Multifunctional Uses and Development Strategies of Tsao-Gung Canal

Shu-shr Yeh [1]

Abstract

Since the completion of its construction in 1837, the Tsao-Gung Canal (TGC) has irrigated the fertile farmlands located in nowadays metropolitan Kaohsiung area. As time goes by, many of the irrigated farmlands has been transformed into industrial parks and residential areas. As a result the TGC irrigation area has declined from more than 14,000 hectares to about 6,400 hectares and the Canal has been facing the transition of irrigation function.

For pursuing the sustainable management of Tsao-Gung Canal, six professional scholars were engaged in research of the following six aspects of concern:

1. Management and development of agriculture
2. Cultural assets and living in Tsao-Gung irrigation area
3. Contribution of the Tsao-Gung Canal to irrigation engineering and management and its future perspective
4. Irrigation water use transfer by Kaohsiung Farm Irrigation Association（KFIA）
5. Planning and promotion of water-friendly facilities in communities
6. Wetland parks

Afterwards, the canal operators and related people in the KFIA's working stations in Tsao-Gung irrigation area were gethered to explore the problems they practically faced and their solutions based on the research results of the six aspects. Taking "developing agriculture to be an industry with high economic value" as the purpose, they proposed appropriate suggestions on the orientation and direction for future development to the aforementioned working stations. Lastly, the related professionals and scholars and local prominent people were invited to explore the desirable ways for multifunctional uses and the strategies for future development of TGC and to reach consensuses on these issues. And it is anticipated that KFIA, local governments, and even central government would scheme the multifunctional uses of Taso-Gung Canal to accommodate the changing social and environmental situations.

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[1] Secretary General of Tsao-jiin Memorial Fundation For R & D For Agriculture And Irrigation(Tsao-jiin Fundation) , tsaojiin@ms24.hinet.net Tel:88675885400

[2] The Whole Paper Is On: http://www.kfia.gov.tw/tjrad/

Introduction

The Tsao-Gung Canal (TGC, as Figure 1-1) is located in the Kaohsiung plain in southern Taiwan, spreading in the territories of Kaohsiung County and Kaohsiung City – the second largest city in Taiwan. It was built in the era of China's Qing Dynasty. In order to commemorate the then Fengshan County Magistrate Mr Tsao Jin's merits of initiation of and achievement in construction of the TGC, his superior official, Mr Xong Yi-Ben, named the canal after the magistrate's family name as "Tsao-Gung" (literally Master Tsao) when it was first completed construction in 1839.

The development of irrigation infrastructure in Taiwan was initiated in the era of Koxinga's（Zheng Chenggong）administration of Taiwan Island, who led his army to the island in 1661 and defeated the colonial army of the Dutch administration. During the era of Koxinga's administration the major irrigation facilities in Taiwan were still mainly of small-scale farm ponds and ditches built by farmers themselves. In 1704, the head of Xinglong village (i.e. today's Zuoying area of Kaohsiung City), Mr Song Yong-Qing dredged the local Lotus Lake and also constructed embankments, diversion dams and canals staring from Jiadungkeng to the foot of Banping Hill. This was the first irrigation engineering works proposed and supported by the local authorities. For solving the event of irrigation water shortage in 1837, Magistrate Tsao Jin found that farm ponds could not only retain the surplus water discharged from canals and the rainwater but also regulate the runoffs caused by heavy rainfalls and thus mitigate the floods in the irrigation area itself and nearby. Therefore he adopted canals and farm ponds where appropriate to construct the TGCand diverted the irrigation water from the Xia Danshui River (today's Kaoping River) into it. Originally there were only two main canals: the Old Wuli and the New Wuli for the Tsao-Gung Canal which were completed in 1839, with their headworks located at Jiuqutang of Xiaozhushangli. Moreover, the then Lotus Lake was dredged which made the TGC' function more effective. In 1840, an event of severe drought occurred in the Kaohsiung plain area. All the farms except those in the service area of this so-called Tsao-Gung Old Canal suffered from serious disaster. Tsao Jin the Magistrate then constructed the new canal, with its engineering cost refunded by the beneficiaries in accordance with their payment method negotiated and resolved by themselves. Such a method was to levy the land taxes of the benefited farms. This new canal was completed

in 1844, which is the Tsao-Gung New Canal nowadays. Both the old and new canals' water sources were the same, namely the Kaoping River.

