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# WATER MANAGEMENT

*ETH Studio Basel*  
Contemporary City Institute  
Laura Pestalozzi, Sandra Schilling-Gehrig

Prof. Roger Diener, Prof. Marcel Meili  
Mathias Gunz, Vesna Jovanovic, Rolf Jenni,  
Christian Mueller Inderbitzin

Spring Semester 2012

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# VI. WATER MANAGEMENT CHALLENGED BY URBANIZATION

## NATURAL THREATS FORM TERRITORIAL STRUCTURE

**Country with rich water resources**  
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## WATER RESOURCE MANAGEMENT SYSTEM

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**Handling of waste water**  
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**Influence of urban growth**  
**Health risks due to polluted water**  
**Support of international organisations and development partners**  
**Sustainable acting demands change of awareness**

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## NATURAL THREATS FORM TERRITORIAL STRUCTURE

The territory of the Red River Delta has been formed by the element of water. Especially during monsoon seasons, floods covered in a yearly term two-thirds of the area and traced the wide and open land. For settlement purposes, people had to find a way to deal with the natural danger. The delta's complex dyke and canal system has been built both for protection and irrigation since the 8th century. The system transformed the delta to a dense and structured landscape. In the past natural threats were the driving force for the further development of the dyke system and though the forming element of the territorial structure. Today the growing industrialisation, urbanization and the climate change are more important drivers than nature and the infrastructure system is no longer an organising force, but running behind the process. While the new forces overwrite the traditional layers of the landscape, the territory's structure remains.

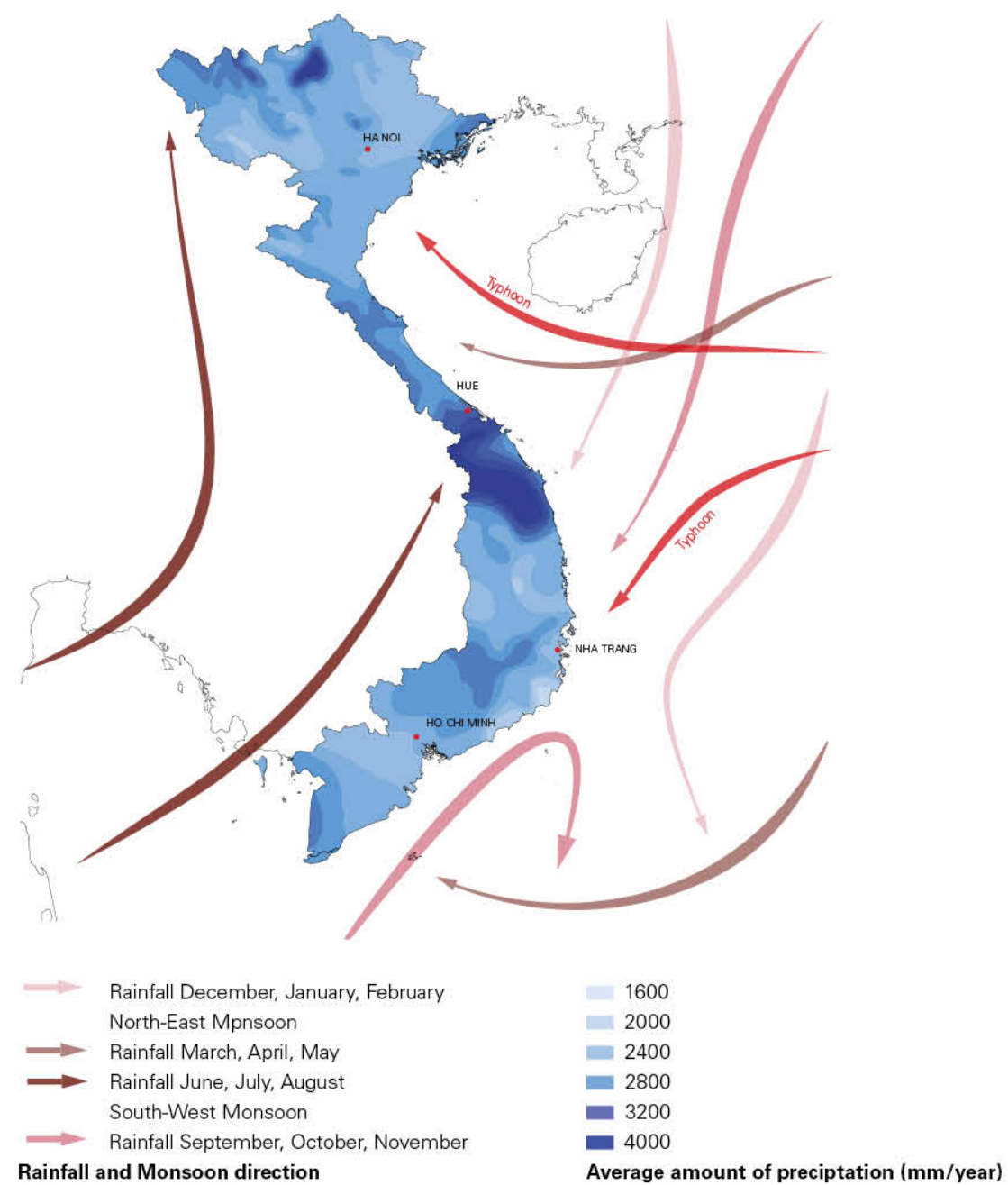


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### Country with rich water resources

In Vietnam about 830 billion m<sup>3</sup> of surface water is discharged per year, which would mean a distribution of 9'856 m<sup>3</sup> per person a year. This number is much higher than the international standard of 1'700 m<sup>3</sup> per person. But by nature there is a great variation of water resources over the year and unevenly spatial distribution due to seasonal fluctuations nevertheless leads to risks of water shortage.



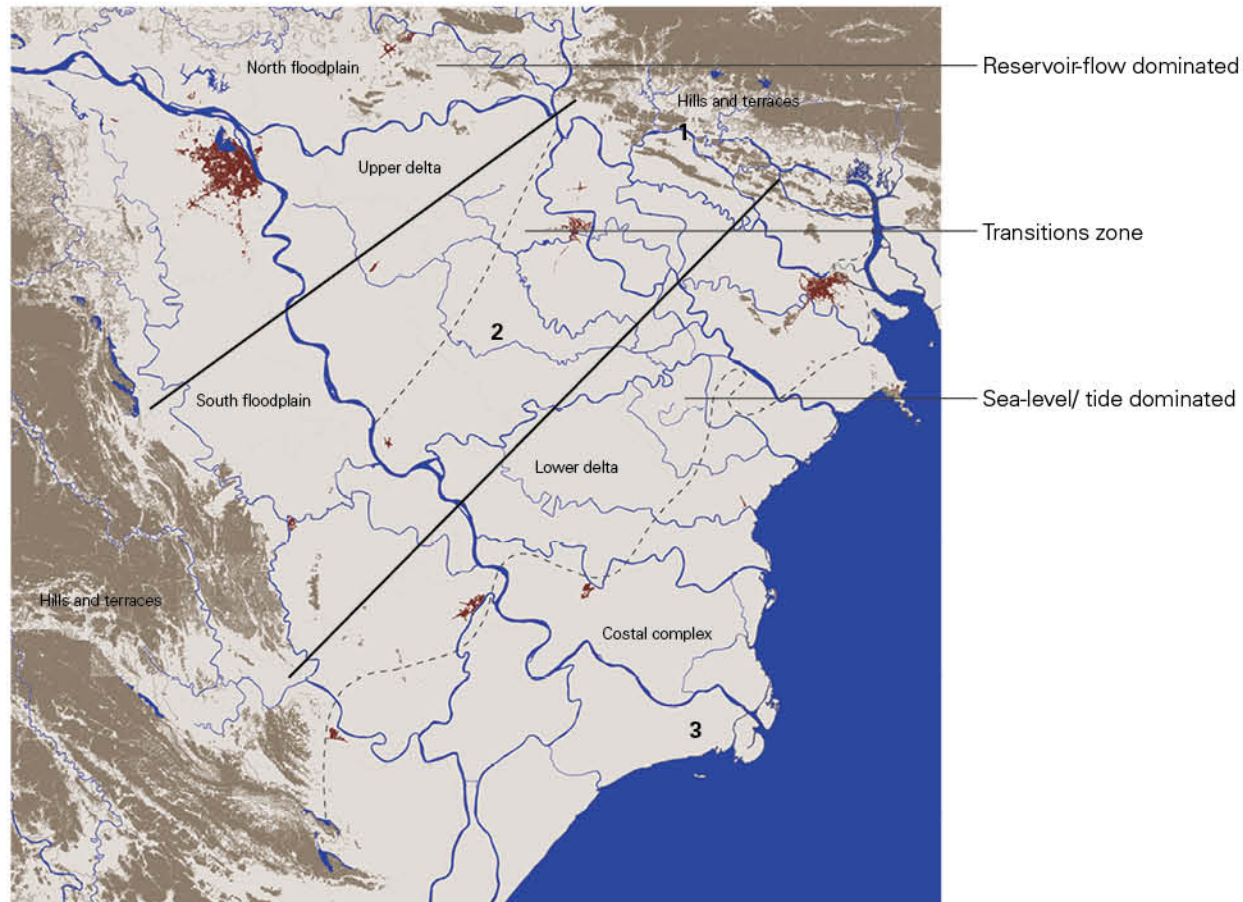
### Uneven seasonal rainfall

The climate in Vietnam varies greatly from north to south. The north has a cool and dry season from November to April and a hot rainy season from May to October. The central coast north of Nha Trang has a similar climate with the winter monsoon bringing cool, wet weather between December and February. The south is hot and humid all year round, especially from February to May. The rainy season lasts from May to November.

The central highlands have a similar climate to the south, but it is cooler and temperatures can be freezing in winter. Mean annual rainfall is about 2000 mm, which almost is the only source of surface flow. About 75% accumulates in only three months, more than 30% usually in only one peak month. This occurs from July to September in the Northern and southern areas and from September to December in the Central area.

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River network bordered by topography

### Three hydraulic zones formed by natural conditions

The quantity and distribution of water is profoundly affected by the country's mountainous topography, that is to say that three-quarters are mountains and hills, and sub-tropical humid monsoon climate. The Red Rivers Delta's water landscape is characterised by the hydrological profile of the rivers. The dense network of rivers and canals has channelled its way through the landscape since hundreds of years and the marks of the surface waters movements have given the landscape its differentiated character. The delta can be sub divided into 3 different hydraulic zones, according to the natural principles of the water flow and topography. The river or reservoir flow dominated

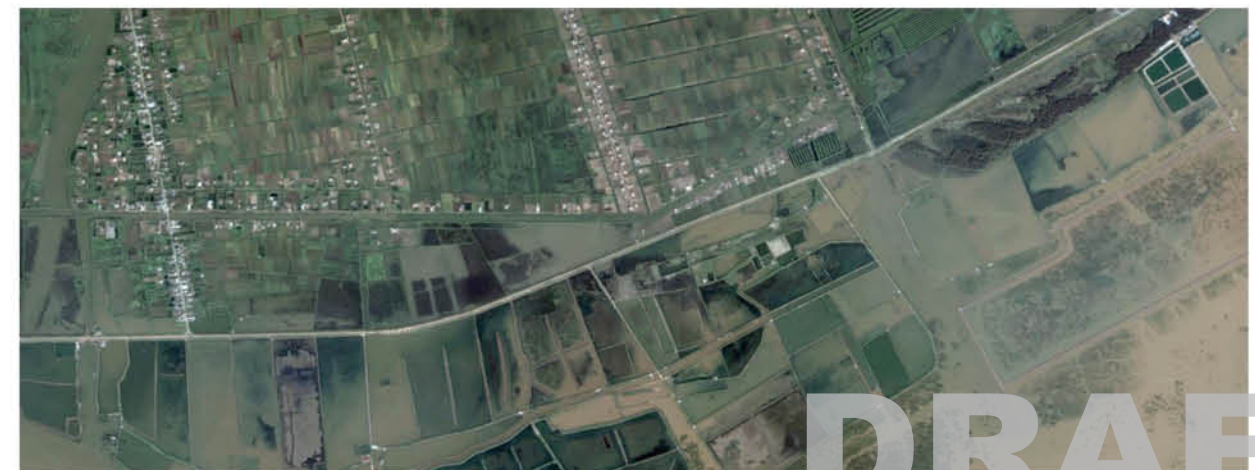
region belongs to the old delta and is formed by terraces, hills or land on higher elevation. It is drained quickly, mostly by gravity. In the transition area, floods are concentrated. Water levels can rise quickly to some metres. While fields are situated on a lower level, human settlements are situated on higher higher ground, where they are better protected from floods. The sea level or tide-dominated region is the newest part of the delta and the land along the coastal line is flat. The flow is spread over a larger flat area. The inflow of salt water from the East Sea reaches 20 km to 30 km into the irrigation system and can cause salinity problems.



