General Strategies of Asset Management by Taiwan's Irrigation Associations

Lee Tsong-Hwei*
Principal Engineer, Sinotech Engineering Consultants, Ltd., Taipei, Taiwan

ABSTRACT

The irrigation associations (IAs) of Taiwan are farmers organizations on participatory irrigation management (PIM) basis, legally vested with public juridical person status. In this paper are introduced the strategies generally guiding these IAs' management of main assets, i.e. irrigation and drainage infrastructure. While the asset management involves a variety of disciplines, focuses of the paper are made at institutional, legal, technical and financial aspects.
Traditionally these IAs care only for achieving optimum conveyance and distribution efficiencies in irrigation service to support crop production. Recently their functions extend to cater for livings as well as ecology due to changing irrigated agricultural situations, especially when gradually shrinking of GDP in the agricultural sector in Taiwan becomes inevitable after Taiwan joined WTO. Such a tendency will cause the financial prospect of these IAs to be gloomy.
Expansion of the financial sources of the IAs is pressing. Therefore the objectives of the AM of IAs are thus have to be extended. The Government is revising relevant laws and regulations so that the IAs may legally undertake or invest in new frontiers of businesses.

Keywords: asset management, O&M, management information system, risk management

1. ORGANIZATIONAL FEATURES OF IRRIGATION ASSOCIATIONS IN TAIWAN

In Taiwan there are presently 17 irrigation associations (IAs), formed, owned and managed by farmer water users. Their service areas in total are 376,455 ha, about 86 % of the total irrigated land of 438,974 ha. According to the state statutes each IA is a financially independent body managing its assets including irrigation and drainage (I&D) infrastructure, operation and maintenance (O&M) facilities, and the water resources registered in the water right certificates it has obtained. The management undertakings are carried out by qualified employees of various related disciplines, under the leadership of the general manager who is designated by and responsible to the chairman. The IA chairman is directly elected from and by the general members. In recent years, the IAs have been legally designated as public legal body. Such a status paves a legal base for enforcing by IAs the relevant laws and regulations.

The competent authority of these IAs is the Central Government's Council of Agriculture (COA), which supervises the management activities and evaluates the annual performances of the IAs. Depending on the financial difficulty situations and the needs and their degrees of urgency of respective IAs, the authority allocates subsidies to respective IAs. Meanwhile, the county level governments play the role of assisting with supervision of the routing operation of irrigation water distributions and regional drainage.

Therefore IAs in Taiwan are of non-governmental organizations (NGOs) based on participatory irrigation management (PIM). For efficient and effective use of limited water resources available,

the service areas of respective IAs are demarcated in accordance with river basins and I&D systems.

Number of Members – 17 IAs: 1,149,494

- 2,000 ~ 5,000 : 2 IAs
- 15,000 ~ < 30,000: 3 IAs
- 30,000 ~ < 50,000: 4 IAs
- 50,000 ~ < 70,000: 4 IAs
- 130,000 ~ < 140,000: 1 IA
- 160,000 ~ 200,000: 3 IAs

Number of Employees – 17 IAs: 2,876

- Less than 50: 2 IAs
- 50 ~ < 100: 7 IAs
- 100 ~ < 250: 4 IAs
- 250 ~ < 400: 2 IAs
- 400 ~ < 600: 2 IAs

1.1 Farmers associations and their relation with irrigation associations

There are also farmers associations (FAs) in Taiwan, serving the farmer members in respects of finance, logistics, skills and dealing mainly with farm inputs and farming skills of farmers at large. The functions of FA include provision of credits, sales of various farm inputs, promotion/upgrading of farming knowledge and skills, and guidance on living standard improvement. The joint efforts of FAs and IAs are ultimately to raise their farmer members' harvests and incomes and improve householding matters, hence to better their well beings.

These FAs, not with public legal body status, are organized on the basis of administrative boundaries. So there are FAs at the township, county and province levels. Over the years it is the combined contributions of these two kinds of NGOs that have greatly helped farmers attaining remarkable progress in agricultural technologies, bettering rural economy, and upgrading their living conditions. However, unlike IAs, a farmer is not obliged to become the members of relevant FA.

2. GENERAL ASSETS OF TAIWAN'S IRRIGATION ASSOCIATIONS

In the followings are summarized the major asset items related the I&D infrastructurs that the IAs in Taiwan possessed as of 2001.