Since it was built over 170 years ago, the TGC ever serviced more than 14,000 hectares in the metropolitan Kaohsiung area. This irrigation canal draws water from the Kaoping River at Jiuqutang, and the canal route passes through the metropolitan Kaohsiung area. In Kaohsiung City the Canal ever crossed three major rivers: Houjing, Love and Qianzhen; and connected the then existing large ponds including: 1. Neiwei Pond (now abandoned), 2. Jinshi Lake, 3. Qifan Pond 4. Yangzilin Pond, 5. Benguan Pond (now abndoned), 6. Baozhugou Pond (now abandoned), 7. Amituo Pond (now abndoned), 8. Tianliao Pond (now abndoned), 9. Caigung Pond (now abndoned), 10. Caoya Pond (now abandoned), 11. Popi Lake (now abandoned),

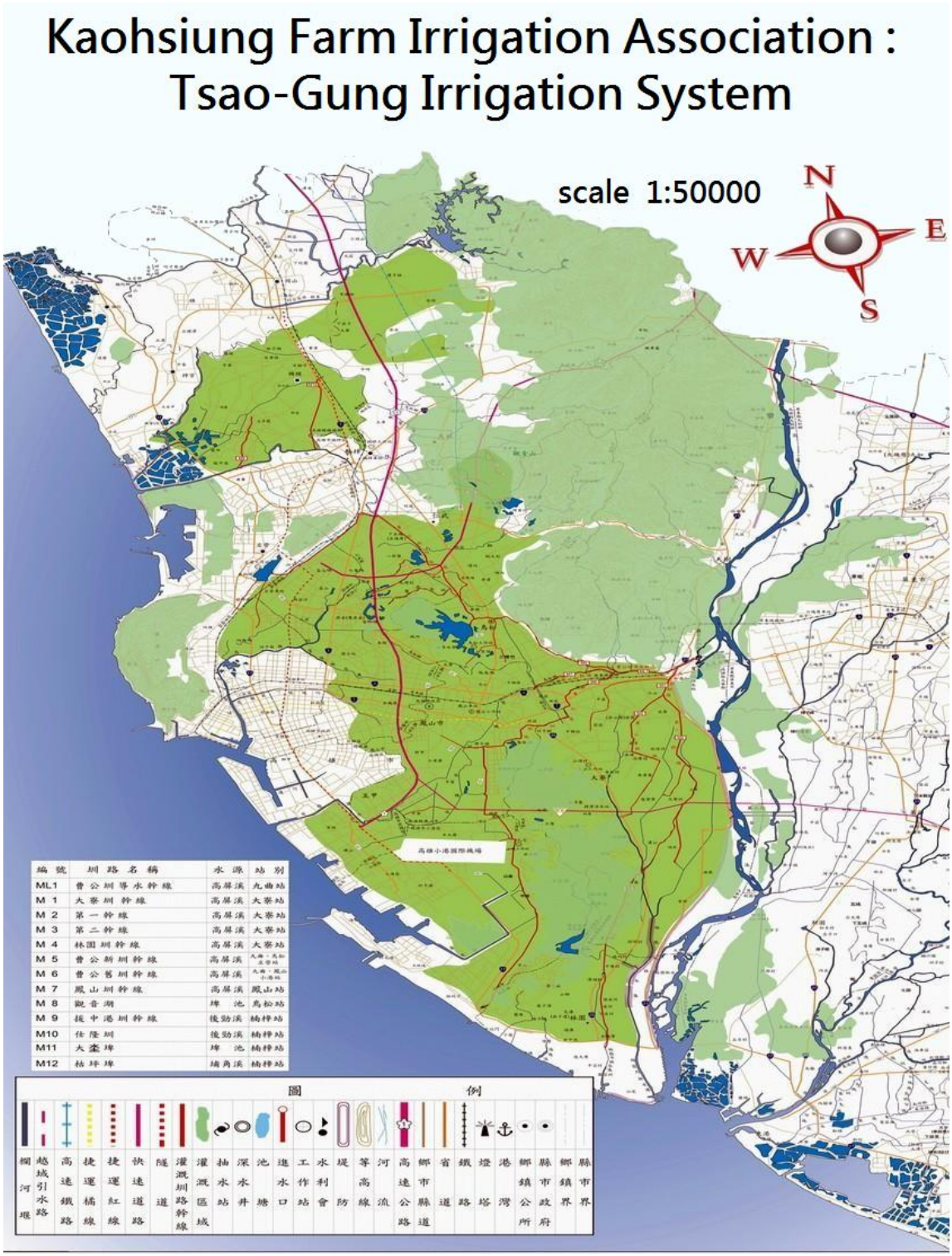

Figure 1-1 Tsao-Gung Irrigation System

12.Caotan Pond (today's Kaohsiung Metropolitan Park), 13. Guanyinhu Pond (discharged into Shilong River and then diverted into the Tsao-Gung irrigation system), and 14. Lotus Lake (the largest of all the ponds). The Tsao-Gung irrigation area spreads in the territories of Kaohsiung County and Kaohsiung City. Its north is bordered by the Gangshan irrigation area and stretches along with the Houjing River into Lingkou, its northeast neighbors with Qishan irrigation area, and its east and southeast are bordered by the Kaoping River. Presently the total irrigation area of TGC reduces to 6.461 hectares, with two rice crop seasons per year plus red beans and muskmelons as the main crops grown in winter. The average annual rainfall is about 1,700 millimeters, but unevenly distributed during the year. The rainy season is from May through September; while the dry season from November to the next April. The study area of this paper is the Tsao-Gung irrigation area serviced by the TGC possessed and managed by KHIA. In the whole area seven working stations have been established by KHIA for irrigation operation and management and maintenance purposes. They are Jiuqu, Daliao, Fongshan, Siaogang, Zuoying, Nanzi, and Niaosong working stations.

Six Directions for Research of Multifunction of Tsao-Gung Canal

In order that the Tsao-Gung Canal functions to support agricultural production, ecology and living (PEL) and to diversify the utilizations of its water resources, in this study was formulated six research directions as described respectively in the following.

Management and Development of Agriculture