1 Upland area



2 Central area



3 Coastal area

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Landscape Ninh Binh province

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Red River Delta



People protect themselves with dykes form river water



Mekong Delta



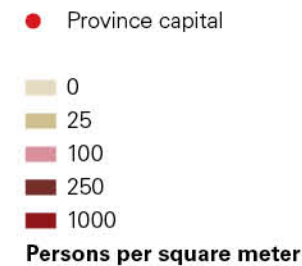
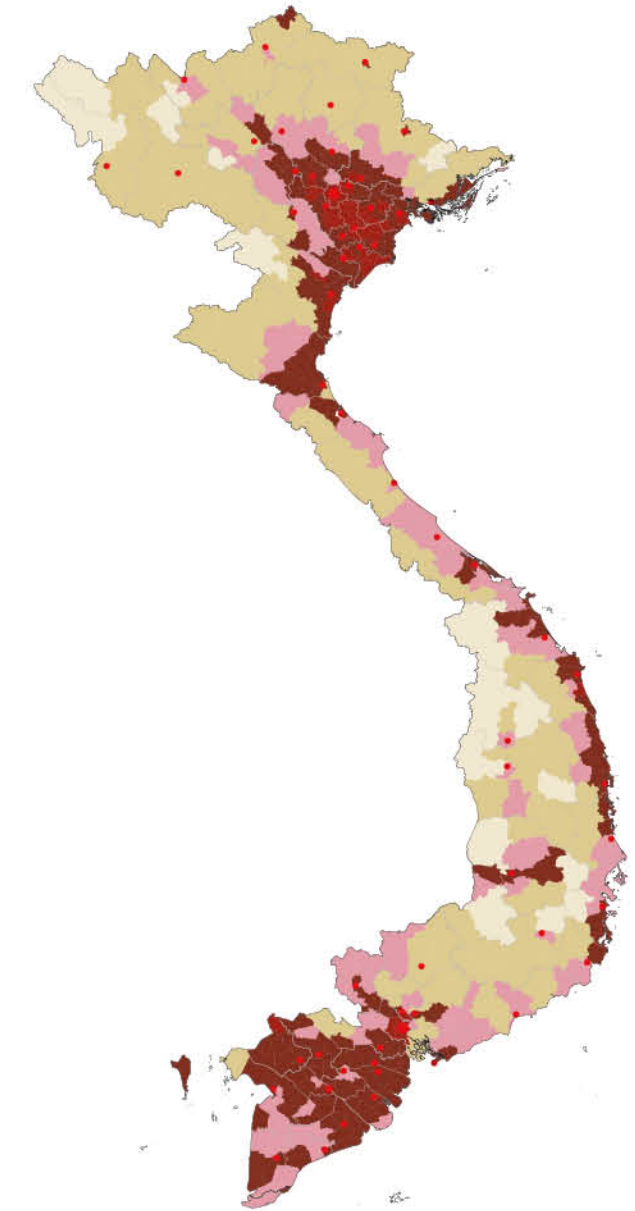
People life with water

### Rice cultivation facing urban growth

Where the two big streams, the Mekong and the Red River, flow into the East-sea two different deltas are formed. Natural conditions of both deltas are not the same, but have formed the way people handled their land for rice cultivation and aquaculture during the last centuries, resulting in a modified landscape of paddy field, fishponds and a complex canal network.

In Mekong delta, where the topography is flat and the rivers are calm, therefore rice can be cultivated on large-scale fields. Houses are built as pile constructions close to the water, flood markets are used for trading and the water channels serve as transport way for goods. People life with the water instead to protect themselves from water.

Compared to the Mekong Delta, the Red River Delta is by nature not very suitable for rice cultivation. One reason are the nearby mountains which lead to the fast downstream of the rivers, but there is also too much rainfall and the climate is much colder. Already thousand years ago, people therefore started to protect themselves, their houses and their paddy fields from the rivers by a dense dyke system. This lead to a dense and complex network of small fields and canals for water supply.



### Deltas as urban settlement areas

The fertile soil, transport and trading possibilities along the big streams made the two deltas the densest places in the country. In the last twenty years the deltas have undergone a huge growth.

The two big cities Ho Chi Minh and Hanoi, the newly developing industrial zones and the countries young popula-

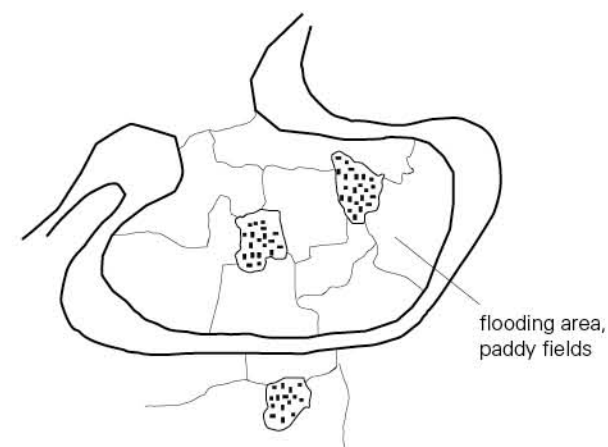
tion age structure, which is leading to a rapid population growth, are the driver of the industrial and urbanisation process. The growing of urban settlements and as a consequence the loss of good agriculture land causes an increasing pressure on local resources and has drastic impact on demand, quantity and quality of water.

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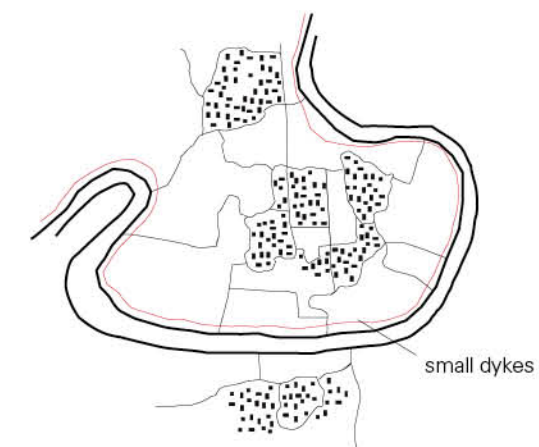


### History of dyke and settlement development

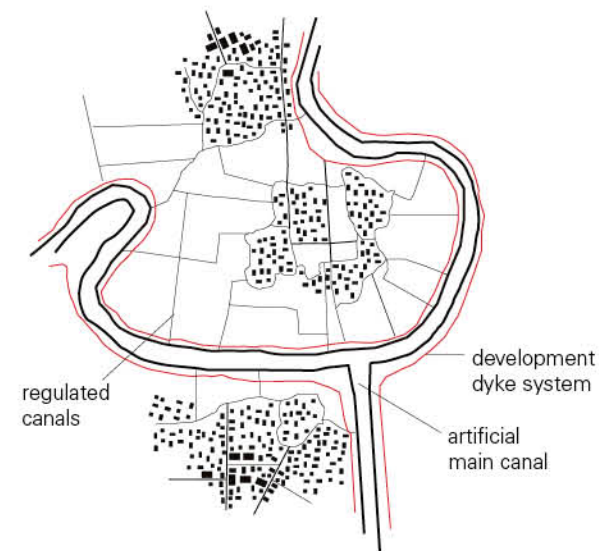
Due to seasonal climate variations and the fast downstream of the rivers the people living in the Red River Delta have always been faced by natural disasters, both floods and droughts. The control of water has therefore always been a very important task. The development of settlements was traditionally closely connected to natural circumstances of water and the works of water control therefore reflected in the hierarchy of communities and the political power.



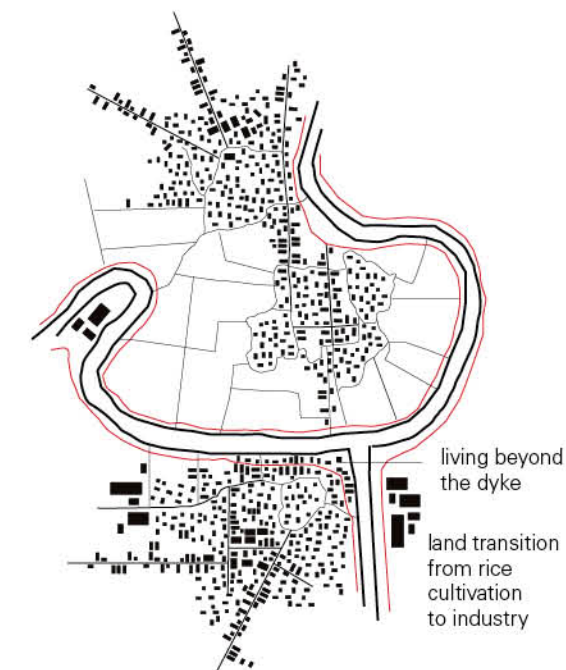
**10th century**  
settlements on irregularities of the ground and river courses



**15th century**  
settlements lineary along waterways and rudimentary roads



**19th and 20th century**  
settlements around village cores, control of nature  
**Adaption of wetlands for settlements purposes**



**21th century**  
settlements along high streets and as extension of rural villages and cities

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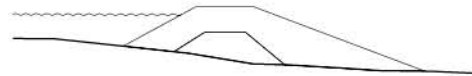
Road on the top of a dyke - Nam Dinh City

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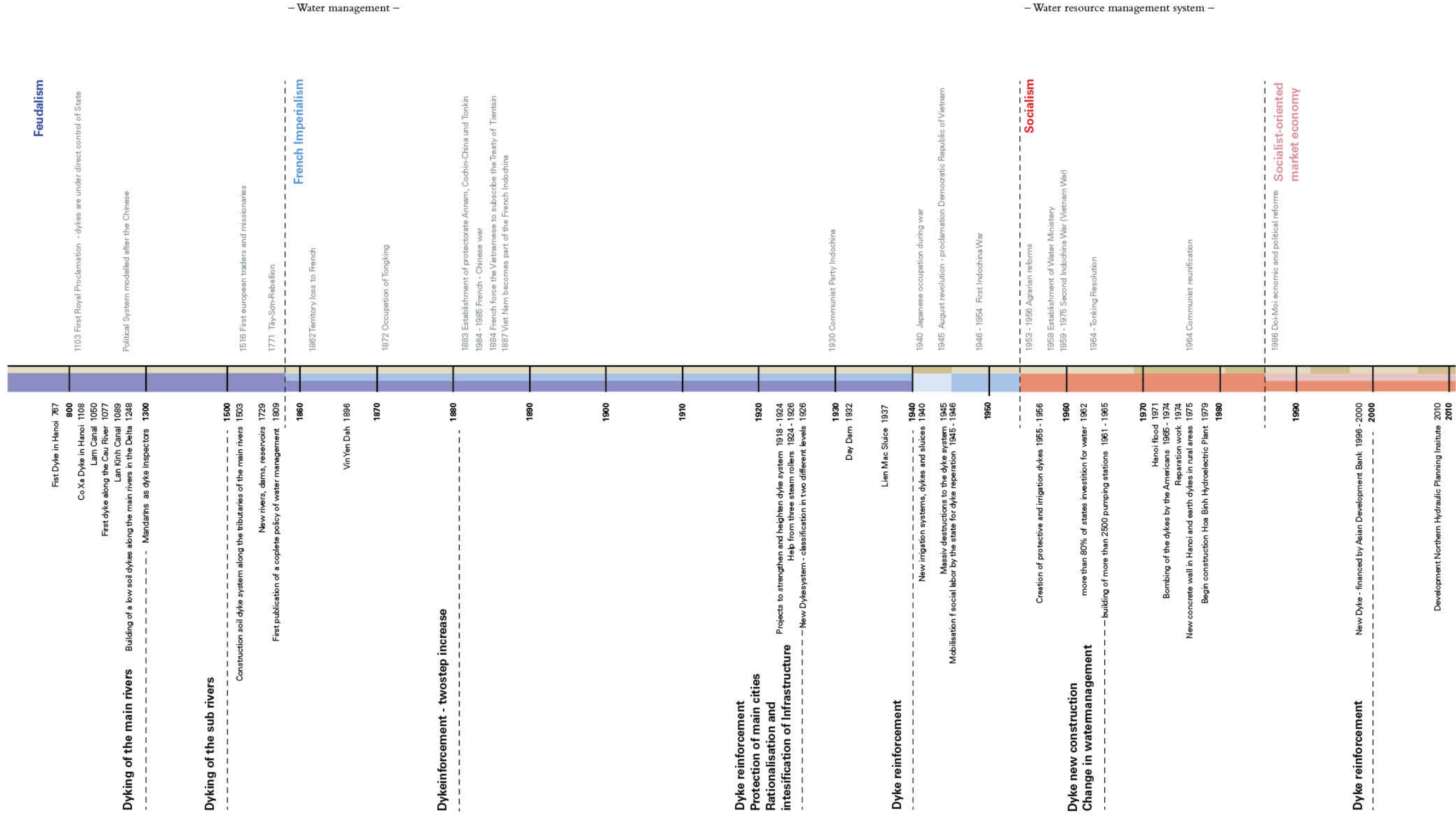
First dykes

