

# Historical Irrigation Development of Thailand<sup>1</sup>

## 1. Introduction

Irrigation is an old art as old as civilization. It has been changed and declined by time (Hansen, *et. al.*, 1980). Hanging garden of Babylon, seven wonder of the ancient world, showed a man can lift water to irrigate the garden at higher elevation.



Fig.1 Hanging garden of Babylon, the first recorded irrigation development in the world

## 2. Definition of Irrigation

Irrigation is generally defined as an application of water to crops. But it actually means the technology for controlling soil moisture level in the root zone for desirable crop growth and yield both in term of quantity and quality. Thus irrigation will related to the following technologies (Rydzewski, 1987).

- water application
- controlling micro-climate around plants
- sub-surface drainage
- surface drainage
- agricultural land flood protection
- water resources development
- water delivery
- water allocation
- water conservation

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- water quality management
- irrigated land development

Due to the large scopes of work concerning human resources, land, water, crops, climate, topography and the environment, an irrigation engineer who is responsible for planning, design, construction and management of an irrigation project must learn varieties of science and engineering disciplines such as water resources engineering, civil engineering, irrigation engineering, social sciences, environmental sciences, management and engineering economy.

## **2. Irrigation Development in Thailand**

Irrigation development in Thailand has been recorded together with the start of our civilization. Evolution of irrigation in Thailand can be classified into 3 periods namely (1) historical period(1238-1583 A.C.) (2) pioneer period(1888-1911 A.C.) (3) modern irrigation development period(1911-present).

### **2.1 Historical Period**

700 years ago or at the beginning of 12 century(A.C.), the very first Kingdoms of Siam (Thailand in the present) called Lanna Kingdom was established in Northern Thailand. Chiangmai was the center of Lanna Kingdom in Ping river basin. The major irrigation development at that time was the construction of a series of diversion weir on a small stream and delivering water from the stream by irrigation ditch to farm lands in each village. This is typical called "People Irrigation System" which still exists until today. The important role of state on irrigation was the invention of law by King Mengrai the Great for controlling water diversion and utilization in equitable manner.

Ayutthaya Kingdom during 1350-1767 A.C. in Chao Phraya Basin in the central plain of Thailand rising after the decline of Northern Kingdom, the first king of Ayutthaya named King Rama I or King U-Thong established Rice ministry, as one of the 4 ministries for kingdom administration (Interior, Palace, Finance and Rice). Rice ministry was responsible for agricultural and irrigation development and management. This type of administration system had been existed throughout Ayutthaya Kingdom, Thonburi Kingdom (1767-1782 A.C.) and the beginning of Rattanakosin Kingdom (1767-1902 A.C.) until the end of this period.



Fig. 2 Lanna Kingdom

## 2.2 Pioneer Period

This period started from King Chulalongkorn the Great (King Rama V) of Rattanakosin Kingdom created Ditch and Dike project on both bank of Chao Phraya river in the central plain of Thailand. The important project was the 25 years concession granted to Siam Canals, Lands and Irrigation Company in 1888 A.C. for construction and operation of canal networks, regulators and navigation locks for irrigation and water transportation purposes in Rangsit area.