Service Areas – 17 IAs: 376,455 ha.

- 250 ha ~ 750 ha: 2 IAs *(1,015 ha)*; - 20,000 ha ~< 30,000 ha: 3 IAs *(80,880 ha)*;
- 5,000 ha ~< 10,000 ha: 3 IAs *(21,960 ha)*; - 40,000 ha ~< 50,000 ha: 1 IA *(44,826 ha)*;
- 10,000 ha ~< 20,000 ha: 6 IAs *(85,963 ha)*; -60,000 ha ~< 80,000 ha: 2 IAs *(141,811ha)*.

Water resources according to water rights –

Service area of IAs (ha):	250~750	5,000~10,000	10,000~30,000	40,000~80,000
Diversion from streams (cms per mo.):	1.040	42.465	380.166	165.870
Allocation from reservoirs/ponds (cms per mo.):	-	3.727	13.841	72.526
Lifting surface water with pumps (cms per mo.):	0.464	1.833	34.189	53.682
Pumping groundwater (cms per mo.):	-	1.493	40.980	30.450
Total (cms per mo.)	**1.504**	**49.518**	**469.176**	**322.528**
Grand Total (cms per mo.)		**842.726**		

Irrigation systems -

- No. of systems: Total 1,963 nos.
  < 500 ha: 1,805 nos.; 501 ~ 2,000 ha: 77 nos.; 2,001 ~ 5,000 ha: 11 nos.;
  5,001 ~ 10,000 ha: 3 nos.; > 10,001 ha: 7 nos.
- Reservoir: 11 nos. (145.585 Mm3 of effective storage)
- Pond: 845 nos.
- Headworks: 1,172 nos.
- Canal - Main: 14,016,029 m;
- Canal - Tertiary: 30,870,803 m.
- Tunnel channel: 98,524 m
- Regulating structure: 33,864 nos.
- Measuring structure: 5,219 nos
- Conveyance structure: 134,173 nos.
- Irrigation well: 2,112 nos.
- Pumps for lifting surface water: 671 nos.

Drainage systems -

- Ditch: 22,627,926 m.

Proprietary lands -

- For I&D infrastructure (ha): 133,699
- Others (ha): 9,836

2.1 Asset registers

The asset registers (ARs) record the inventories of IA's, and are updated every year by respective IAs. They are part of databank giving detailed information on asset conditions, including addition of the data of the new, revision of the data of the improved or modernized, notes of those repaired, replaced, dismantled, etc., for the due period. Just several years ago the geographic information system (GIS) was introduced in the ARs of IA-owned land lots and the irrigation lands.

The contents of ARs in respect of land lots are based on relevant inputs from local land administration authorities, because the land owner has to pay IA membership fees and the land size determines the amounts of the fees. In addition to in-situ patrols and inspections of infrastructure facilities by IA personnel, the data periodically transmitted from GIS supplement field situations of these facilities, and hence are very helpful to IAs to take appropriate actions or measures of AM.

3. ASSET MANAGEMENT PROCEDURE

The scope of AM undertaken by the IAs is almost the same, as summarized below:

- Operation of I&D systems;
- Maintenance, repair/replacement, improvement, rehabilitation and renovation/ modernization of the I&D infrastructure and supporting facilities/equipment;
- Management of water rights;
- Delivery of bulk water to non-irrigation customers;
- Management of proprietary lands;

- Management of affiliated businesses; and
- Financial management, including collection of membership fees (O&M charges).

3.1 Asset management cycle

Every fiscal year (FY), the AM cycle comprises three stages interconnected for each year, starting from planning, followed by implementation, and then monitoring and evaluation (M&E). But the third stage's results are fed back to the first two stages for improving their relevant activities. In the planning stage, the IA prepares its annual work plan or AM program (AMP) including financial plan and budget, and submits to the COA by the end of September of the preceding year. The COA approves the AMPs, following the approval of its budget of corresponding FY by the Legislative Yuan (Parliament). And within three months after the end of each FY the IA submits its annual work/AM implementation realization report including settlement statement. The AMP contains mainly the aforementioned scope of AM.

3.2 Norms for AM implementation

Implementation of AMP is done in conformity with established laws, regulations and rules, and also essential administrative guidelines and technical specifications. Most undertakings of maintenance, repair, replacement, rehabilitation and modernization of assets are carried out with outsourcing, whereas the others are with insourcing.