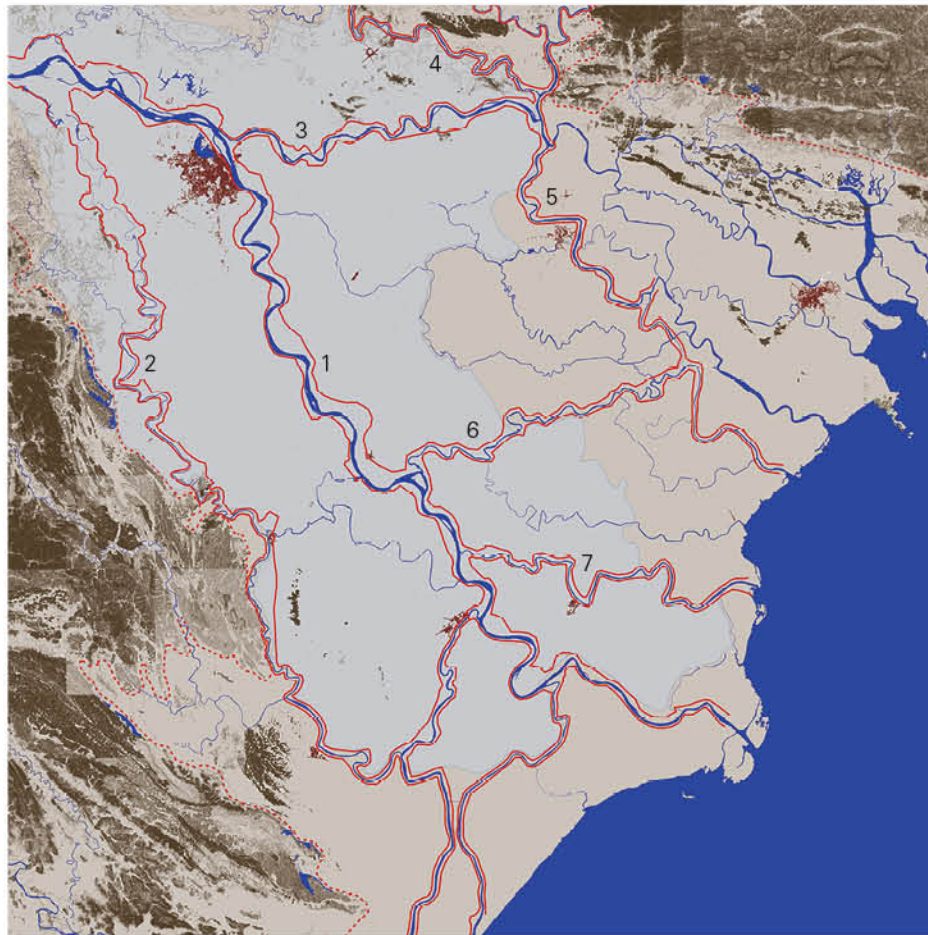


1883 to 1926



1926





- Sea level
- Dyke
- Hypothetical floodplain without dyke system

**Dyke developed by French**

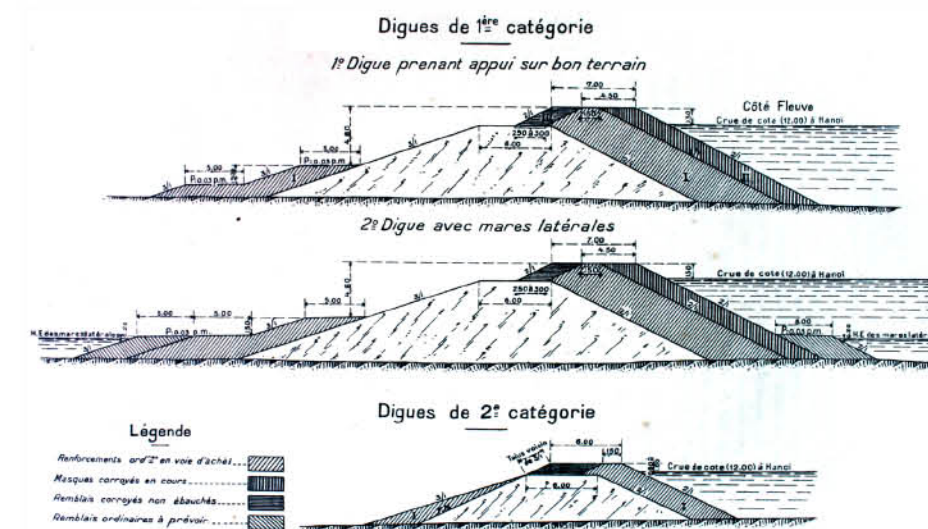
- 1 Red River in vietnamese Song Hong
- 2 Day River
- 3 Duong River
- 4 Cau River
- 5 Thai Binh River
- 6 Luoc River
- 7 Tra Li River

**Main rivers in the Red River Delta**

**Imperial water management**

Already in the 8th century the first dykes were built. In the 15th century a soil-dyke system was set up by mandarins for protection of the floods and to gain more land along the coastal zone. Without this dyke system, two-thirds of the Red River Delta would be inundated in the summer.

With the arrival of the French imperialists Vietnam's landscape changed drastically. The former art of adapting to nature changed to a large-scale control of the natural conditions. The development of more economic agriculture antedated the development of the water management system.



Dyke profile improvement in 1926



Historical photography from reinforced dyke

**French colonial dyke improvement**

After some big natural catastrophes, flood control obtained highest priority and was approached by upgrading the old river and sea dykes and regulating the irrigation canal system. The upgrading of the former dykes by new technics enabled a major a change in the water management.

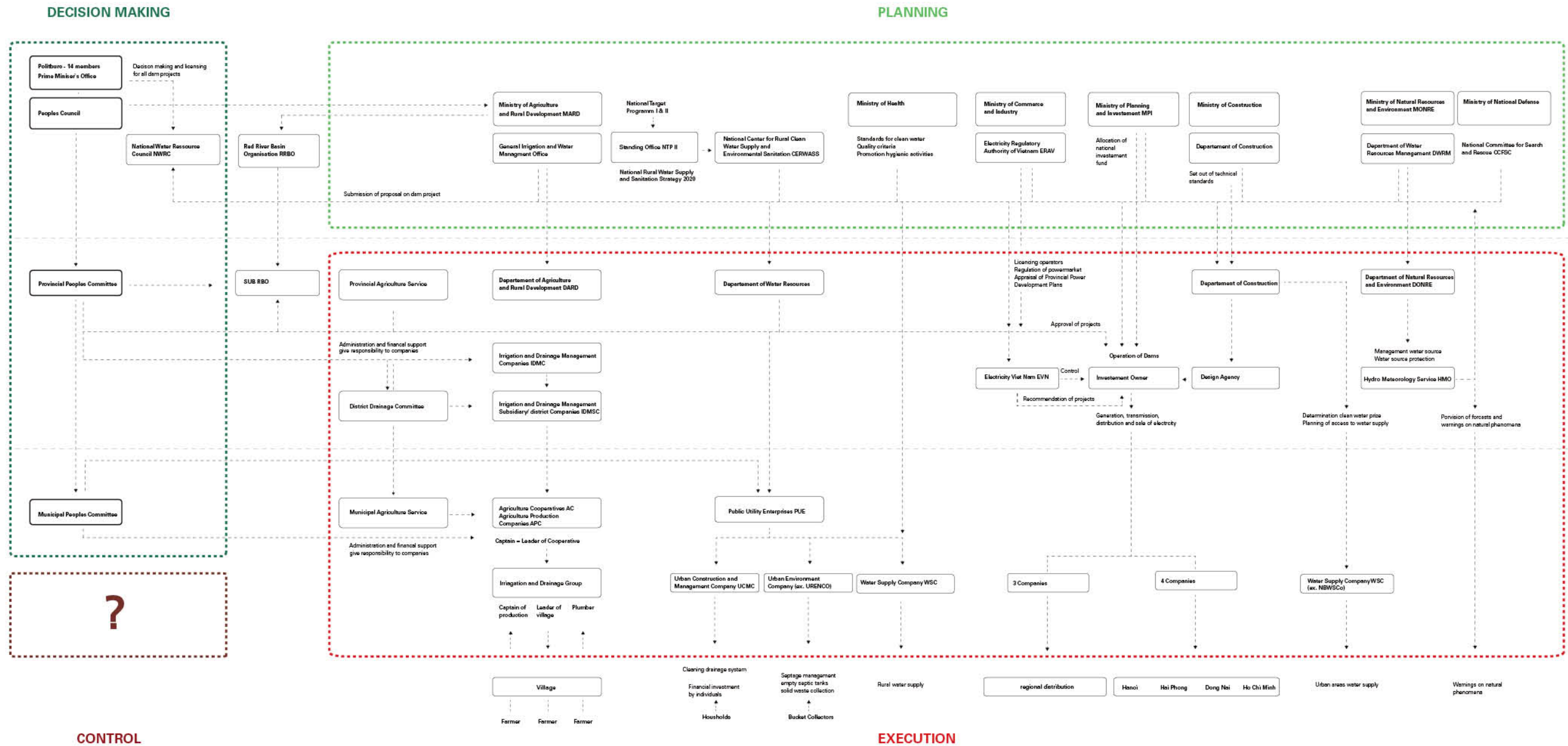
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## WATER RESOURCE MANAGEMENT SYSTEM

The development of hydraulic infrastructure resulted in a hierarchic organised society and brought a change of mentality. Since the feudal period villages were responsible for the management of water, which was detained by law. The villages managed smaller projects themselves, bigger projects were achieved under the states responsibility and financed by taxes. Red River Delta water control modernisation began under the political framework of agriculture collectivisation and cooperatives settlement. Today, 60 years later, demands have grown, distribution and supply have assumed a high complexity and climate change comes up as a new component to deal with, but the management system has hardly passed through reformation and the infrastructure is out of day.



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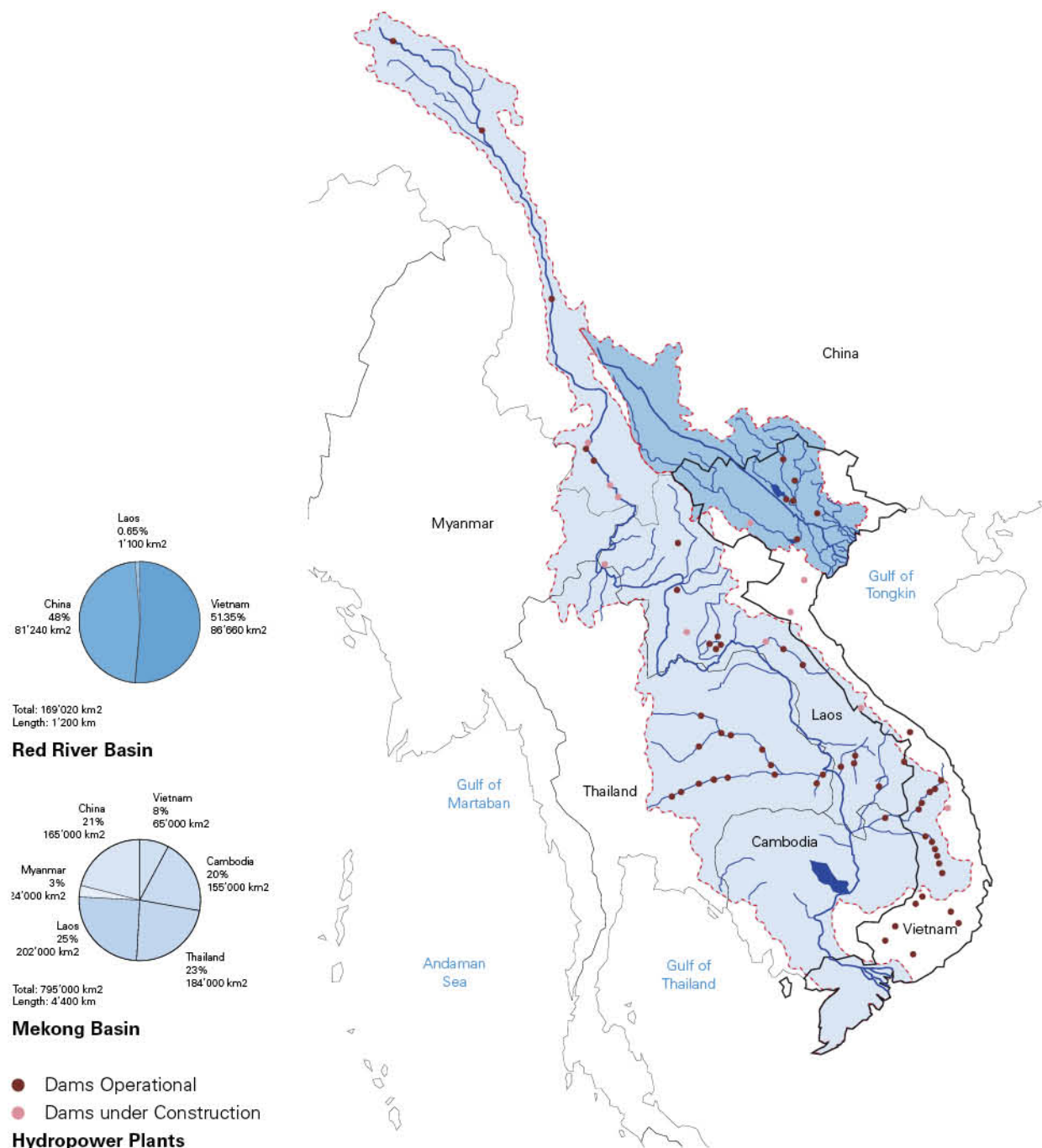


Water management organigram

### Topdown organised distribution of surface water

The complexity of the water sector reflects the current problems concerning water management in Vietnam. Surface water is not managed by one institution, but organised top down from Prime Minister through different political and hierarchic levels, in particular ministries, departments and companies. The planning of several fields, such as waste water and clean water are handled by different ministries, which makes the whole system even more complex. Check and balance, two important aspects of management, are not solved yet.