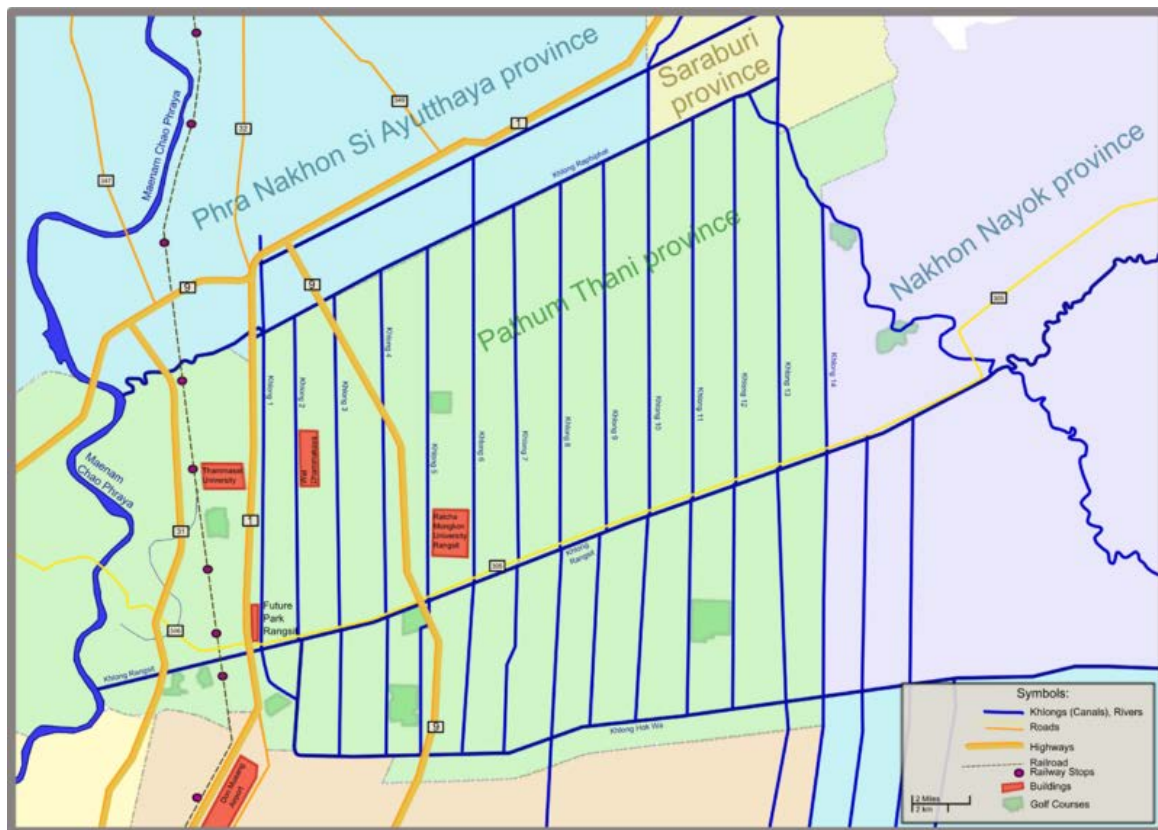
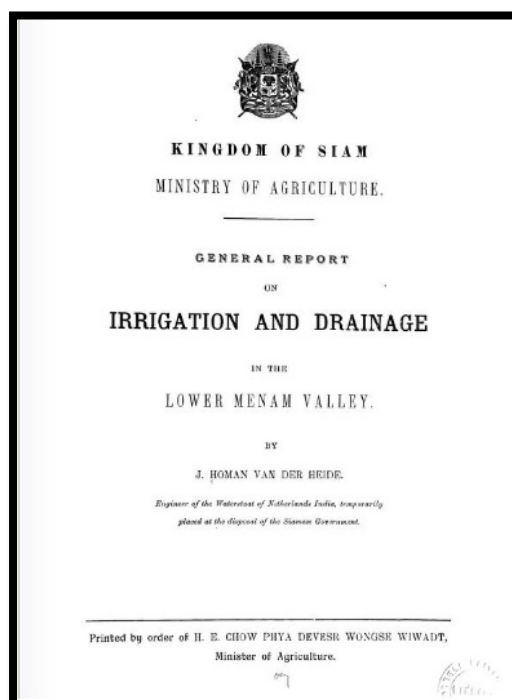


Fig. 3 Canal networks in Rangsit area

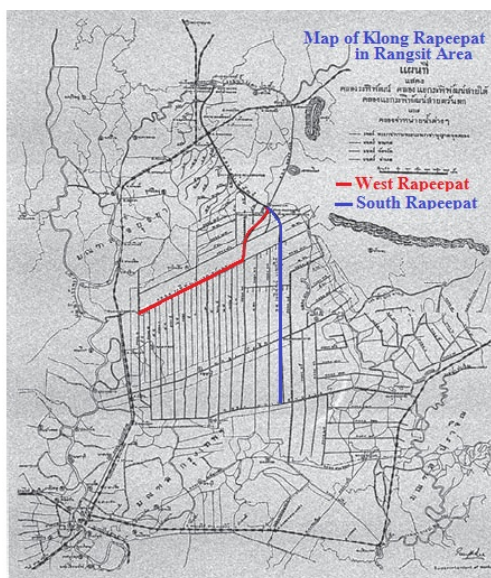
14 Years later the canal networks proved to be very successful. In 1902 the government decided to established Canals Department and invited Mr. Yehoman van der Heide(Fig. 4a), a Holland engineer working in Indonesia, to be the first director general of the new Canal Department with the salary of 2,000 THB per month. Mr. Yehoman van der Heide wrote the general report on "Irrigation and Drainage in Lower Menam Valley"(Fig. 4b), Chao Phraya river is the Menam Valley in the report. The main recommendations were the construction of Chao Phraya Barrage at Chainat province and the irrigation canal and drainage networks on both banks of the river for storing and distributing water to farm lands in Lower Chao Phraya area from Chainat to the gulf of Thailand (Fig. 5). However the project cost was too high, 47 million THB. Thus the project was proponed. Mr. J. Homan van der Heide was assigned to work on canal excavation and repair and construction of regulators(Fig. 6) and navigation locks(Fig. 7) for more efficient control of water for irrigation and navigation until 1909. Canals Department was in operation only for 11 years before transforming to Barrages Department according to the need for other development requirement of the country and this was the end of the pioneer period.