Special measures for emergency repairs are formulated by respective IAs. Most of such repairs are carried out for repairing the sudden breakdown or damage, and or imminent failure of canal reaches and or structures, which are caused by unusually strong storms, typhoons or earthquakes.

The M&E activities are periodically executed internally by the IA manpower. Besides, periodical M&E missions on the implementation of AMP by all IAs are dispatched by the COA every year, too.

4. MAJOR ASSET MANAGEMENT PRACTICES

4.1 Asset management program

The preparation and implementation of AMP, including budgetary plan, is also an important strategy for the AM of IAs. Three components in the AMP are of pivotal to the IA: irrigation operation or service, maintenance of facilities, and financial management. Since the great majority of farmers of irrigation lands in Taiwan are of small farmholders, this condition does not favor the direct distribution of water to each irrigation plot. Therefore, the irrigation service strategy is generally formulated on the resources availability-oriented basis, to supply water down to the turnouts on the main canals, in accordance with fixed schedules, except in the areas of pump irrigation where demand-oriented strategy is adopted.

Whereas the operation of main systems is implemented by the IA employees, the water distribution in the tertiary blocks is the responsibility of corresponding irrigation groups that are formed on tertiary boundary basis. Activities of these IGs are placed under the supervision and guidance of the IAs concerned.

4.2 Management information system

Although the principle of zero-based and needs-based budgeting (NBB) procedure has been set for preparing annual budget plans in the maintenance component of AMPs, it has been hardly applicable in most of the IAs due to their chronicle constraints in financial resources. the various categories and items of maintenance works and their budgetary amounts to be allocated are usually selected and compiled from the ARs of the IAs' incorporated with management information systems (MIS's). These MIS's incorporated with GIS's, are supported by information centers.

4.3 Irrigation service

In management of the water resources as allotted in the water right licenses for irrigation purpose, the IAs are usually instructed by the Government to concede parts of their water rights in severe drought seasons to domestic and industrial uses, with reasons of living needs and national economy sustenance. Although the transferred water quantities are compensated by related water companies, yet the compensations actually received by IAs often are much lower than the actual costs due to social and economical factors specific to water. To meet the irrigation water supply to be reduced, the Government decreases planned cropping areas accordingly, which are to be serviced by the systems concerned, and meanwhile provides compensations to the farm plots so let fallow.

The monitoring of irrigation water quality throughout the I&D systems and at and around various water sources is also part of AM activities. Because many industrial estates or community compounds are located beside or passed through by some reaches of canals/ditches, or situated beside or around water sources, and hence the irrigation water as well as drainage is very susceptible to pollution. For maintaining the irrigation water as well as drainage in good quality, the local environmental protection agencies give support to IAs in protection of the illegal discharges of detrimental wastes into water body for irrigation purpose, and the return flows for the water demands and environments at the basin downstream.

The traditional role of IA in promoting the productions of rice, the staple food of the people in Taiwan, has changed recently, especially since Taiwan entered the World Trade Organization (WTO) in January 2002. From now on although the irrigated farmlands may be reducing, the IAs are additionally involved, through maintenance of assets of infrastructure, in promoting rural living environments and providing leisure and recreational spots for urban residents, and in conservation of ecology in canals and ditches and paddy fields. In this regard, rules of distribution of water to farms for irrigation for water-save purpose are not strictly applied to the systems in seasons when the water availability for these systems is sufficient for the irrigation demands. This is done with a view to allow surplus water from farmlands to recharge groundwater and surrounding wetlands.

4.4 Maintenance of assets

Routine and some of the periodical maintenance activities, and also minor emergency repairs are carried out by IA own manpower. And others of major or complicated works including the large-scale or the special equipment required emergency repairs are done with outsourcing, by means of force account or contracting. Planning and detail designs of the various maintenance works, except emergency repairs, are prepared in preceding fiscal year(s). Yet only part of them can be picked up for inclusion in the due AMP based on the rating of their priority. The priority rating processes involve the application of risk management.

Improvement and modernization of assets are proposed in line with technical, social and economical changes. For in stances, the information centers, MIS and GIS have been introduced on this ground, when expensive manpower cost rates require enhancement of work efficiencies as well as effectiveness, when data transmission devices can be fast, clear and in great volumes, and when hardware prices become affordable and worthwhile.