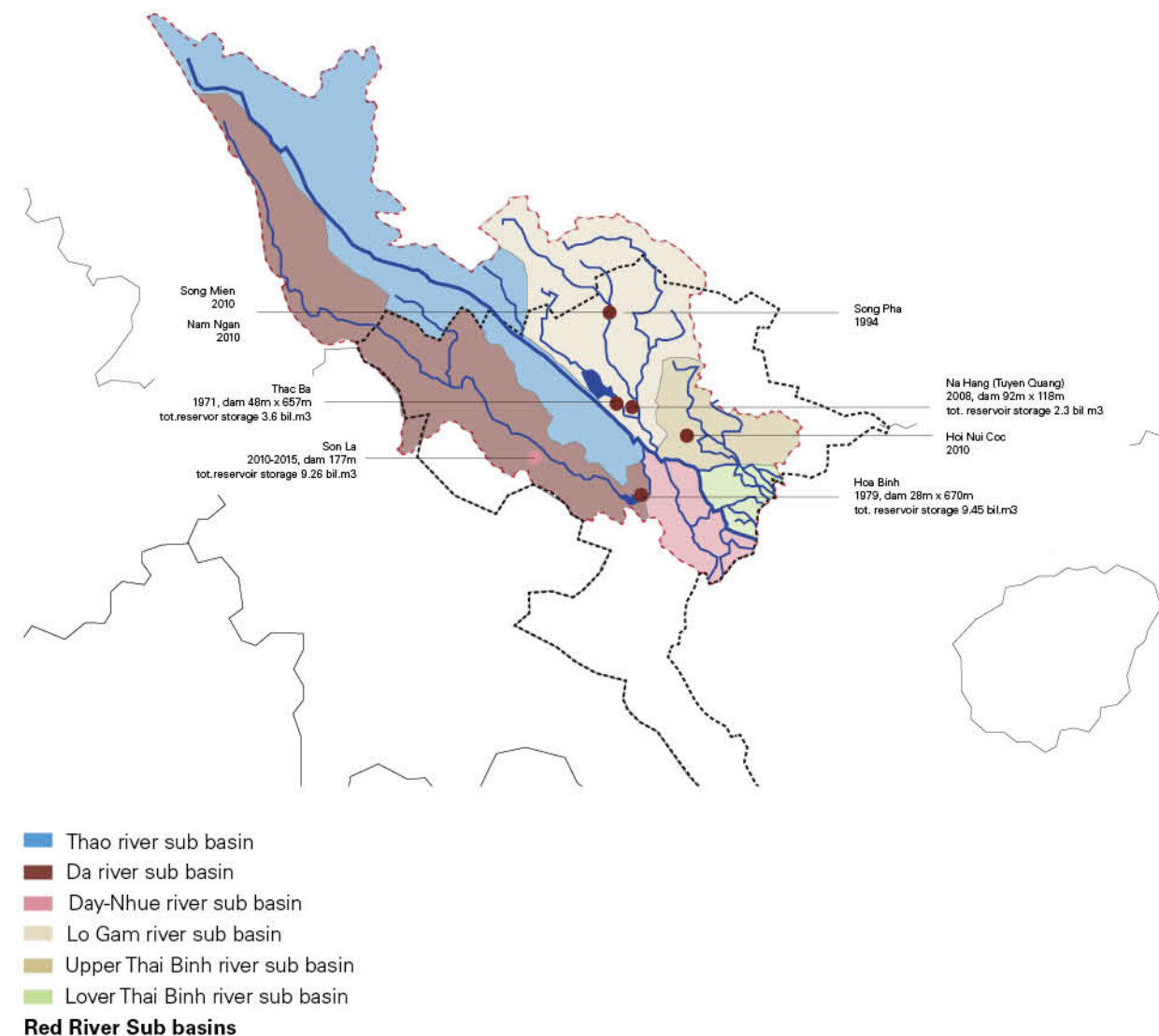
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### Main rivers drain from bordering countries

More than 60% of Vietnam's surface water comes from outside of the country. Six of Vietnam's river basins are dependent on river water from a neighbor country. The two main rivers, the Mekong with a length of 4'400 km and the Red River with a length of 1'200 km, have

their source in the upstream country China. In both cases Vietnam is the last traversing country and therefore highly susceptible to water resources decisions in upstream countries. Particularly the development of dams has a large impact on downstream water resources during dry season.



### Outline of the Red River system

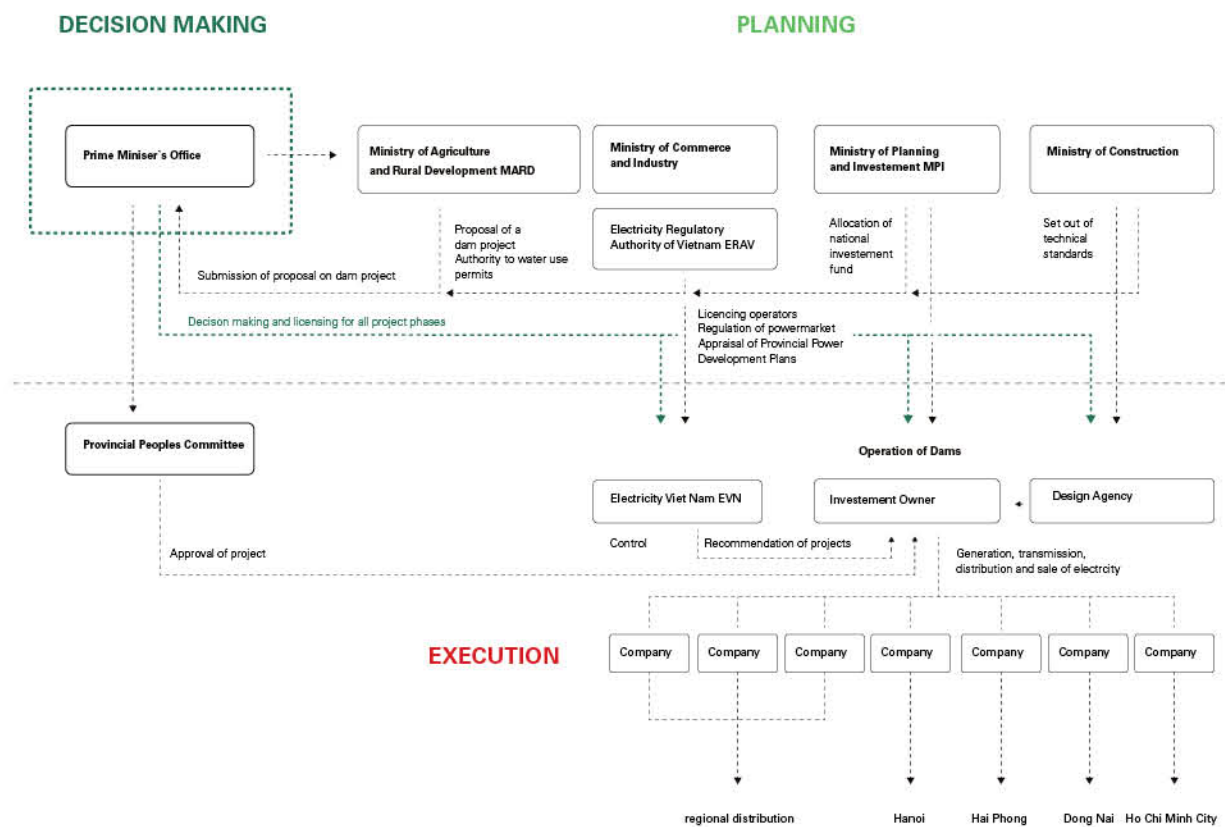
The Red River (Song Hong) is the second largest river in Vietnam. Main headwaters are the Lo, Thao and Da River, which rise in the southeastern part of China. That means, that nearly 40% of Red-Thai Binh Basin surface water originates in China. The Basin is divided into five sub basins, whereof each one is related to one of the sub rivers of the Red River.

The Red-Thai Binh Basin supplies the major cities with water; in its range lie the major ports and the basin provides land and water for the ongoing industrialization processes. Some of the sub basins, such as the Day-Nhue River sub basin, are the most polluted basin in northern Vietnam, mainly because of Hanoi's wastewater, but also because it provides land for new domestic and industrial settlements.

### Sub basins regulated by dams

Over 45% of Vietnam's active water storage is located in the Red-Thai Binh Basin, which has to supply a third of Vietnam's population. Most dams and reservoirs in Vietnam have been constructed for multiple purposes, including flood control, irrigation, hydropower and water supply. The Red-Thai Binh Basin includes four main reservoirs, Thac Ba (1973), Hoa Bin (1990), Tuyen Quang (2007) and Son La (2012). Today water supply is provided to almost every time, even if dams are mainly opened through the time of flood.

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Hydropower plant Hoa Binh

**Excerpt water management organigram**

**Responsibility of the Prime Minister**

Vietnam is a rapidly developing economy country and its demand of energy is increasing fast. The development and modernization of hydropower plants takes therefore one of the most important position in the water sector. Hydropower plants are managed under the Ministry of Agriculture and the Ministry of Commerce and Industry. The Prime

Minister is responsible for regulations, nevertheless regulation problems occur often in times of water shortage, due to a lack of agreements about regulations and because too many institutions are involved in decision making. A draft for a water law was made in 1998, the commencement of the act hasn't come into effect yet.