(a) Mr. J. Homan van der Heide



(b) Irrigation and Drainage in Lower Menam Valley report  
(<https://archive.org/details/cu31924023604600>)



(c) Map of Klongs in Rangsit Area

Fig. 4 Mr. J. Homan van der Heide and His General Report on Irrigation and Drainage





Fig. 6 Sam Rong regulator in Bangkok



Fig. 7 Navigation Locks

### 2.3 Modern Irrigation Development Period

This period began in 1911 during the early year of King Rama VI (King Mongkut) reign. Due to low rainfall for 3 consecutive years, this created critical drought in the central plain of Thailand. The ditch and dike project for irrigation inundation scheme created in the pioneer period could not be operated due to too low level of water in the river. Sir Thomas Ward (Fig. 8), a British expert, working in India was invited to revise the irrigation development plan of Thailand in 1913 A.C. Sir Thomas Ward proposed the irrigation development of 5 projects with the total cost of 23 million THB namely Suphan river project, Eastern Phetburi project, South Pasak project, Lampang irrigation project and irrigation and drainage project in low lying area on both banks of Chao Phraya from Ayutthaya to the gulf to make Thailand a rice producing country of the world. Since the nature of work of Canals Department was changed, it was transformed to the Barrages Department in 1914. Mr. R.C.R Wilson, Sir Thomas Ward assistant, was selected to be the first Director General of this new department.



Fig. 8 Sir Thomas Ward

In 1915, South Pasak irrigation project was launched. The first river barrage called Rama VI barrage (Fig. 9) was constructed in Pasak river at Tha Luang



sub-district, Tha Rua district, Ayutthaya province. From Rama VI dam, the irrigation canal was constructed to distribute water from Pasak river to Rangsit area. The irrigation command area was 600,000 rai. The project was completed in 1924. In 1922, Suphan river project was started as an inundation scheme taking water during high flow from Chao Phraya river to Suphan river. This project later was called Pho Phraya irrigation project. Later on Chiengrak-Klong Dan project was constructed for drainage and navigation proposes and using the unused water from Pasak river for controlling salinity on agricultural land along sea shore. Barrages Department was finally transformed to Royal Irrigation Department(RID in short) in 1927 in the reign of King King Phrapokklao (King Rama VII). Phraya Chollamark Pijarn was the first Director General of RID. RID has been responsible for water resources-irrigation development and management until today.



Fig. 9 Rama 6 Barrage in Pasak river, the first river barrage of Thailand

## 2.4 Irrigation Development Data

Since 1902 A.C., the irrigation in Thailand has been progressively developed. The inundation projects were initiated during the early period by constructing the canals linking the major rivers to bring water during flood season to the central plain. Later on, the diversion weirs and dams(barrages) were constructed in the major rivers to increase the water diversion capacity to the irrigation canal systems in Northern and central plains. During this period, the irrigated agriculture was rapidly expanded. Around year 1957, the large scale multi-purpose reservoirs such as Bhumipol and Sirikit storage dams were constructed to store large volume of water for crop cultivation, flood control and etc.

At present, many water resources and irrigation development including large, medium and small scale projects have been developed in the 25 river basins throughout the country. Those projects can deliver irrigation water for cultivation to an area of more than 27 million rai. The general statistics of irrigation projects are given in Table 1. The irrigated area of Thailand is given in Table 2.

**Table 1** Data of irrigation projects in Thailand by 30 September 2006.  
(RID. 2007)

Types of project	No. of projects	Storage volume (mcm)	Irrigated area (million rai)
Large scale irrigation projects	85	7,549	17.19
Medium scale irrigation projects	703	3,893	6.54
Small scale irrigation projects	11,567	1,673	0.57
Electricity pumping projects	2,129		3.78
Large scale reservoirs of EGAT	10	61,203	
Total	14,494	72,645	27.99

**Table 2** Total cultivation area and irrigated area in different regions of Thailand

Region	Cultivation area (million rai)	Irrigation area (million rai)	% irrigated area to cultivated area
Central	25.17	10.95	43.5
North	23.07	5.06	21.9
East	11.62	2.54	21.8
South	20.95	3.28	15.6
North-east	59.00	6.16	10.4
Total	139.81	27.99	20.0

### 3. RID Vision and Goals

#### 3.1 Vision

Royal Irrigation Department is a leading organization in water resources development and integrated water management with the present irrigated area in the world top ten.

#### 3.2 Mission

(1) To develop water resources and to increase irrigated area according their potential and natural balance

- (2) To manage water allocation in equitable and sustainable manners
- (3) To prevent and mitigate water hazards as appropriate mission
- (4) To encourage people participation in water resources management and development

### 3.4 Core Value

WATER for all

Work hard	=	be dedicated to work
Accountability	=	be accountable to duties
Teamwork	=	be learning and cooperative
Ethics	=	be ethical on performance
Relationships	=	be bonded and united

### 3.4 Strategies

- (1) Water resources development and increase of irrigated area
- (2) Integrated water management
- (3) Water hazards prevention and mitigation as the department's mission

### 3.5 Goals

#### A: Mission Effectiveness

- (1) Amount of reserved water and irrigation area is increased.
- (2) Water is supplied to all sectors thoroughly and equitably
- (3) Loss caused by water disaster is reduced.

#### B: Services Quality

- (4) Workable condition of irrigation structures is maintained.
- (5) Consumers are satisfied with water management.

(6) Water quality meets standards.