The Tsao-Gung irrigation area of TGC is plentiful with recreational and leisure (R&L) resources and therefore is very suitable for developing R&L agriculture for people to experience its special agricultural products, farm landscapes, rural culture, cultural assets and ecological environments. Additionally, this kind of R&L agriculture will also promote the further growths of related industries such as agriculture, restaurants, home stays, cultural relic souvenir shops and transportation services, among others.

The government at present stage is encouraging the development of domestic R&L tourism agriculture. For example, the national Tourism Bureau has proclaimed the "New Strategy for the Development of Tourism in the 21st Century", the Council for Economic Planning and Development has stipulated the "Plan for Promoting the Development of Taiwan's Tourism", and the Council of Agriculture (COA) has formulated the "Regulations for Guidance and Management of Recreational Agriculture". Based on the guidance regulations mentioned above, the recreational agriculture will be able to be further developed.

There are four characteristics in the Tsao-Gung irrigation area in respect of agricultural R&L: (1) the abundance of natural ecological resources; (2) the cultural education related to rural historical relics and ancestral halls; (3) the agricultural resources with respect to the economic crops such as pineapples, longans, water caltrops, rice, sunflowers and white ginger lilies; and (4) waterwheel irrigation systems, hiking, bicycling and crop harvesting. With the incorporation of the

aforementioned R&L activities it is possible that the Tsao-Gung Canal will be able to be developed multi-functionally.

This research was focused on the Tsao-Gung New Canal. Its command area together with the Old Canal's area in Fongshan City was divided into 5 sub-areas for planning of its R&L districts based on the basin's upper, middle and lower stream regions. Three tour corridors were laid out; namely, rural ecological corridor (green line), landscape ecological corridor (red line), and historical arts corridor (brown line). Furthermore, five R&L districts were schemed out according to townships, districts and cities. They are: the Water Area of Tsao-Gung (Dashu Township), the Flower Area of Tsao-Gung (Niaosong Township), the Pleasure Area of Tsao-Gung (Renwu Township), the Forest Area of Tsao-Gung (Zuoying District), and the Historicity Area of Tsao-Gung (Fongshan City).