4.5 Financial sources

The financial mainstay of each IA is the association's membership fees (MFs, equivalent to O&M charges). According to the state codes, it is compulsory that every IA member shall be obliged to pay the fees, collected by the concerned IA annually. The rates of MF, assessed on the bases of area size irrigated taking into account other factors including distances from the distribution canals concerned, soil fertility, drainage conditions, etc., according to relevant laws. And the criteria of such rates for registered irrigation land plots prescribed that they shall be paid in kind, with the maximum ceiling at 300 kg of unhusked rice grains.

The farmholders of such registered farmlands, in spite of what crops they have grown or how much water they have received for irrigation, make payments of annual MFs in a certain month every year. The rates may be reduced or exempted by the decision of the Government in case crop productions are severely affected by natural disasters. The IAs directly collected MF payments from their members and deposit them in respective special accounts in the banks designated by the Government.

Because of the Government's policy, the IAs can not propose the MF rates on cost plus basis. So such rates have not ever been adjusted over the past 40 years despite sharp rises of costs of manpower and goods in the same period. The considerably stable prices of rice are attributed to the Government's control for reasons of social and economic stability. Consequently, the amounts of MFs have never been able to suffice the overall AM expenses in the past. And the deficiencies have been growing. In recent years, the Government's revenues dropped due to economy recession, and hence decreased the amounts of subsidies to the farmers' MFs and major projects of IAs.

4.6 The Government's financial assistance

Conventionally the IA is responsible for acquiring the funds for asset operation and normal maintenance undertakings. However, the costs for serious emergency repairs caused by natural disasters such as floods and earthquakes, and also large-scale repair, replacement/renovation,

rehabilitation, improvement, and modernization works of the infrastructure assets are financed to a great extent by the Central Government to IAs, except a few IAs possessing a great fortunes of real estate properties in urban areas.

Further, since some ten years ago, the Government has adopted the national policy on supporting the economically weakest agriculture among all sectors, and hence fully funded to the IAs the MFs that have to be paid by the IA farmer members. But the financial constraints of most of IAs still remain.

As other means to supplement their financial capabilities to maintain normal functions of main assets, especially irrigation service, nearly all the IAs in Taiwan get other incomes by combinations of some or all of the following sources:

- charges for uses of I&D facilities, such as conveying of water which is of the right of non-membership customers, e.g., water supply companies, industrial estates, plants, etc.;
- sales of bulk waters to local water supply companies, etc.;
- rents or sales of the buildings and lands not necessitated by IAs for I&D undertakings - the mainstream business;
- tourism through utilization of existing assets with proximity to water as well as attracting scenery; and
- invested enterprises (e.g., small-scale hydropower plants) having prospective profits, by means of utilizing the available water heads from existing canal flows and the IA-owned land lots as part of capital to be required.

Among the above-mentioned sorts of income sources, the last two have been few up to date.

In the beginning in the AM by IAs, only separate charges to the uses of the I&D infrastructure, for purposes other than I&D aspect, are legal. Provision of bulk water to supplement water supply companies (WSCs) has been carried out later as instructed by the competent authority when domestic and industrial water demands exceeding the capabilities of concerned WSCs have been frequent. Rents or sales of the idled lands, and the buildings not being occupied by IA, have been realized when the land lots originally used for I&D infrastructure once lost their functions. This phenomena rise from the fact that the irrigable farmland plots, which have been in the proximity of urban or industrial estate areas, have been changed their land use from agricultural category to others like industry, housing, school, organization, etc.

5. DIVERSIFICATION OF IA BUSINESSES

5.1 Rationales

The Government did not start formulating the strategy of promoting the diversifications of businesses of IAs at large in Taiwan, until some five years ago it sensed the heavy financial burdens would gradually growing due to foreseeable and unceasing decrease of agricultural sector economy growth. As an evidence, the Government's subsidies of O&M expenses due to suspension of collecting the membership fees from the IA members starting 1990, plus special financing of emergency repairs and improvement works, was NT$ 1,87 billion, increased to NT$ 2.53 billion in 1995, NT$ 3.0 billion in 2001.

Besides, due to adverse impacts to agricultural sector development after Taiwan's admission into WTO, general farmers' incomes would still be difficult to grow, and hence the amounts of MF rates at best remain as before, while total MFs may be decreasing as a consequence of reducing irrigated farmlands.