(7) Flood forecasting and warning system is in workable condition.

**C: Performance Efficiency**

(8) Construction, repair and improvement are preceded as planned.

(9) Preparation before construction is done as planned.

(10) Participation of people, communities, and relevant sector are achieved.

(11) Comprehensive public relations are encouraged continuously.

(12) Effective water planning and management are implemented.

(13) Results of studies, researches, and development are used in the departments operation.

(14) Rules and regulations are modernized and up-to-dated.

(15) The administration is effective.

**D: Organizational Development**

(16) Its personnel are competent and motivated for work.

(17) Organizational knowledge is managed

(18) Appropriate database system and informational technology are implemented.

(19) Machinery and tools are in workable condition.

### 3.6 Strategic Map

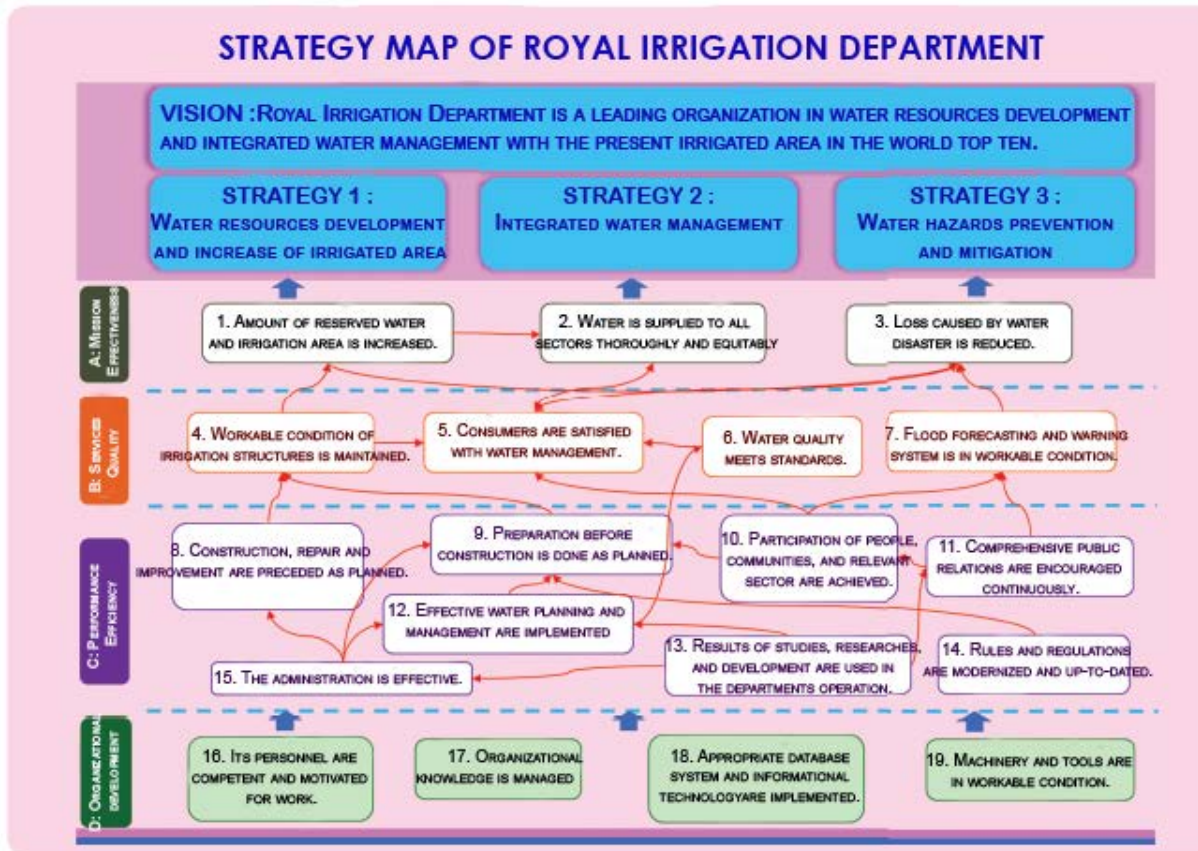


Fig. 10 RID Strategic Map

## 4. Vision and Strategy of Department of Water Resources

(Source : <http://www.dwr.go.th>)

Department of Water Resources (DWR), Ministry of Natural Resources and Environment was established in 2002 from the government structure reform policy. DWR is the new water related government agency responsible for developing policy and plan for the integrated water resources management of the river basins and of the whole country while RID is the agency for planning, implementation and management of irrigation projects. Although the functions of these two agencies (RID and DWR) are different, the linkage of work of these two agencies are not clear defined in practices. Therefore the role and responsibility of RID and DWR have to be defined in order to reduce the redundancy in practices between the 2 government agencies. The organizational structure of DWR is given in Fig. 11