In sum, based on the application of the concept of PEL (agricultural production, ecology and life), the five R&L districts proposed are summarized in Table 2-1:

Table 2-1 Tsao-Gung Canal area development with concepts of agricultural production, ecology and living

PEL / Districts	Production	Ecology	Living
Dashu Township	✓	✓	
Niaosong Township	✓	✓	
Renwu Township	✓	✓	✓
Zuoying District		✓	
Fongshan City			✓

2-1 .Cultural Assets and Living in Tsao-Gung Irrigation Area

In this research it was tried to investigate and examine the cultural features under the TGC area's cultures viewed from the veins of its development. Based on the research results, the Tsao-Gung Canal system may be divided into: (1) "district of water source from the Kaoping River" in Meinung and Qishan Townships; (2) "district of water intake of the Tsao-Gung Canal" in Dashu, Daliau and Linyuan Townships; and (3) "Tsao-Gung irrigation district" in Fongshan City, Niaosong Township, and Zuoying and Nanzi Districts. The demarcations of featured cultural districts in the TGC system area are as shown in Figure 2-1.

(1) The district of water source from the Kaoping River (Meinung and Qishan Townships)

(2) The district of water intake of Tsao-Gung Canal (Dashu, Daliau and Linyuan Townships)

(3) Tsao-Gung Canal irrigation district (Fongshan City, Niaosong Township, and Zuoying and Nanzi Districts)

2-3.Contribution of the Tsao-Gung Canal to Irrigation Engineering and Management and its Future Perspective

In response to the social changes such as the drastically decreasing farmlands which has been difficult to proportionally reduce the related irrigation canals, the Tsao-Gung Canal should be, in addition to keeping the existing agricultural irrigation function, studied the feasibility of its multifunctional uses to meet the needs of society and community environments. Therefore the purpose of this study was to review the mutual interference between drainage and floods in the entire water system of Tsao-Gung New Canal, and use of the Monte Carlo's simulation method to understand the flow situations under different canal flow conditions. The conclusions thus obtained are as follows:

1.The Tsao-Gung Canal (TGC) has been used for a long time, but most reports on it have been focused on its history, and part of them were about its irrigation performances, while its drainage and flood-prevention functions remain to be further studied.

2.There is no need to renovate the TGC without taking well prepared plans in advance and at the expense of its history and natural scenery. The problems due to previous inappropriate design of urban drainage should be solved by installation of sewage pipelines and improvement of sewer systems, instead of blaming the Tsao-Gung Canal.

3.The design discharge of the Tsao-Gung New Canal is about 110cms. After review of the statistics and analysis of its uses, it was found that at the times of big floods (once in every 20 years), its cross-sections were insufficient. For dealing with this problem, the KHIA itself should conduct relevant study and analysis to clarify the responsibilities due, and request the water regulation authorities to take into account the design of adequate drainage facilities such that the irrigation function of Tsao-Gung Canal can be sustained.

4.In this research the Monte Carlo's method was applied to practically calculate and analyze the variations of flows. Under the circumstances of lack of data and rather difficulty in control of scenarios, this tool was quite helpful in simulating the possible events that had never happened before, and hence is worthy of being promoted for further application.

2-4 . Irrigation Water Use Transfer by Kaohsiung Irrigation Association

It is increasingly uneasy to develop new water sources in Kaohsiung area nowadays, and the existing water resources have been gradually becoming insufficient to meet the growing demands. Under such conditions, it is essential to regulate and distribute the available limited water resources in the optimum way so

that the good water distribution will be achieved. In this research some suggestions were presented to the Kaohsiung Irrigation Association on save of more irrigation water for being transferred to other use purposes with charges of reasonable compensation for the transferred irrigation water. The suggestions are as follows:

1.In pricing the compensations for transferred water, it is necessary to take into account the additional costs for feedbacks to the costs required for the existing accomplishments of irrigation management techniques and the follow-up acceleration of R&D of new irrigation techniques.