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Flooded village

### Reduced natural flooding

Floods are the biggest thrate to the life and property of people, as well as the biggest constraint to various developments in the area. To reduce the damages caused by floods the followings measures are taken:

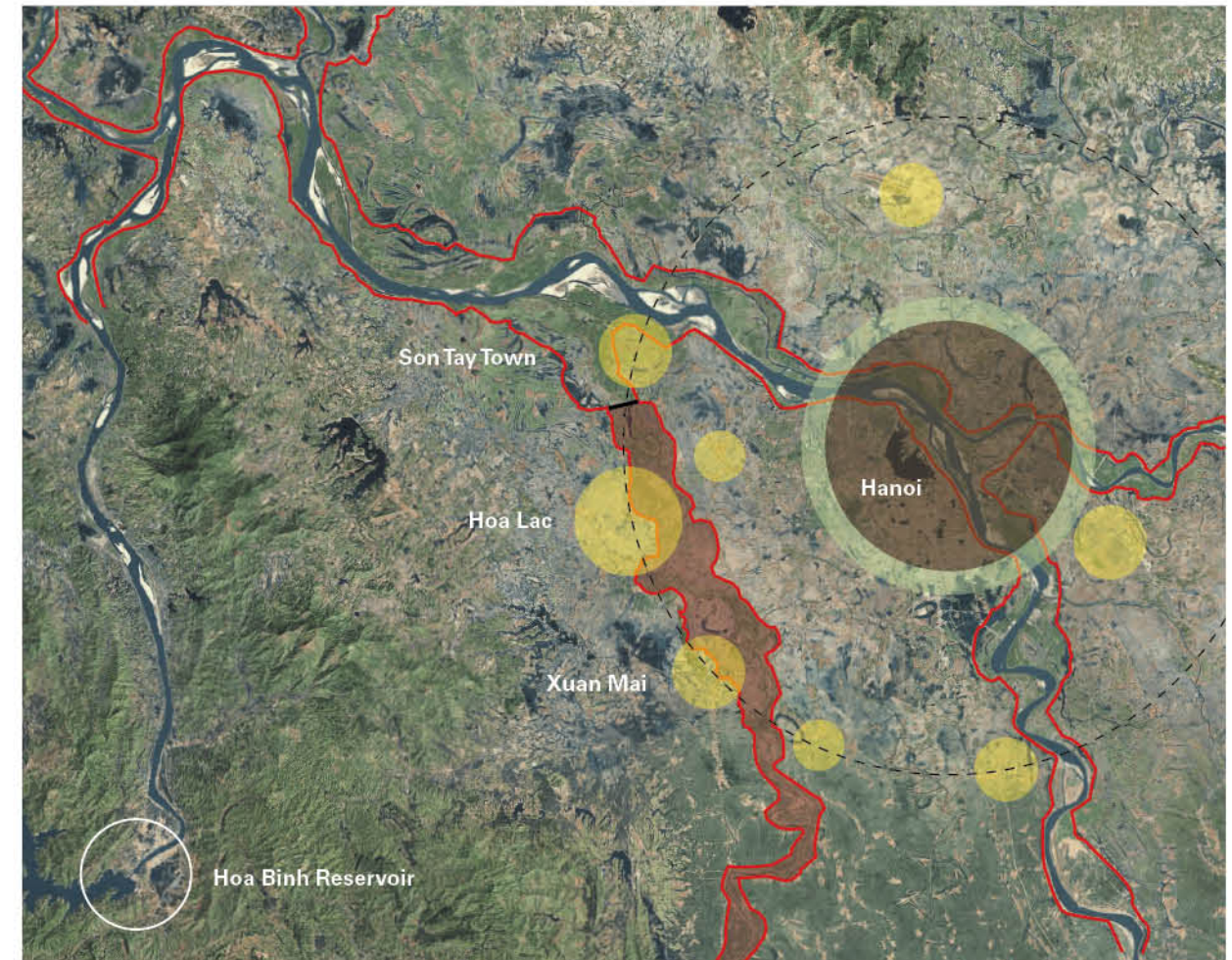
- Strengthening dyke system
- Clearing river flows for flood discharge
- Building reservoirs in upstream areas of big river to reduce floods
- Diverting and retaining floods
- Reforesting in the watersheds
- Intensifying dyke protection and management



Dried-up fishpond

### Water shortage affects the economic activities

The Red River Delta is frequently occurred by droughts. Many regions suffer water shortage during dry season. Water shortage affects the economic activities, but also the water supply for domestic use of the local people. Along the coastal line, shortage also leads to saline intrusion.



- Dyke
- Sluice of the sub basin
- Capital Hanoi
- New satellite cities - masterplan 2030

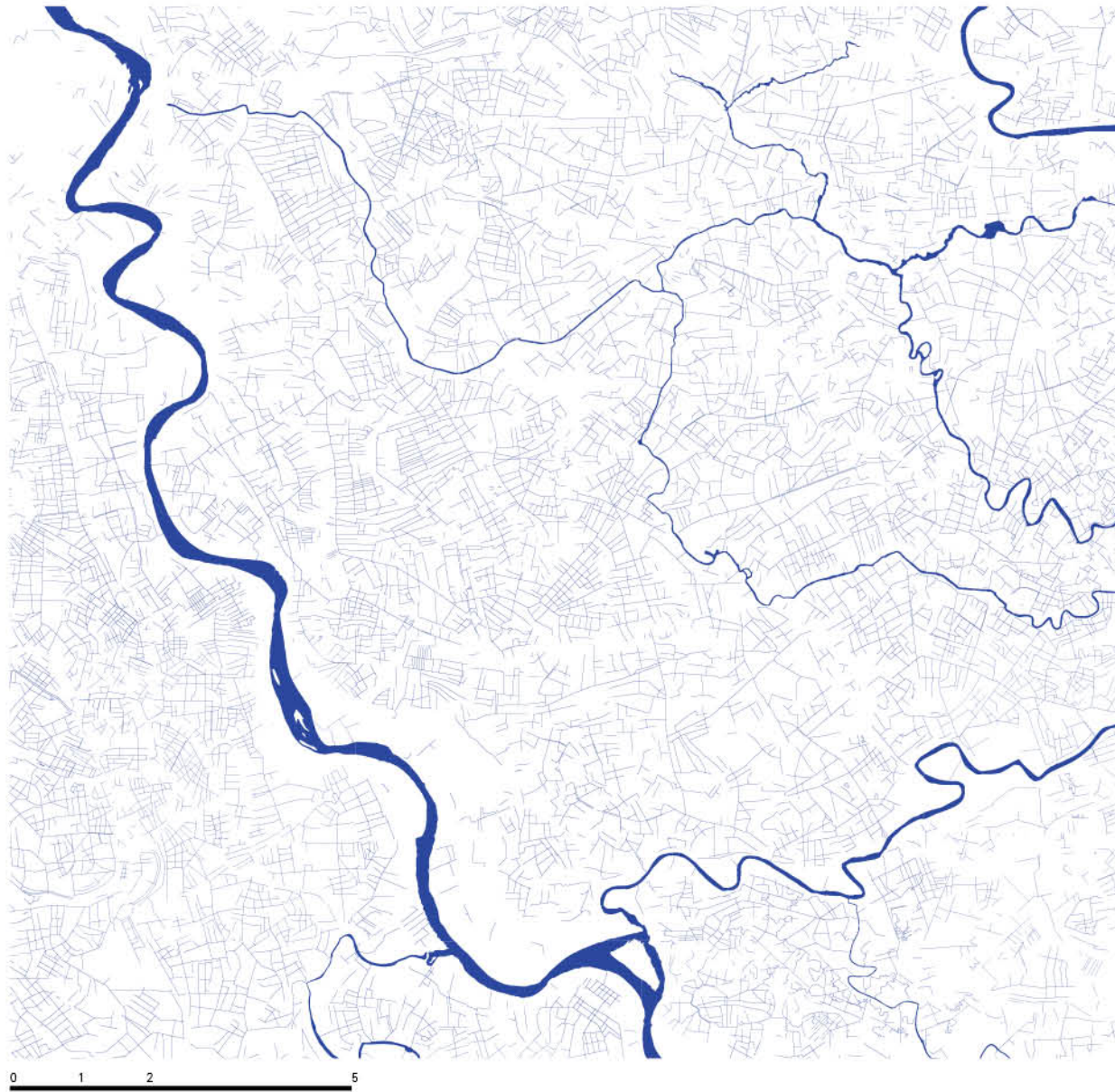
### Day-Nhue river sub basin

#### Draining of flood plain

Since the development of the Hoa Binh Reservoir, which can store a big amount of water masses during flood time, the Day-Nhue river sub basin is not used for land-flooding anymore. The sluice of the sub basin will be therefore opened only in the case of a „100 years flood“.The land is now used for intensive agriculture, the development of industrial zones and has recently become part of the master plan 2030.

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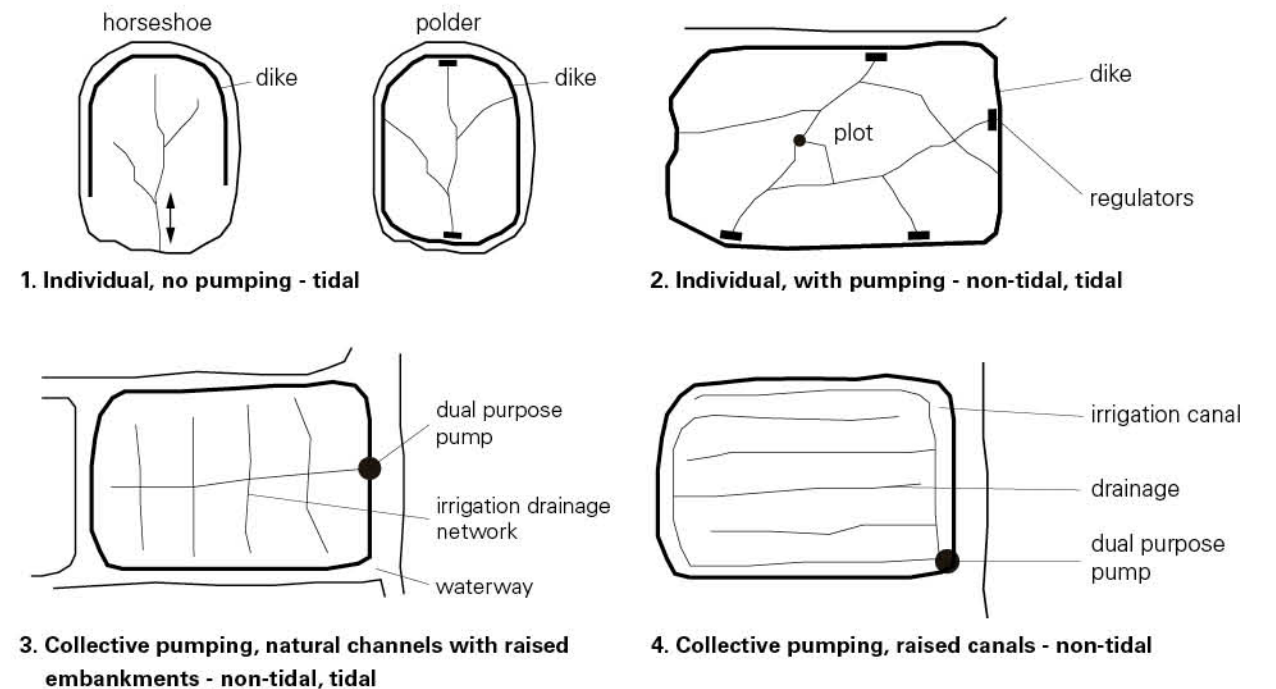




### Complex irrigation and drainage network

The further development of the existing dyke system by the French led to an extension of protected land and allowed a shift from an one post-monsoon rice crop to double or triple cropping in most areas. Nevertheless the natural conditions of the delta, which doesn't allow to cultivate large-scale fields by machines, couldn't be changed. Between the 30's and 60's traditional irrigation and drainage technics were adopted to at that time modern infrastructure, which are still in use.

Hydraulic works, such as sluices and dams, work as gates between the main rivers and the protected polders and regulate the water flow. In summer time, during monsoon season, the intakes are closed and prevent the land of floods by high river flow. The main canals work as collecting ponds for the runoff surface water from the fields. In wintertime, during dry season, the intakes are open and provide water from the rivers. The main canals act as reservoir and transit ponds to bring water from the river to the irrigated area.

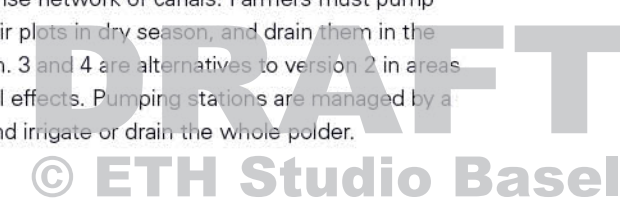


### Typologies of hydraulic units

In comparison to the Mekong Delta in the Red River Delta all pumping activities are managed by collective organizations and no individual pumping activities could develop. Reasons can be found in the history of the political system, but also in the topography of the region. The facts that the small plots make pumping difficult and not profitable, that the plots are not accessible enough to go there individually by boat on the waterway and the lack of money to buy individually a pumping machine fostered the collective ideology, a well-organized system of labors, which still works. 1 Dykes protect the land. Gates regulate water inlet. The Horseshoe is a system found in the Irrawaddy Delta,

closed dykes called polders are common in tidal and flood-affected regions, such as the Red River Delta. Gates regulate inflow of freshwater in upstream regions and control saline intrusion in the downstream regions.

2 Most common system in delta flats. The area is partly or totally protected from tidal effects and from saline intrusion, freshwater comes from upstream areas or rivers and fills up a dense network of canals. Farmers must pump to fill up their plots in dry season, and drain them in the rainy season. 3 and 4 are alternatives to version 2 in areas without tidal effects. Pumping stations are managed by a collective and irrigate or drain the whole polder.





Sluice at the lake Yen Thang - Ninh Binh Province

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- |                 |                |                  |
|-----------------|----------------|------------------|
| 1 Bac Hung Hai  | 11 Xuan Thuy   | 21 Bac Duong     |
| 2 Nam Thanh     | 12 Hai Hau     | 22 Song Cau      |
| 3 Chi Linh      | 13 Song Nhue   | 23 Nam Yen Dung  |
| 4 An Kim Hai    | 14 Phu Sa      | 24 Soc Son       |
| 5 Kim Mon       | 15 Ba Vi       | 25 Lien Son      |
| 6 Bac Thai Binh | 16 My Duc      | 26 Nam Ninh Binh |
| 7 Nam Thai Binh | 17 Thuy Nguyen | 27 Bac Ninh Binh |
| 8 Bac Nam Ha    | 18 Tien Lang   | 28 Yen Lap       |
| 9 Nam Ninh      | 19 Vinh Bao    | 29 Uong Bi       |
| 10 Nghia Hung   | 20 An Thuy     | 30 Dong Treu     |

The Delta is structured by thirty polders

### Dyke system forms independent hydraulic units

All the main rivers are framed by dykes, which protect the lower land from flooding. The closed system of protected land is called polder or hydraulic unit. There exist about 30 polders in the whole Red River Delta.