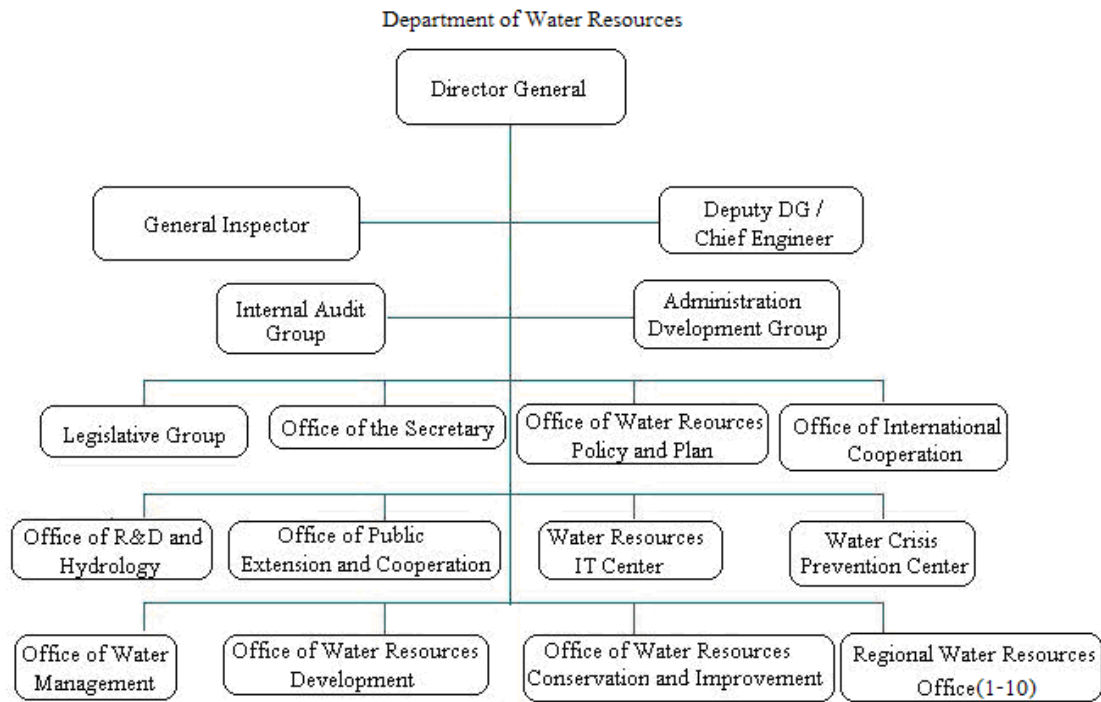


Fig. 12 Organization structure of DWR

The vision, mission, policy and strategy of DWR are given below:

#### 4.1 Vision

“Integrated water resources management in the efficient and sustainable manners under the good cooperate governance” is the DWR vision.

#### 4.2 Mission

“Develop the policy, plan and measures related to water resources including management, development, conservation and improvement and all together with controlling, directing, coordinating, evaluation and resolution of water resources problems, research, standard specifications and water resources technology transfer on both national and river basin levels” are the DWR mission.

### 4.3 Policy

DWR is the organization for management, conservation, development and resolution of water resources problems in efficient, equitable and sustainable manners under good governance. The participation of the Tambol Administration Organization (TAO), communities, non-government organizations and all sectors of the society to improve the quality of life of the people is the main focus of the DWR.

### 4.4 Strategy

(1) Develop recommendations, policy, plan, specification and measures for active integrated water resources management under public participation of all sectors in the river basin for sustainable development of the nation.

(2) Management, development, conservation and improvement of water resources throughout the country in order to response to the people needs and to ensure that water resources are managed in sustainable way including prevention, mitigation and resolution of critical water problems.

(3) Promote and support human resources development of stakeholders, local organization and water resources management organization networks via public relation, knowledge and technology transfer in order to sustain water resources management.

## 5. Vision and Strategy of Department of Agricultural Extension

Department of Agricultural Extension (DOAE), Ministry of Agriculture and Agricultural Cooperative is an important department to support the increase of agricultural production of irrigation projects. At present, DOAE focuses its agricultural extension activities only on the cultivation area out of the project command area. Thus RID has to work with DOAE in order to provide the necessary services to improve the agricultural production for the irrigated area including irrigation water, other production techniques and marketing conditions.

The vision, mission and objectives of DOAE are given below:

### 5.1 Vision

DOAE is the prime agency for extension and development to improve the well-being and sustainability of farm families.

## 5.2 Mission

- (1) To study, research and develop agricultural extension and technology transfer to promote production and services for agriculture.
- (2) To promote and develop the farmer family and institution to have enough strength and be self reliance.
- (3) To promote and develop small and micro community enterprise (SMCE) to improve the production and services capacity according to the self sufficiency economy concept.
- (4) To provide the sufficient support to solve the farmers and community problems

## 5.3 Policies

In year 2008, DOAE focuses on the promotion and development of the quality of life of farmers by sufficiency economy philosophy. The main KPIs of this policy are the ability of farmers to be self reliant. By this approach, farmers are the center for development. The main issues for implementation of this policy are to change the ways of thinking and behavior of farmers on both the ways of living and working in accordance with the self sufficiency economy. DOAE has to coordinate all the assistances to relief the farmers' problems in all aspects. DOAE has to change the approach from resource-based to knowledge-based. The field officials will act as the coordinator and facilitator in working with farmers and will integrate their works with other sectors via the center of agricultural service and technology transfer at tambol level in order to utilize the limited budget effectively.