The tendency of reducing irrigated farmlands is inducing water users of other purposes, especially for domestic and industrial demands, to claim for shift of parts of irrigation water rights to them. This is because the water resources in Taiwan are very difficult to have further development in view of geological problem and ecological and environmental issues. So Taiwan is also frequently facing the squeezing pressure of water resources deficits, particularly during dry seasons and sometimes even in rainy seasons when seasonal monsoon rainfalls come too late.

However, the national policy maintains that safe stock of staple is necessary. Therefore, the minimum irrigated area in the country has to be reserved, and accordingly irrigation service by IAs will continue. For sustaining the IAs, funds for their proper AM are of major concern. Yet facing the financial situations mentioned above, it is a tendency that the management of each IA has to pay more concern for finding new financial sources. So engagement in the new businesses by IAs for this purpose is one of the desirable alternatives, subject to the conditions that such businesses are legally permitted, technically feasible, economically viable, and financially affordable.

5.2 Legal basis

Presently, relevant laws and regulations are being revised to accommodate the strategy of promotion of business diversification of IA based on more effective utilization of the IA assets. Before the legal basis is available, special approvals of the new businesses, case-by-case, by the COA and concerned authorities have to be obtained by respective IAs proposing such category of new businesses. So far, there is one IA in central Taiwan operating by its-self a small hydropower plant, and another in southern Taiwan investing in a similar plant being operated and managed by a new company with a domestic chemical industrial company as its affiliated enterprise. However, the Government regards these two projects as exemplars demonstrating the feasibility of new business undertaken by IAs. For extension purpose, practical guidelines for financial, technical and environmental impact analyses of new businesses to be undertaken by IAs are under promulgation by the Government.

6. CONCLUSIONS

The AM strategies for IAs in Taiwan are adjusted to accommodate the significant changes taking place specially in agricultural, economical and rural development; and are incorporated with engineering and information technologies. In addition, the Government's strong support to the sustenance of the IAs of Taiwan continues. This is viewed from the aspect that IAs in Taiwan nowadays play their roles not merely in support to crop production but also to environmental and ecological sustainability. The latter is concerned with general public, not just the irrigated crop growers.

Different countries have their own peculiar situations related to the AM of I&D infrastructure.

While some developing countries are trying to introduce irrigation service fees, the equivalent MFs of IAs in Taiwan have been temporarily shifted to the Government for payment for the IA members, for a period to be determined later by the Parliament.

It is generally agreed in Taiwan that the IAs in their AM still have to strengthen their irrigation services and adjusting service levels to meet the changing agricultural development. In addition, the IAs are encouraged to obtain new financial resources by means of undertaking new businesses concerned with utilization of their assets. Relevant laws and regulations are under revisions and guidelines are in preparation.

REFERENCES

Chen, Y.Y. (2003) Performances of Agricultural Engineering Undertakings Last Year in Taiwan, *Engineering*, Vol. 76 No. 3, pp 55-60, Taipei, Taiwan. (Chinese version)

Council of Agriculture, Executive Yuan, R.O.C. (2003) *Agricultural Statistics Yearbook 2002*, Taipei, Taiwan.

Council of Agriculture, Executive Yuan, R.O.C. (2002) *Annual Report on Taiwan's Irrigation Associations Performance Monitoring for Year 2001*, Taipei, Taiwan. (Chinese version)

Council of Agriculture, Executive Yuan, R.O.C. (1999) *Profile on the Businesses of Taiwan's Irrigation Associations*, Taipei, Taiwan. (Chinese version)

Kuo, H.S. (2002) the Transition of Irrigation Operation Policy to Cope with the Impacts of Serious Paddy Surplus and Institutional Democratization, *the International Workshop on Asian Irrigation in Transition – Responding to the Challenges Ahead*, Bangkok, Thailand.

Taiwan Joint Irrigation Association (2002) *FY 2001 Irrigation Associations Data-book*, Taichung, Taiwan. (Chinese version)

Tsai, M.H. (1998) Policies and Strategies for Irrigation and Drainage Undertakings in Taiwan, *Scientific Agriculture*, Vol. 46 Nos. 1-2, pp 28-33, Taipei, Taiwan.

Malano, H.M. et al (1999) Asset Management for Irrigation and Drainage Infrastructure, *Irrigation and Drainage Systems*, 13, 109-129, Dordrecht, The Netherlands.

Moorehouse, I. (1999) Asset Management of Irrigation Agriculture, *Irrigation and Drainage Systems*, 13, 165-187, Dordrecht, The Netherlands.