2.To promote the Irrigation Association's management technologies for efficiently raising its capability in digitalized management and fulfilling water-save irrigation as well as rotational irrigation management, so as to increase irrigation efficiencies and hence save irrigation water.

3.To carry out R&D work of new irrigation techniques, step up the experiments and researches of the next generation's new paddy field irrigation techniques, and promote their applications at suitable times when it is economically beneficial.

4.To conduct research of related trading mechanisms of the trade platform of water bank, promote rational water trading markets, and facilitate the rationalization and economization of regulation, distribution and transfer of water.

2-5 .Planning and Promotion of Water-friendly Facilities in Communities

The following suggestions are proposed based on the on-site reconnaissance results at some spots where the Tsao-Gung Canal runs through, if these places are to be built the community water-friendly facilities:

1. Presently the quality of the water source of Tsao-Gung Canal is turbid. So before constructing community water-friendly facilities, the quality of the canal's water source is suggested to be improved first; then the treatments of water quality would be more efficient if certain places in the Canal's middle and down stream reaches are planned for construction of community water-friendly facilities.

2. The water gates of Tsao-Gung Old Canal have been assessed as the humanistic historical relics, and the local residents also suggested that the related competent authorities preserve their original appearances. Such a suggestion if adopted would bring about another business opportunities to local communities.

3. According to the present picture of the Mengli Village of Fongshan City where the downstream reach of Tsao-Gung Canal runs through, although the landscape design of the canal's banks have been primarily laid out it was found that the participation of the local community residents were less enthusiastic; and that the canal bank landscapes were designed with use of vertical earth-walls, and therefore are less water-friendly. Moreover, the water quality is not clean enough and needs be improved.

4. The improvement of Tsao-Gung Canal's reach that runs by the prophyta garden is still mainly to its water quality. Parts of the waterways obviously were deposited with quite large volumes of sediments and the flows contained lots of suspensions.

However, as there are some non-governmental organizations established at local communities for preservation of sustainable environments (such as the Prophyta Garden Community and Empowerment Association of Kaohsiung City), the communities in other canal reaches to construct the water-friendly facilities construction are suggested to refer to the related practice made in this canal reach.

5. For the present situation of the Dianpu Bridge in Fongshan City where the Tsao-Gung Canal passes under, some of the hardware items of water-friendly facilities already designed are suggested to be revised, so as to make them more water-friendly; for example, the slopes of the canal's banks can be made less steep. By so doing the relevant community residents would be more willing to participate in the planning of such facilities. Besides, the aspect of safety at water playgrounds should be paid attention to.

2-6.Wetland Parks

In the past agricultural development eras, both of natural and artificial wetlands in irrigation systems were mainly the irrigation ponds functioning to regulate the canal water. However, because of the previous land development in the Kaohsiung plain, most of the ponds had disappeared. The maintenance of canal waterways and preservation of paddy field ecology thus can make up the adverse impacts to the environments and ecology caused by the decreased water-surface areas. In recent years in the greater Kaohsiung area a series of planning of development of wetlands have been conducted. Under such circumstances the Tsao-Gung Canal is playing the role of water source supply to the wetlands of Shezilinpi, Jiufanpi and Zhouzi. The Canal will enable these wetlands to exist sustainably so that their ecological systems can be preserved.

Most of the natural wetlands in Taiwan's plain areas have been disappeared, but the promotion and management of paddy field ecology can correct the environmental and ecological problems due to lack of wetlands. It is also the key to restore traditional culture and reestablish land ethic. It is strongly suggests that the importance of paddy field ecology be fully recognized and practiced.