The policy for agricultural extension in year 2008 consists of 5 aspects as follows:

- (1) To raise the ability of DOAE to be the main agency in driving the self sufficiency economy in agricultural sector.
- (2) To change the working approach from the resource-based to knowledge-based.
- (3) To develop working partners in order to integrate and expand the sources of budget to support the agricultural extension in the area.
- (4) To adjust the field work approach by using the agricultural service and technology transfer center at tambol level as the center of operation and to maximize the utilization of the network of partners.
- (5) To increase the efficiency of organization and personnel in order to effectively response to the policy under the planned budget and other assignments.



## 6. Irrigation Management Structure of Thailand

Irrigation in Thailand has been continuously developed since the establishment of Canal Department in 1902 and Royal Irrigation Department in 1923. At present, there are the large scale, medium scale, small scale and pumping projects more than 15,000 projects covering the irrigation area of more than 27 million rai or about 20% of the total cultivated area of the nation.

Royal Irrigation Department is the main and only agency responsible for irrigation development and management of the country in the area of more than 27 million rai. RID also works with other agencies in order to relief and solve the water problems including drought, flood and water quality on both in the command and non-command areas.

### 6.1 Organization Structure of RID

RID has set up the organization structure in irrigation management of the country as shown in Fig. 13.

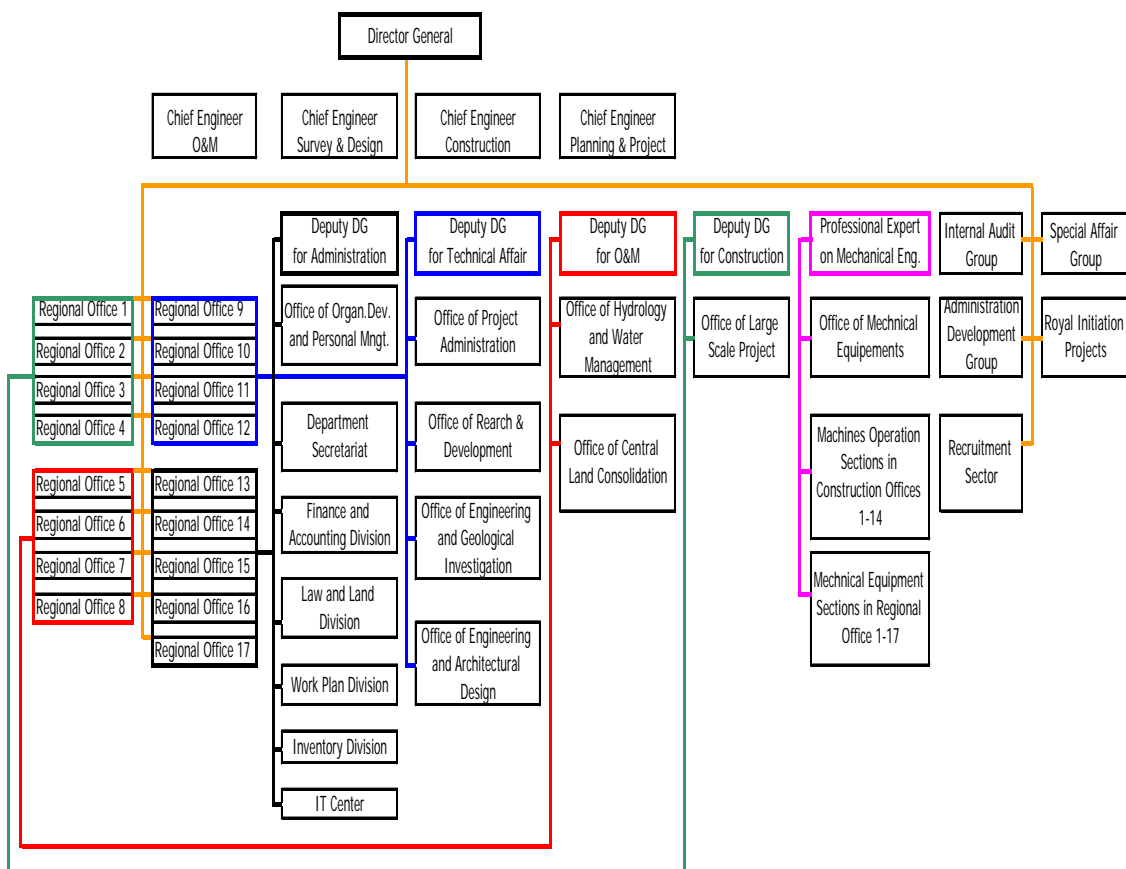


Fig. 13 Organizational Structure of RID

As shown in Figure 13, the 17 Regional Irrigation Offices of RID are the main organization responsible for irrigation management of 27 million rai. The Office of Hydrology and Water Management provides the technical support in operation, maintenance, establishment of and strengthening the water user groups. The Office of Organizational Development and Personnel Management provides the support on training and human resources development for the projects and regional offices. Irrigation Development Institute under the Office of Research and Development is responsible for research and development to solve the irrigation problems. In the past, the Regional Irrigation Offices are under the administration of the Deputy Director General for O&M. However in the present organizational structure, the administration of the 17 Regional Irrigation Offices are divided among the 4 Deputy DGs (O&M, Construction, Administration and Technical). The 4 Deputy DGs have to be responsible for administration of the 17 Regional Irrigation Offices besides the responsibility for their functions.