Inlet - Sluice on the border of the Bac Nam Ha polder - Nam Dinh province

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Province borders

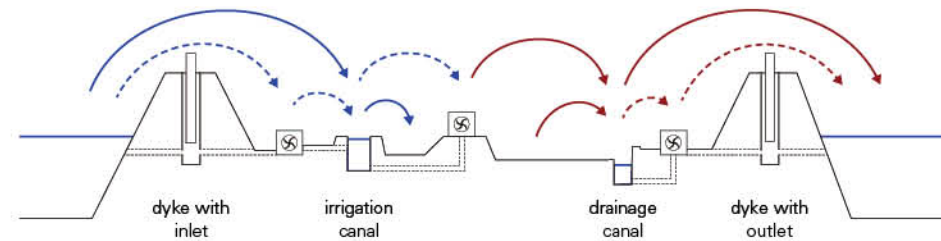
**Polder and province borders**

### Incongruent borders of hydraulic unit and provinces

Polders are managed by state founded irrigation and drainage companies, so called IDMC's. Some polders include land from different districts and the large polders include even land from several provinces. Complex processes therefore form the administration and management of polders. Most companies nevertheless work still autonomous and without prior consultation with companies of other polders.



**Polder 8 - Bac Nam Ha**



- Irrigation by gravity
- Irrigation by pumping station
- Drainage by gravity
- Drainage by pumping station

**Irrigation and drainage system**

Fields  
Pumping station/Sluice

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Main Canal KC



Canal category CI



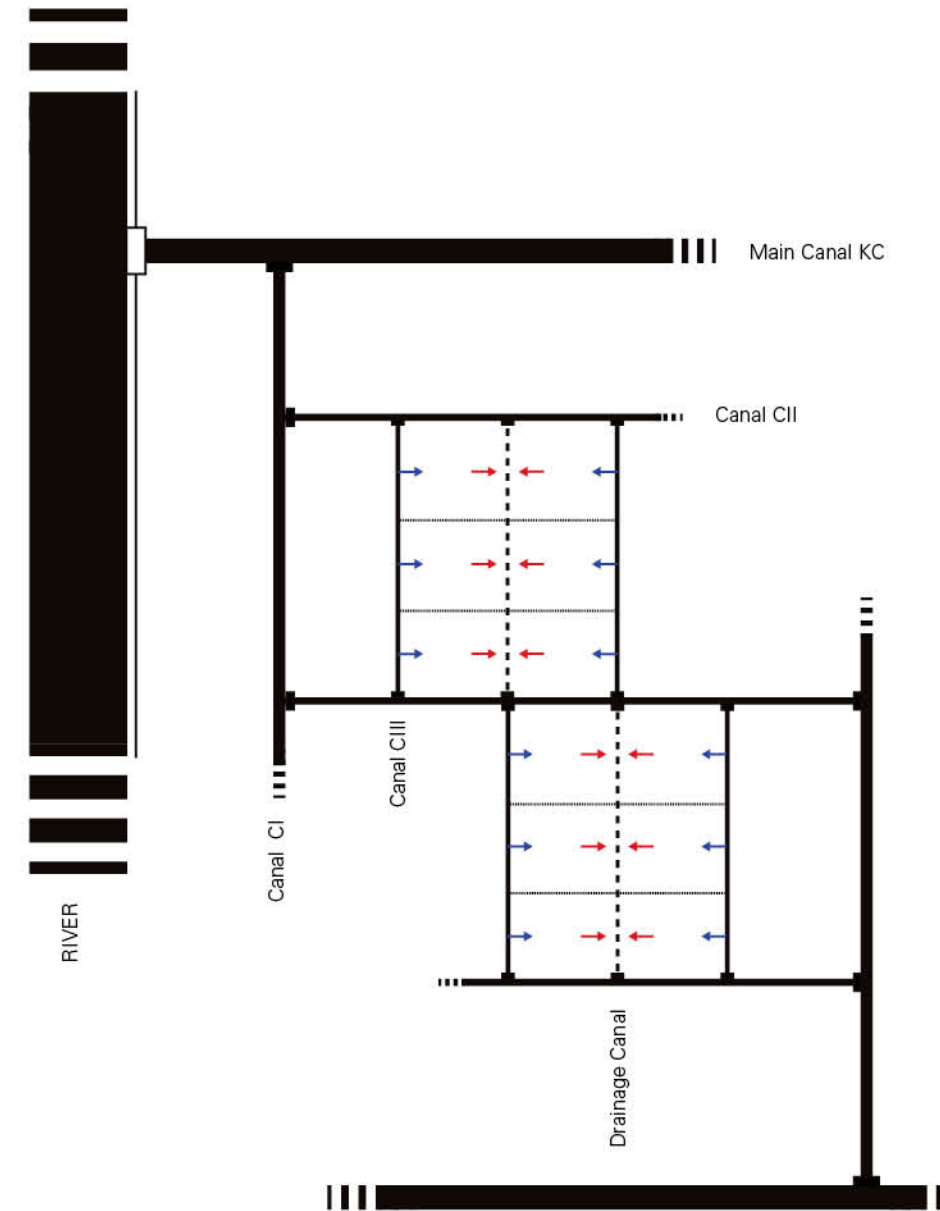
Canal category CII



Canal category CIII

### Different categories of canals

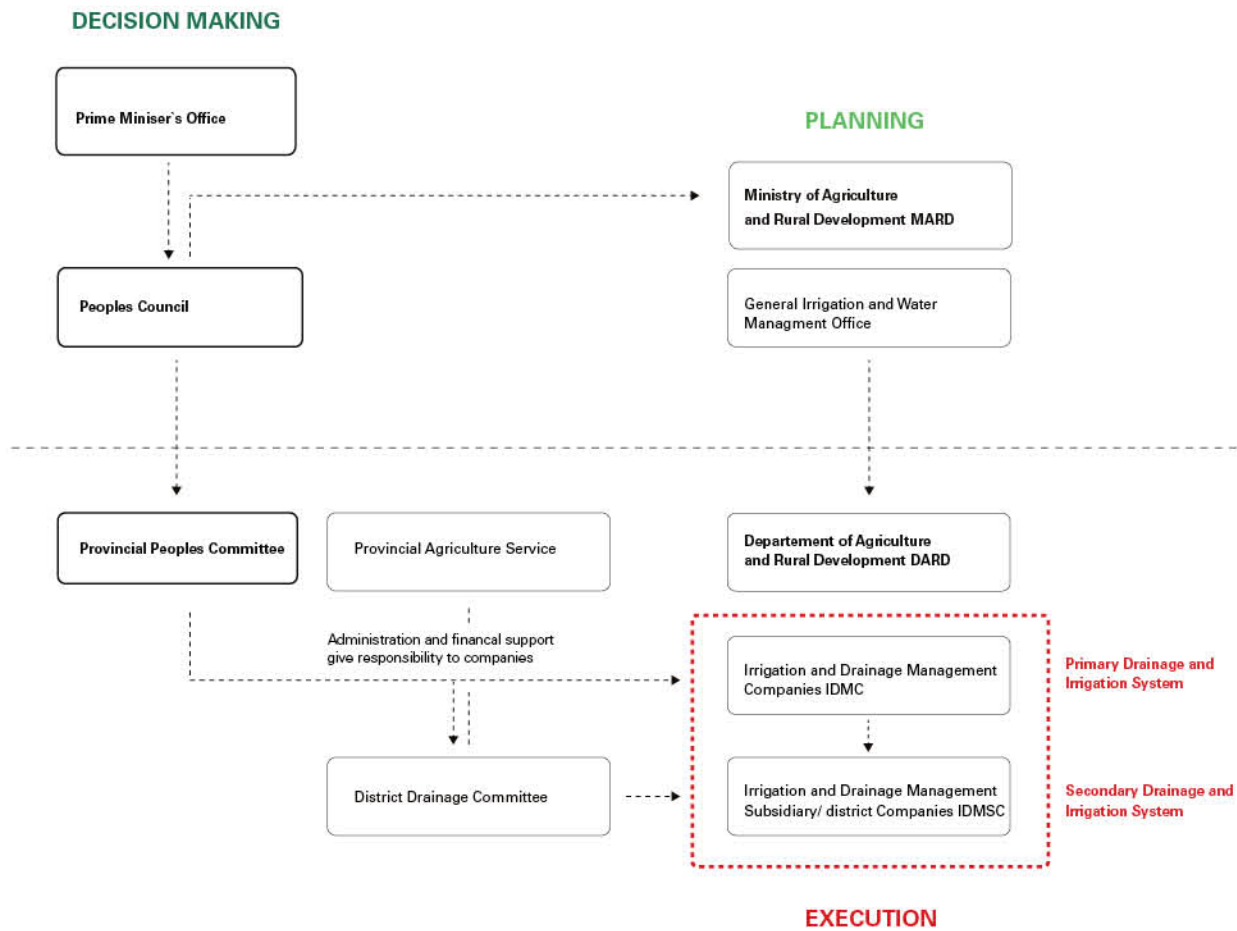
The canal system is shaped by the topography; it was build by the basic principle of lowest resistance. Canals are responsible to distribute the incoming and outgoing surface water, both for agriculture and other uses. Canals either serve for irrigation, drainage or both purposes. They are divided into categories from I to IV.



- Inlet or outlet / pumping station
- Sluice/ pumping station
- Irrigation
- Drainage

Schematic representation of canal-categories

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**Excerpt water management organigram**

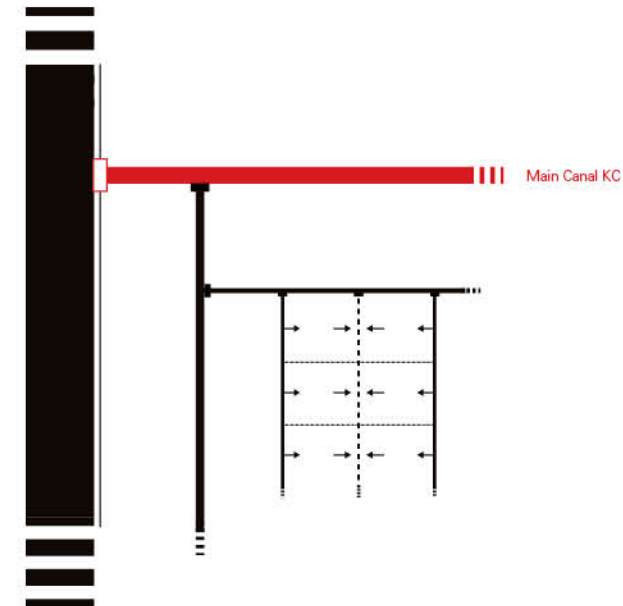
**Main canal, category I and II managed by the province**

The management of the primary and secondary irrigation and drainage system is under the responsibility of 12 corporations with a total of 317 companies and 22'5000 employees and is under the control of Ministry of Agriculture and Rural Development MARD.

The main canals are responsible for the transfer of water from the river to the smaller dual-purpose canals. Irrigation and drainage companies IDMC's get direct payment from

the government for activities and maintenance work. Canals of category I on the province, canals of category II are managed on the district level.

Irrigation and drainage subsidiary district companies IDSDC's are responsible for irrigation and drainage activities, maintenance work and supervision of the pumping stations and sluices. They get payment from irrigation groups and cooperatives.



