen in the period of Nationalist China. It also was discussed by Mao Zedong after the founding of the People's Republic of China. However, there is some trepidation about environmental change after the construction of the Three Gorges Dam. Because some researchers' evidence has shown that the benefits outweigh the costs, the construction of the Three Gorges Dam was confirmed as one of the structure measures after 1998. As a lesson from the devastating floods in 1998, it is recognized that reinforcing levees and regulating river courses are important measures to raise flood control capacity. Accordingly, reinforcing stem levees, constructing high-standard levees and dredging river beds are included in this structure measure policy.

[2] Non-structure measure

Because major floods were coming again and again and the economic loss of the damage in floods was becoming larger and larger, the government realized the flood control cannot only depend on the structure measure. Especially after the 1998 flood event, the non-structure measure is taken to prevent the floods and reduce the damage. The non-structure measures include "Changing land use", "Welfare rule", "Moving out the prone zone" and "Protecting the environment".

"Changing land use" includes changing agricultural fields to forests and agriculture fields to lakes, and urban areas to forests or lakes. One major reason for frequent water disasters in China is the serious destruction of the ecosystem and environment. Such big lakes as the Dongting Lake and Poyang Lake in the Yangtze River basin have suffered from continuously increasing sedimentation, over 60% of which is from the cultivated slopes in the upper and middle reaches of the river. According to the evidence shown that the forest and grass can release the flood and delay the peak discharge, It is imperative to implement ecological rehabilitation in the upper and middle reaches of the Yangtze River with focuses on water and soil conservation by transforming slope fields into terrace fields, enclosing mountains and planting trees, transforming farmland into forests and grassland on a large scale. The water surface area of key reservoir lakes such as Dongting Lake and Poyang Lake in the Yangtze River was reduced 40% or more in 1998 than before 1949 by building the ring dykes to use the lake for farmland. The function of the key reservoir lakes to storage and release was almost lost. With the realization of the flood control function of these key lakes, transforming fields back into lake area is carried out to reduce floods. In the downstream, changing some part of urban areas will help to reduce the floods.

The “Welfare rule” provided welfare money and equipments for the people who suffered from the flood disaster. It marks the first time to that welfare was provided for victims of flood disasters.

“Moving out of the vulnerable areas” required the people who lived in the prone zone to move to a new city. The government supplied some welfare money and houses for these people. Most of these people were living in the lake prone area. This movement can increase the surface are of lakes and reduce the economic loss and death.

The last part considers the environment and its impact on climate change and flood frequency.

With rapid climate and land use change, the flood control policies need to consider management of extreme flood events urban area floods (Georg Petersen, 2009). The flood disaster insures should be considered to cover in the flood area.

4. The river channels’ straighten fix

According to the Japanese geographic situation, the river channels’ straightening can allow the water to flow very quickly from the upstream to prevent floods, but it cannot hold the water and reduce the sediment.

5. High water level plan and flood control

The maximum water level in each river is counted according to the historical records. The height of dykes depends on this maximum water level. This kind of flood control measure can prevent the flood disaster to some degree. However, the height of dykes is raised again and again because of the sediment accumulation in the river bed. This flood control measure could be enhanced, if it was combined with dredging and the trends in climate change and land use change would be considered.

6. Natural flood control methods

A strong opposition to building construction concrete dams occurred in the 1980s. Green dams were a popular option for natural flood control in that time. Many researchers did some good studies on the flood control capacity of green dams. Takara et al. (2004) reported that the green dam has eight important functions, such as ecosystem function, nutrient cycling function, earth environmental persistence function, flood control function, irrigation function, local environmental persistence function, recreation function and production function. There is some evidence shown that the flood control function of the green dam can relieve the flood in the short-term. If the rainfall continued for more than one week, this function of a green dam would be lost. A combination of green dams and concrete dams is a good way to control floods. Good flood disaster management must be coordinated with a good communication system of flood disaster information, support for the rebuilding and education for evacuation. This information communication system must focus on forecasting the flood disaster, sending the flood disaster information and leading the people to evacuate floods. For the support of the rebuilding, the people must be assisted in rebuilding the cities and homes with money, technology and equipment. Education is a very important part to teach the people how to keep themselves safe during the coming flood.

The recent research on flood control in Japan is focused on the urban flooding, real-time flooding model building, and flooding under extreme climate conditions. According to this recent research, some new flood control measures are found such as Storing Flood Water in the Retarding Basin Protects the Urban Area, Underground River Reduces Flood Water Damage in the Watershed, and Dissemination of River Information by Mobile Browser Phones (JEIC report, 2009).

5. Conclusion and suggestion

We review flood disasters in China and Japan and identify some flood characteristics in these two countries. The period of flood in China is longer than Japan. The floods in the two countries have not been stopped during the whole history.

Some relationship between Japan and China are shown in the overview history of flood control policies. Some similar technology is used in both countries in the ancient period. This is expected, because of the close contact and communication between the two countries in ancient times. The Chinese government studied some policy approaches to addressing flood control in the recent period.

Some suggestions are given with the comparison between Japan and China. In China, good flood communication systems and education for the citizens is required. In Japan, the Co-ordination on part and whole of flood control can help control flood more successfully.

Acknowledgements

The authors are grateful to the Committee members for DPRI Publications, who made the previous versions of this instruction, and also to the staff of GCOE Human Security Engineer of Kyoto University and my laboratory for giving me much help.

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日本と中国の治水政策の評価

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要　旨

優れた治水政策は，頻繁する洪水を防ぐ為に歴史的に非常に重要な役割を果たしてきた。中国治水史は大禹らの治水対策から始まり，4000年以上の歴史があると考えられる。日本の文化は中国の文化と類似する点が多くあるが，治水に対しては異なるアプローチを用いてきている。 1660年以降の土木技術の高度化で，治水面では主としてダム，堤防，その他の治水施設の建設により達成されている。 しかし，これらの構造物のみに頼る治水政策では洪水被害を完全に食い止めることはできない。本研究では，両国の治水史変遷の相互比較を通じてあるべき治水対策を評価する。

キーワード: 治水，都江堰，歴史，潅漑，土地利用