For the line of advisory, there are 4 chief professional engineers (experts) in 4 main tasks of RID as follow:

- (1) Planning and project
- (2) Survey and design
- (3) Construction management
- (4) Operation and maintenance

The chief professional engineers are the chief technical advisors in the particular aspects. Besides, RID has established the professional experts on various aspects including project planning, design, operation and maintenance. The professional experts are responsible for technical support and assistant to the DG, Deputy DG and the Office Directors in the central RID.

## **6.2 Organizational Structure of the Regional Irrigation Office**

The organizational structure of the regional irrigation office or regional RID consists of the operation and maintenance projects, the provincial irrigation projects, water management division and other divisions. The operation and maintenance projects and provincial irrigation projects have their own command area or service area. Their main tasks are planning, operation and maintenance and management of the service area. The division of water management is the regional unit working closely with the projects on water allocation, monitoring and control of the budget, establishing the criteria and

procedure for water management , analyzing and solving water problems, and establishing and strengthening the water user groups. This division is the supervisor of irrigation projects. Its roles is to provide guidelines and to monitor the water management performance of irrigation projects. The organizational structure of the regional irrigation office is given in Fig. 14.

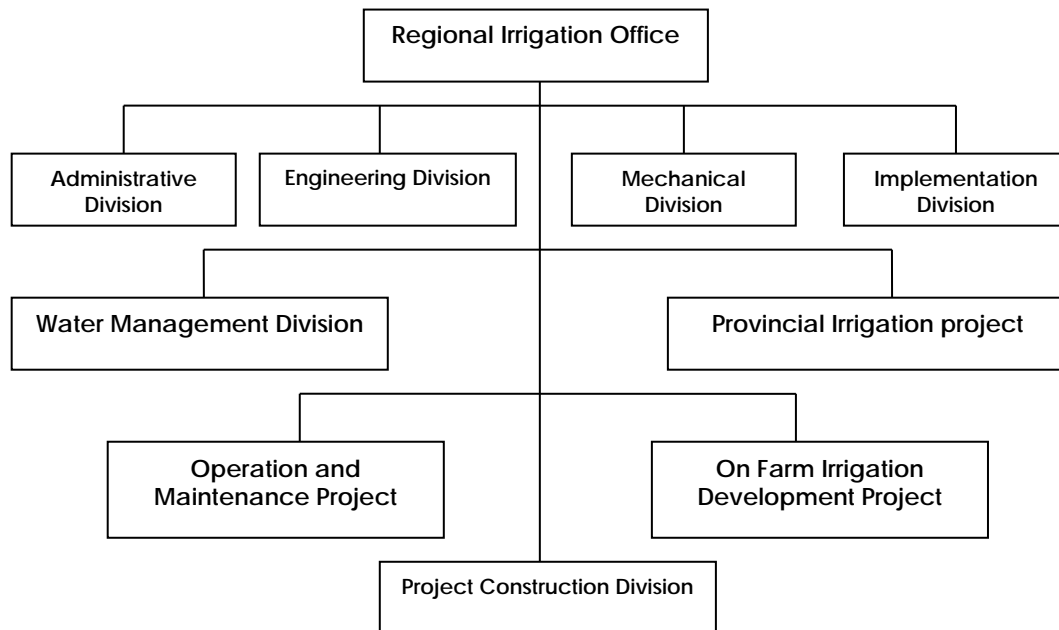


Fig. 14 Organizational Structure of Regional Irrigation Office

### 6.3 Organizational Structure of Irrigation Project

The irrigation project is the unit for planning, operation and maintenance and management in the field. There are 2 types of irrigation projects namely (1) O&M project and (2) provincial irrigation project. The O&M project is the large scale project which may have its own storage reservoir, such as Phetchaburi O&M project or may not have its own storage reservoir such as Borrommathad O&M project. The O&M projects have the water delivery and distribution system including the main, second level, third level canals and farm ditch system to distribute water to the crop cultivation area. The O&M project has the organizational structure as shown in Figure 15. There are 76 provincial irrigation projects. The provincial irrigation projects are responsible for operation and management of the medium scale, small scale and irrigation pumping projects and work with other agencies in the province to solve water problems of the province. The organizational structure of the provincial irrigation project is the same as that of the O&M project.