Main canal KC



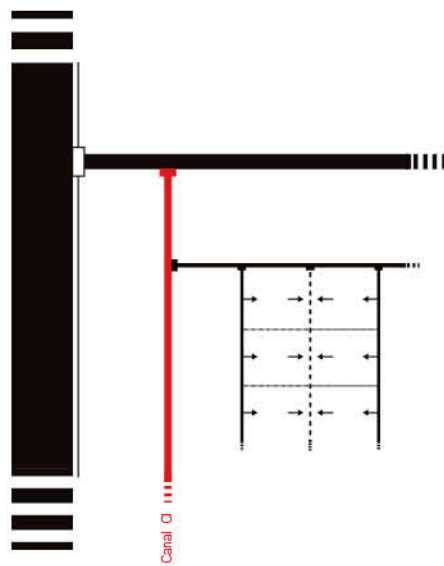
Inlet / outlet

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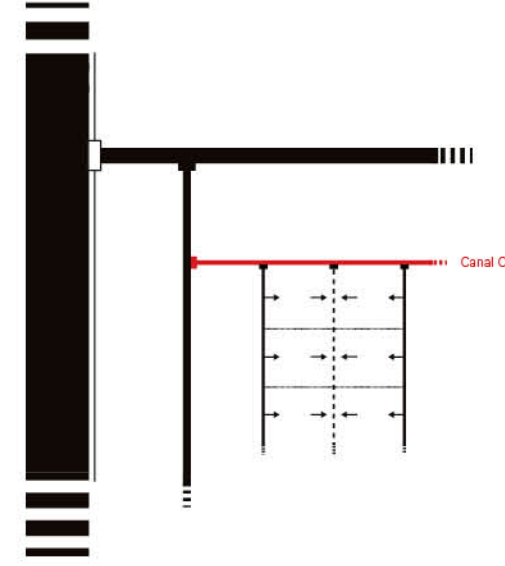


Big pumping station - Nam Dinh Province

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Sluice category I



Canal category CII

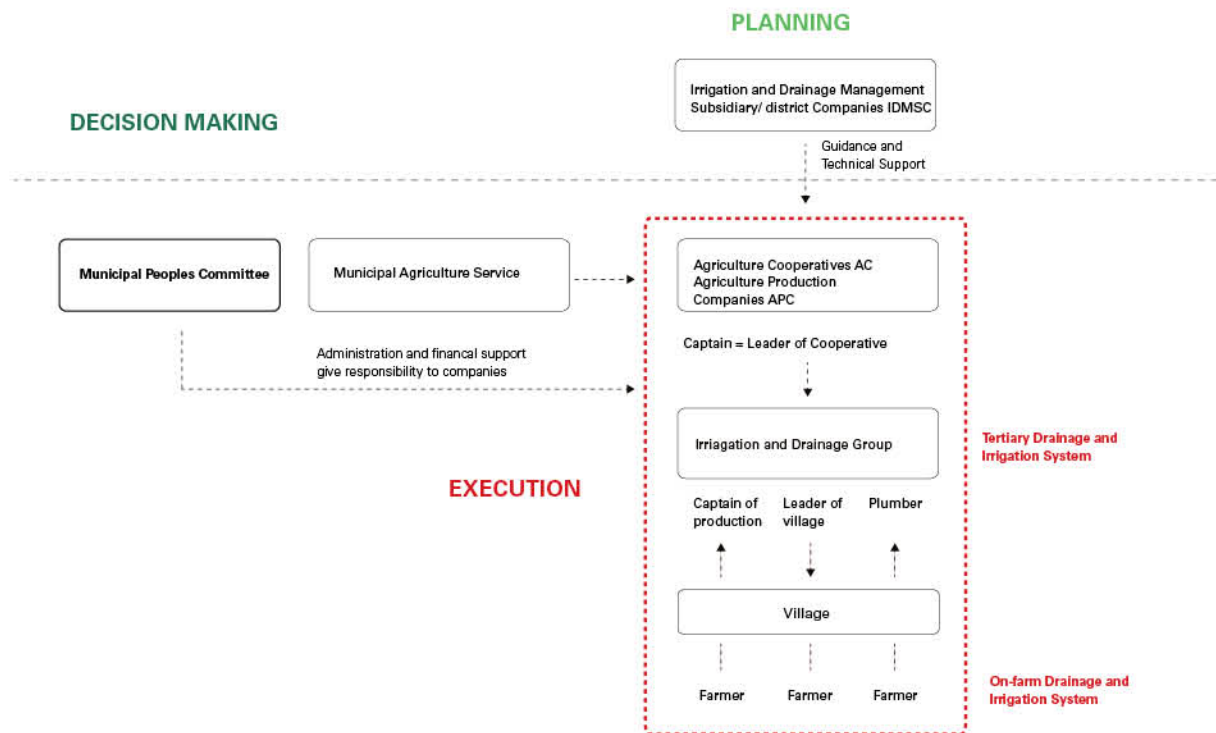


Sluice category II

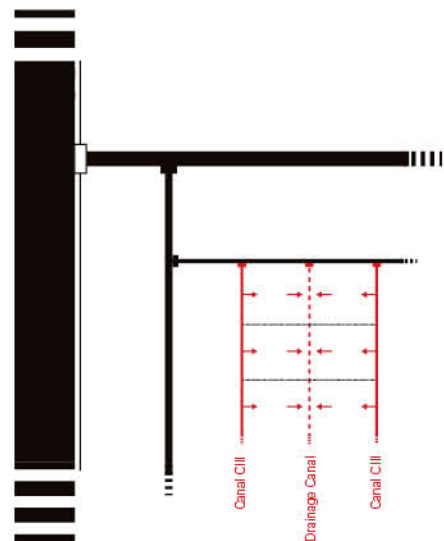


Canal category CI





Excerpt water management organigram



**Category III managed by the commune**

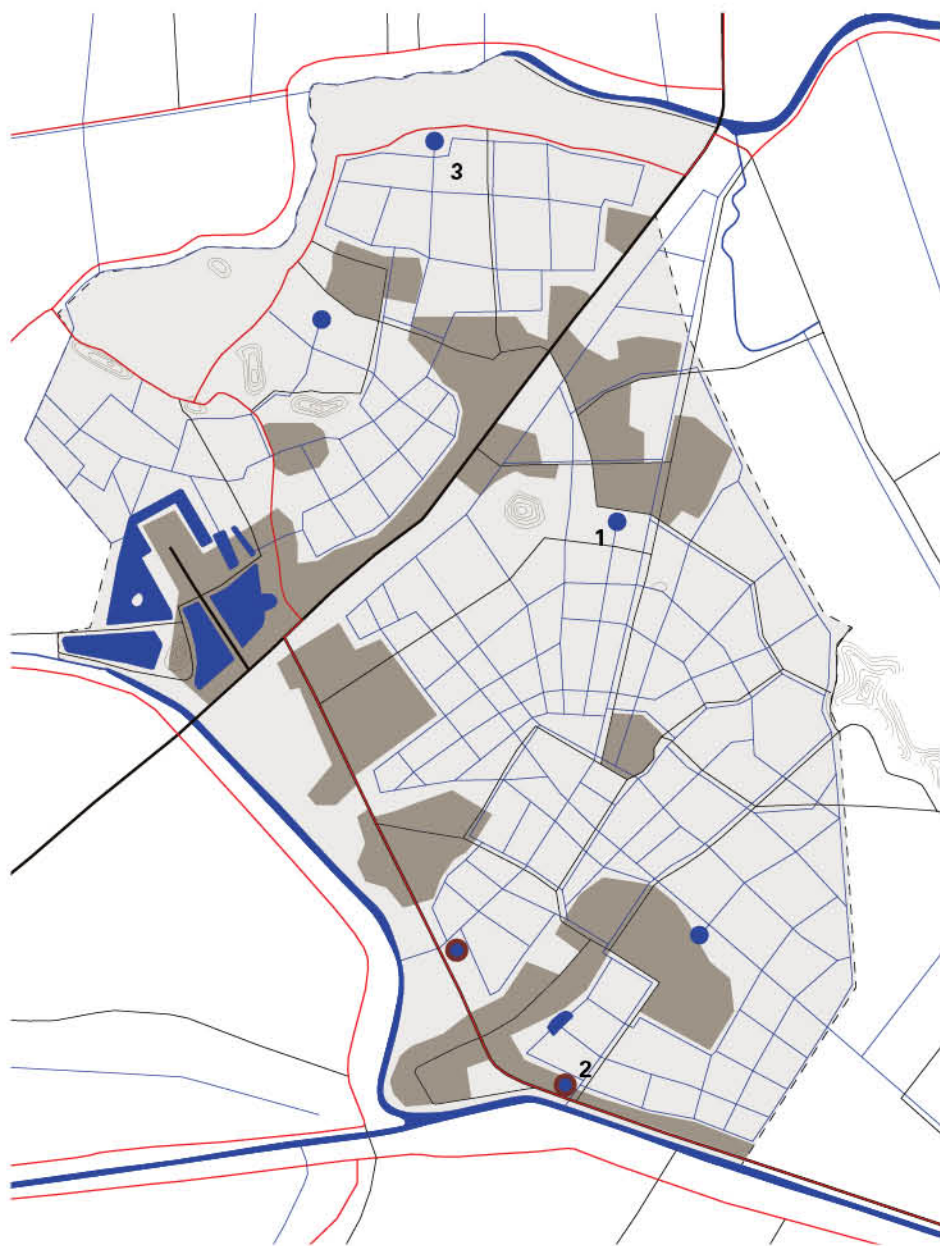
Canals of category III are managed on communal level. Irrigation groups are build up by elected farmers or other people from cooperatives, such as the leader of the village and the captain of production, who are responsible for the irrigation and drainage activities. They are responsible for the operations of the small pumping stations and sluices and the observation of the

irrigation calendar, which they get from the IDMSC's. The cooperative have to collect taxes to pay the maintenance work of the tertiary drainage and irrigation system and to pay the IDMSC's. IDMSC's sometimes compete to the cooperatives, because in some places they do the same work and depend on the taxes from the farmers.



Pumping station Den To in Mai Son commune - Ninh Binh province

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- Irrigation pumping station
- Irrigation and drainage pumping station
- Dyke
- Canals
- Streets

- Rural villages
- ⋮ Mai Son Cummune

Mai Son commune - Ninh Binh province

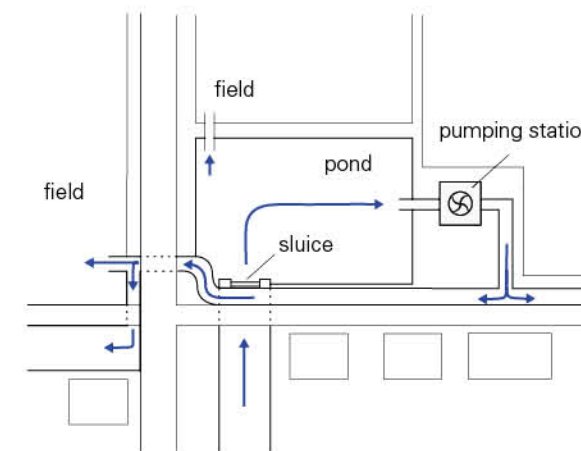
### Pumping stations fulfill different purposes

Pumping stations on the communal level have different functions. Some are only used for irrigation or drainage others have dual-purposes. The captain decides when the

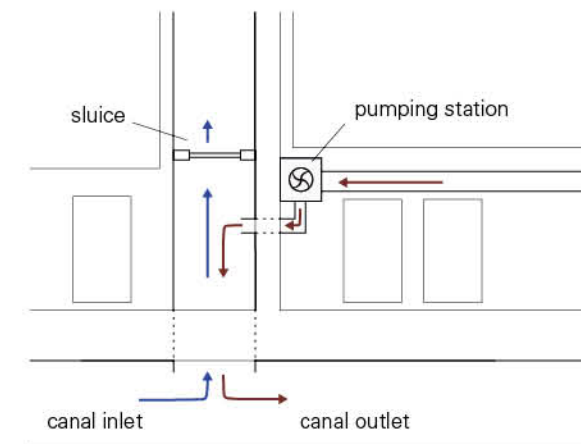
pumps have to be run, he decides in accordance with the lunar calendar. The plumber, who is elected for one year, is responsible for the pumps.



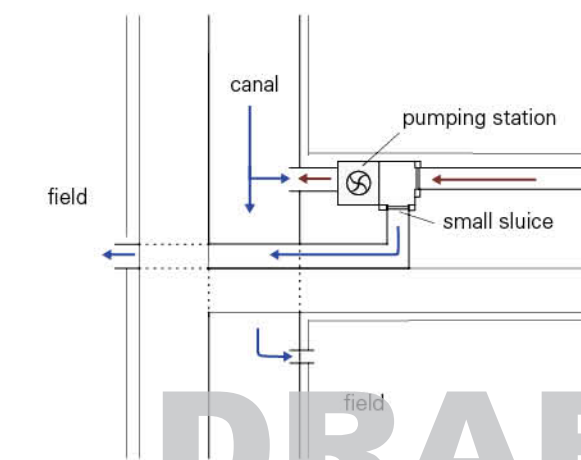
1 Pumping station - Den To - irrigation



2 Pumping station - Dong Dam - irrigation and drainage



3 Pumping station - Can Co - irrigation and drainage



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Farmers let the water into the small canals

### Irrigation rhythm based on the lunar calendar

In the tide-dominated region occurs not only a wet and a dry season, but also a wet and a dry period every month, depending on the lunar calendar and the level of the seawater. During 5 to 7 days in every month, the inflowing seawater pushes up the river water. In this time the sluices can be opened. During those days the polder work as a reservoir, the farmers have to be ready to let the water into the canals and to distribute it onto the fields. In March and August the irrigation rhythm can't be based on the lunar calendar due to exceptional seasonal water level: in March the water level is the lowest, therefore the fields can only be irrigated every 12 days. In August during the rainy season, fields can be irrigated every 2-3 days, but drainage has more priority due to heavy rainfall.