3.Survey on Opinions of Employees for Tsao-Gung Canal Service Area of Kaohsiung Irrigation Association

This chapter was the focus of the second year program of the research work. It mainly surveyed the opinions of the on-site employees assigned in the service area of Tsao-Gung Canal (TGC) of Kaohsiung Irrigation Association (KHIA). In the course of the research, discussion meetings with them were held separately in seven working stations of the Association: Jiuqu, Daliao, Fongshan, Siaogang, Zuoying, Nanzih and Niaosong. The concerned employees and committee members of the Association were invited to attend these meetings. The main topics were on the multifunctional issues of community water-friendliness, wetlands, historical culture, ecological environments, R&L tourism and agricultural water use transfer in the service areas of respective working stations. The purpose was to probe in depth the changes and problems that the YGC encountered in recent years, in order to find out the future development orientation and directions of the aforementioned working stations, and

eventually to promote the achievements of PEL (agricultural production, ecology and life) and the multifunctional uses of water resources by KHIA. The conclusions of the discussing meetings at these seven working stations are respectively summarized in the following:

4.Stakeholders' Comments on Multifunctional Uses and Development Strategies of Tsao-Gung Canal

The main task of this study was to invite the stakeholders including related professionals and scholars, and local prominent people in the Association's TGC service area, to hold a forum for discussing about the desirable ways of multifunctional uses of the Canal and also its future development strategies. The purpose of the forum was to find out the sustainable management strategies for the Canal, so that KHIA and the stakeholders including the local and even central governments will be able to cooperate with each other and reform a whole brand-new TGC that will be adapted to the social and environmental changes in contemporary era.

In this chapter are summarized the achievements of the aforementioned forum as described below in accordance with the topics:

1. Agricultural management and development
2. Cultural assets
3. Contribution of the Tsao-Gung Canal to irrigation engineering and management, and its future perspectives
4. Agricultural water use transfer by Kaohsiung Irrigation Association (KHIA)
5. Community water-friendly facilities
6. Wetland parks

5.Conclusions and Recommendations

The Tsao-Gung Canal (TGC) over the past 170 years has transformed the people living in the now metropolitan Kaohsiung area from prosperous rural settlements into rich industrial societies; and will improve the health of tomorrow's cities in the area through sustainable water management. As the TGC is being developed as a canal of multifunctions, the promotion of the Canal's reconstruction has become the most important task.

This research was conducted on six basic aspects of development of the multifulnctional uses of Tsao-Gung Canal:

1. Management and development of agriculture
2. Cultural assets and living in Tsao-Gung irrigation area

3.Contribution of the Canal to irrigation engineering and management and its future perspective
4.Irrigation water use transfer by Kaohsiung Farm Irrigation Associatio （KFIA）
5.Planning and promotion of water-friendly facilities in communities
6. Wetland parks

The six aspects above and the attention from stakeholders provided the directions for KFIA's furthur planning of the Tsao-Gung Canal's multifunctional roles. Complete discussions were conducted which scope included the preservation of cultural assets, and construction of the present irrigation-related facilities to long-term schemes in the future. It is anticipated that KFIA would make good use of it and get into detailed planning and construction of TGC, so that its environments would conform to the requirements of PEL and coherent with the future development, and its management and development would be sustainable.

However, while the hardware installations are complete, the people living in, and even out of the Taso-Gung irrigation area should form related organizations to share the responsibilities of mantaining and managing the new canal hardware and local cultural relics, and enhancing the special humanity tradition nurtured by Taso-Gung Canal. By doing so the Canal will be enabled to continue nurturing multiple local culture.

The role of the related government agencies is also a very important part. Although KFIA is a public judicial body, it doesn't have any legal authority, and its funds are mostly relied on supports from the related agencies, which are the obstacles to the Association in the management and maintainance of canals. If the related agencies could be intergrated in cooperation with KFIA in management and construction of Tsao-Gung Canal, it is for sure that the Canal's service efficiencies and acheivements would be increased, and past achievements revitalized.

The related centural agencies, the Kaohsiung City and Kaohsiung County Governments, KFIA, and related community organizations as well as community residents are related to each other and each one of them is a key part in the sustainable development of Taso-Gung Canal. The planned merger of Kaohsiung County and City in the year of 2010 will be a huge advantage for the multifunctional development of Tsao-Gung Canal. It is hoped that the event of merger would facilitate the planning and reconstruction of a complete and flawless Tsao-Gung Canal, which would make the Canal fully play its functions of irrigation and

flood-prevention, and also the people enjoy its functions and natural rural sceneries, and futhurmore the foundations for the future it establishes.

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