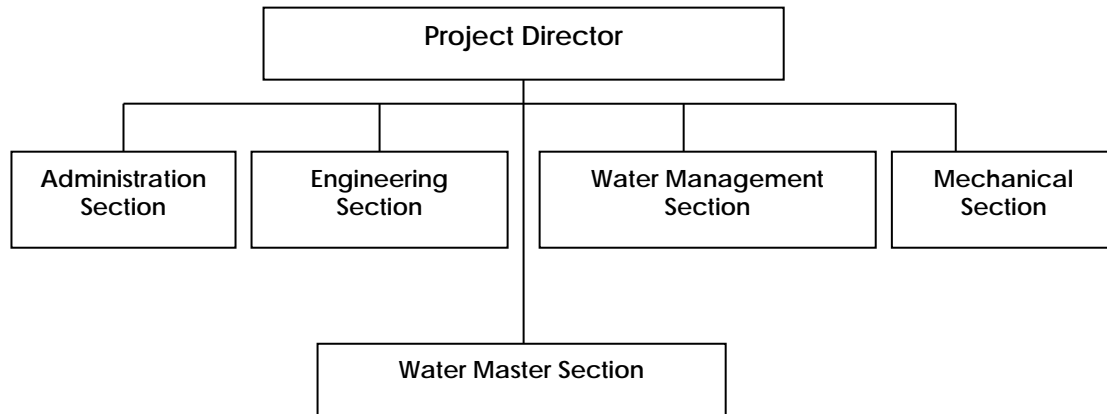


Fig. 15 Organizational Structure of the O&M Projects.

Although the O&M project and the provincial irrigation project have similar organizational structure but the scope of work are different. The O&M project is responsible for the large command area of many hundred thousand rai along the irrigation canal. The project command area is divided into water master sections. Each water master section has the command area around 50,000 rai. The provincial irrigation project is responsible for operation and management of medium scale, small scale and irrigation pumping projects. At present, most of the small scale irrigation projects and irrigation pumping projects are transferred to TAO. Besides, the provincial irrigation projects work with others agencies for solving the water problems such as water for agriculture and flooding problems. Although the provincial irrigation projects have less command area than the O&M projects but the non-command area that the provincial irrigation project have to work is quite large. At province level, there is another implementation unit of DWR that also works on the water issues. However, recently this implementation unit has been transferred from DWR to the provincial office of MONRE. This water resources implementation unit of provincial MONRE works on the policy and plan for solving the water problems at the province level. There are 2 agencies from 2 ministries working on water problems in the province. Sometimes, the province is confusing on which agencies should responsible for the water problems. Besides, TAO is the organization responsible for management of natural resources including water resources at local level. Therefore it is necessary that the role and responsibility of the 3 agencies in water management practices at provincial level are clearly defined. The water resources unit of provincial MONRE should focus on the establishment of policy and plan for integrated water resources management. Provincial RID should focus on development and management of medium scale irrigation projects. TAO is responsible for development and

management of small scale water resources projects and maintenance of irrigation facilities transferred from RID. However at present TAO is lacking of personnel and know-how to do this function. RID should provide the technical support to TAO.

The structure of O&M project related to irrigation management is the engineering section, water management section and water master section. The engineering section is responsible for planning and control of the budget and planning for project maintenance and repair. The water management section is responsible for water allocation and delivery to different water master sections, data collection, control of repair and maintenance activities of the water master section and working with the water master section in order to establish and strengthen the water user groups. The O&M project is divided into various water master sections. Each water master section has an approximate area 50,000 rai. The water master section is the field operation unit responsible for planning and control of water distribution to different zones (each zone consisting of approximately 5,000 rai), repair and maintenance of irrigation system, collecting and reporting the data related to irrigated area, crop yield and other data to the water management section, and establishing and strengthening the water user groups.

In each zone, there is one zoneman responsible for controlling of water delivery to different areas according to the water allocation and delivery plan. The zoneman is also responsible for water measurement, routine maintenance of canal and irrigation structure, coordination with water user groups in order to collect data and problems for the water master section. The zoneman may have the gate operator and canal tender as assistant for gate operation and routine maintenance of the canal and irrigation structures.

Typically, the nature of works of the provincial irrigation project in the command area of medium and small scale irrigation projects are similarly to those of the O&M project. However the provincial irrigation project has large area out of the irrigation command area to deal with. Each water master has to handle quite a large area of about 2-3 districts.

## 7. References

- Hansen, V.E., Israel, O.W and G.E. Stringham (1980), *Irrigation Principle and Practices*, 4<sup>th</sup> edition, John Wiley & Sons, New York, USA, 417p.
- Rydzewski, J.R., (1987), *Irrigation Development Planning: An Introduction for Engineers*, John Wiley & Sons, New York, 265p.
- Vudhivanich, V., (2008), *Technical Report on Design and Operation, Technical Cooperation Programme on Policies and Strategic Planning for The Thailand Irrigation Sector Reform Programme*, Ministry of Agriculture and Cooperatives and FAO, October 2008, 219p.