Shifting line of salinity intrusions and land loss

### Rising sea level contaminating downstream irrigation water

Up to the end of the 21st century an estimate for climate-change assumes a sea level rise from 18 cm to 59 cm. Already in these days coastal areas are affected by both saline soils and salinity intrusions during times of high tide and especially in the dry season. With the rise of the sea level this would be even worse and the affected territory could gain large dimensions. Many farmers would have to change to other irrigation methods than by tide-dominated water flow, such as for example irrigation by groundwater wells.



Portable pump for irrigation - Ninh Binh province

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Old pumping station - Nam Dinh province

### Outdated infrastructure

Most hydraulic infrastructure is over 40 years old, in particular some works are still from French time and are 70 years old, and some dams are over 30 years old. Most of the infrastructure hasn't been refurbished, resulting in leaking inlets losing water and pumping stations delivering insufficient water quantity.



Sluice under construction - Nam Dinh province

### Lack of money for renovation work

Major refurbishment work or replacement of the infrastructure is insufficiently carried out because of lack of financing. The provincial budget is even less than the budget from the state. In Vietnam the price for water services for irrigation purposes is too low which leads to a missing tax income. Water pricing could be an important instrument to indicate the value of the resource and would encourage institutions to maintenance the infrastructure.



Outdated sluice - Nam Dinh province

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### Handling of waste water

In dealing with wastewater and water supply systems the rural and the urban regions have to be contemplated separately. Access to clean water and sanitation facilities is mainly a problem of the rural poor in Vietnam. Most big cities have a wastewater system based on the system developed by the French, which covers the former city cores of the early last century. Households in expanded quarters have mostly been tied to this system. Highest wastewater producers are the industries, mainly the sectors of paper-, textile-, clothing- and leather production. Wastewater is a very precarious topic, laws are formulated very open and people don't like to share information.



Drainage under construction - Nam Dinh City

### Finish of waste water in the city

In Vietnam exist three different methods of solid waste collection: septic tanks, latrines and rudimental latrines. In regions and in cities where access to the water supply system is no problem traditional latrines get more and more replaced by pour-flash toilets, which are connected to septic tanks. Septic tanks filter the solid waste and lead the treated wastewater out into the canal system. Septic tanks have to be emptied every few years, which is quite expensive and is therefore mostly avoided as long as possible.

Beside Industries cities are the most polluting factors in the whole system. The Hanoi Sewerage and Drainage Co. estimated that 247 large-, 540 manufacturing firms, 450 craftsmen cooperatives, 36 hospitals and the households daily lead about 415 000 to 550 000 m3 wastewater directly and not treated into the four rivers of Hanoi city.



Treatment plant of an industrial park

### Industrial waste water

Industrial production sites and factories should treat their wastewater by their own treatment system. Where finances and technical equipment allows it, the standards will be kept, especially in cases of international exporting industries. But in most cases, the system works insufficient or doesn't exist at all, because the firms can avoid statutory requirements by paying enough money. Untreated industrial water is charged directly into the drainage system and into the rivers.

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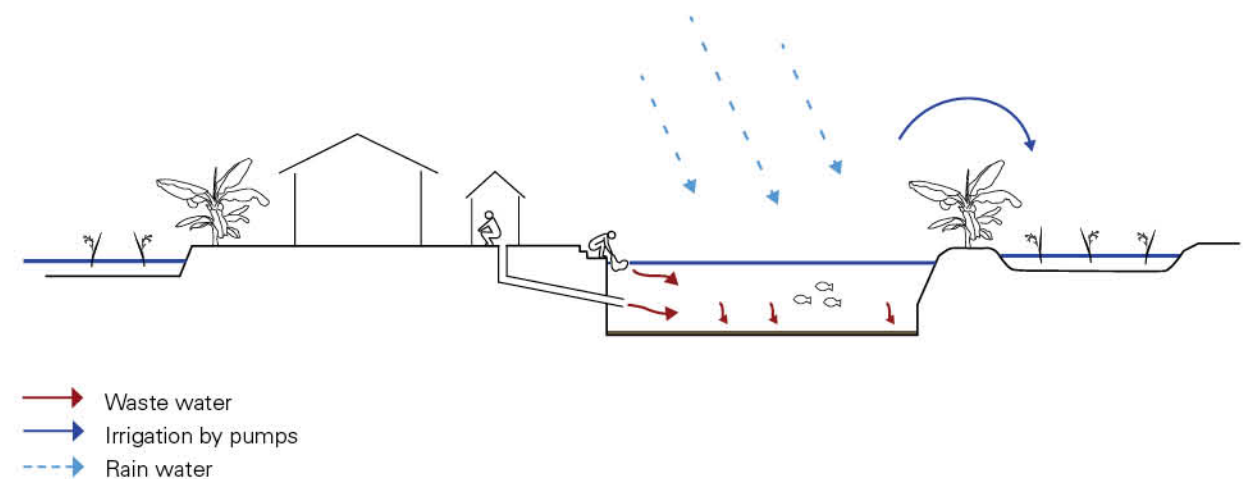
Rudimentary latrine - Mai Son commune

### No achievements in the sector of rural domestic wastewater

Most rural households use traditional dry latrines like simple pit latrines, single vault latrines and double vault composting latrines. Only the last one reaches the sanitary standard accepted by the Ministry of Health.

In rural villages the wastewater gets dumped directly out into fishponds, the canals-system and is further pumped onto the fields.

A campaign from the level of Ministry and international organizations should convince people to change from dry latrines to septic tanks, but process is very moderate. In urban villages, wastewater is mostly collected in septic tanks. The relative high coverage with new septic tanks is facing a very low collection capacity of the public services and septage is dumped into the canal behind the building.



Schematic representation of a low cost treatment

### Fishpond - low coast treatment

In rural regions and in the periphery of the city, fishponds work as local low-cost-treatment plants. Human solid waste is a traditional fertilizer for the rice and nutrients for the fishes. Fresh dung can causes several health problems; therefore it should be stored a half a year before charging it on the paddy fields, which is mostly not adhered. Fish-ponds are also used for washing the laundry. With laundry detergents polluted water is then spread over the fields and ends up in the food chain.

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Fishpond - Ninh Binh Province

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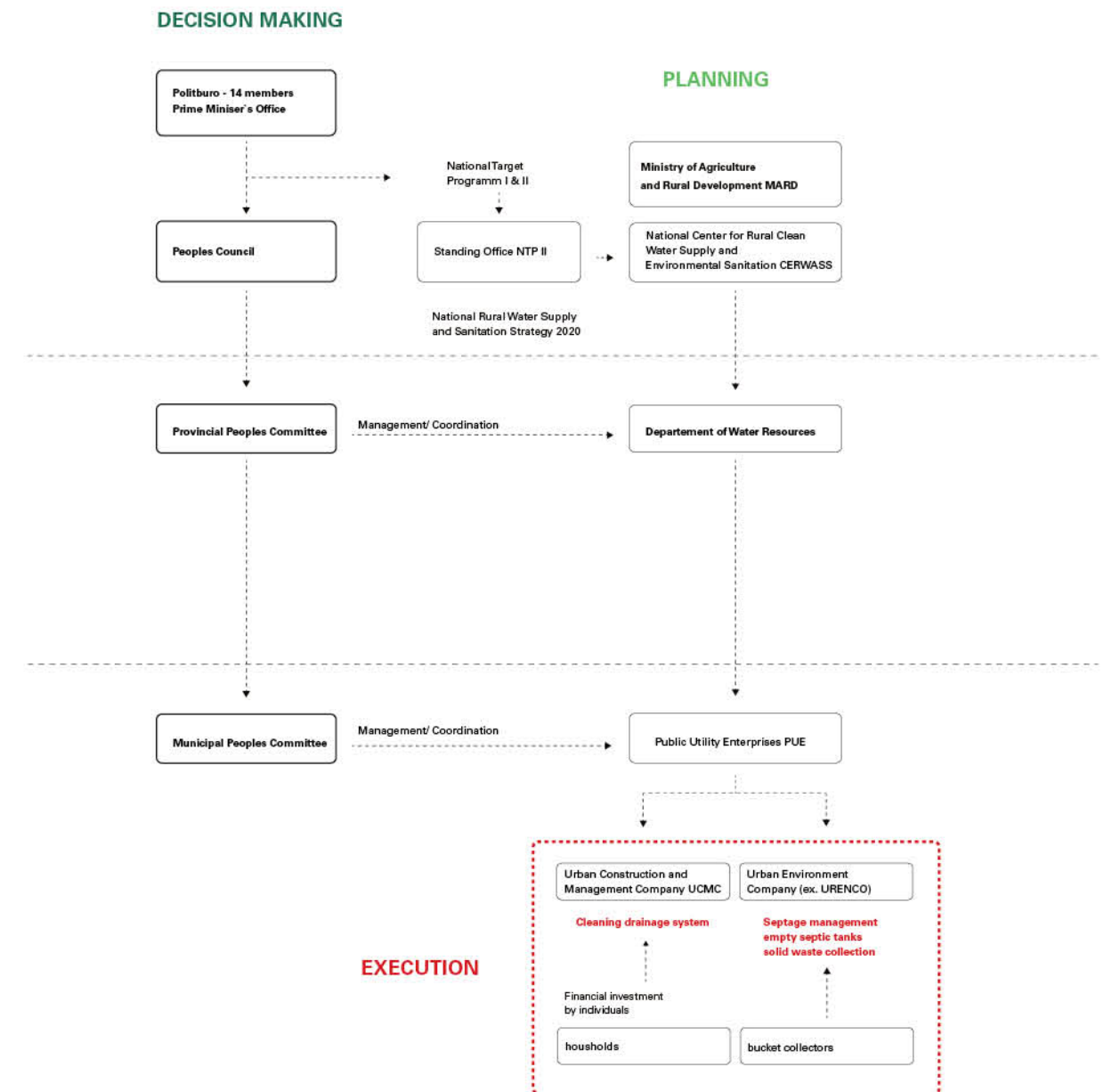


Draining of Nam Dinh City's wastewater into the river - Gia canal - Nam Dinh province

### Insufficient waste water treatment plant

Most basins have no treatment system and the wastewater is directly charged into rivers and lakes. Wastewater treatment plants exist only in few cities, and most of them are small treatment plants for hospitals or other places of production. Only 10 out of 61 large- and provincial cities have a drainage system. In most regions of the Red River

Delta the drainage system is used for different purposes, such as drainage for industrial wastewater, for domestic wastewater and also for storm water during flood times. Regions, which have a very flat topography, are often struggling with blocked solids and get quickly flooded with wastewater during rainy season.



Excerpt water management organigram

### Unclear jurisdictional for waste water management

The Ministry of Agriculture, the Ministry of Construction and the Ministry of Health are responsible for the waste water treatment. In industrial zones also the Ministry for Industry is responsible for Industrial wastewater. The Ministry of Planning and Investment coordinates all large-scale projects. The responsibility of water resource protection and control is divided over different Ministries, which leads to even more coordination difficulties and complications.

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### Human right of access to clean water

In July 2010 the General Assembly of the United States accepted the right for access to clean water as a part of the Universal Declaration of Human Rights. In Vietnam access to clean water is a very young topic, most of the infrastructure is build in the last ten years or is under construction. Still many households do not have any access to the water supply system, and in many rural regions, a supply system doesn't even exist yet. Until 2007, unclear organisational arrangements and poor policies have prevented agencies and enterprises in doing any progress. In July 2007, decree No. 117/2007/ND\_CP on clean water production, supply and consumption was published. It should lead to major changes in the way clean water is produced and distributed and how finances can apply in a more sustainable way. In the last years international organizations, particularly the United Nations Children's Fund UNICEF and the World Bank have provided financial and technical support for the development of supply system and campaigns to promote the use of clean water.



Rainwater collecting system

### Sources of fresh water

In Vietnam clean water is gained by to 66% out of surface water and to 34% out of groundwater. Access to fresh water means to have access to rural sources of water including drilled groundwater wells, rainwater, tap water, constructed wells, and river, lake or pond water treated through qualified filtration systems. Clean water is used to meet the 'daily needs', for activities such as cooking and personal hygiene, but also for watering animals and the irrigation of 'clean' vegetables. Due to the increasing urbanization and industrialisation surface- and groundwater are more and more polluted by wastewater.

### Collection of rain water

The collection of rainwater as clean water is still very common in many rural parts of Vietnam, mainly in regions where households haven't got an access to the water supply system during the last years. Households, which are already connected to the system, still collect rainwater to irrigate the garden, to wash motorbikes and cars and for the toilet flush.



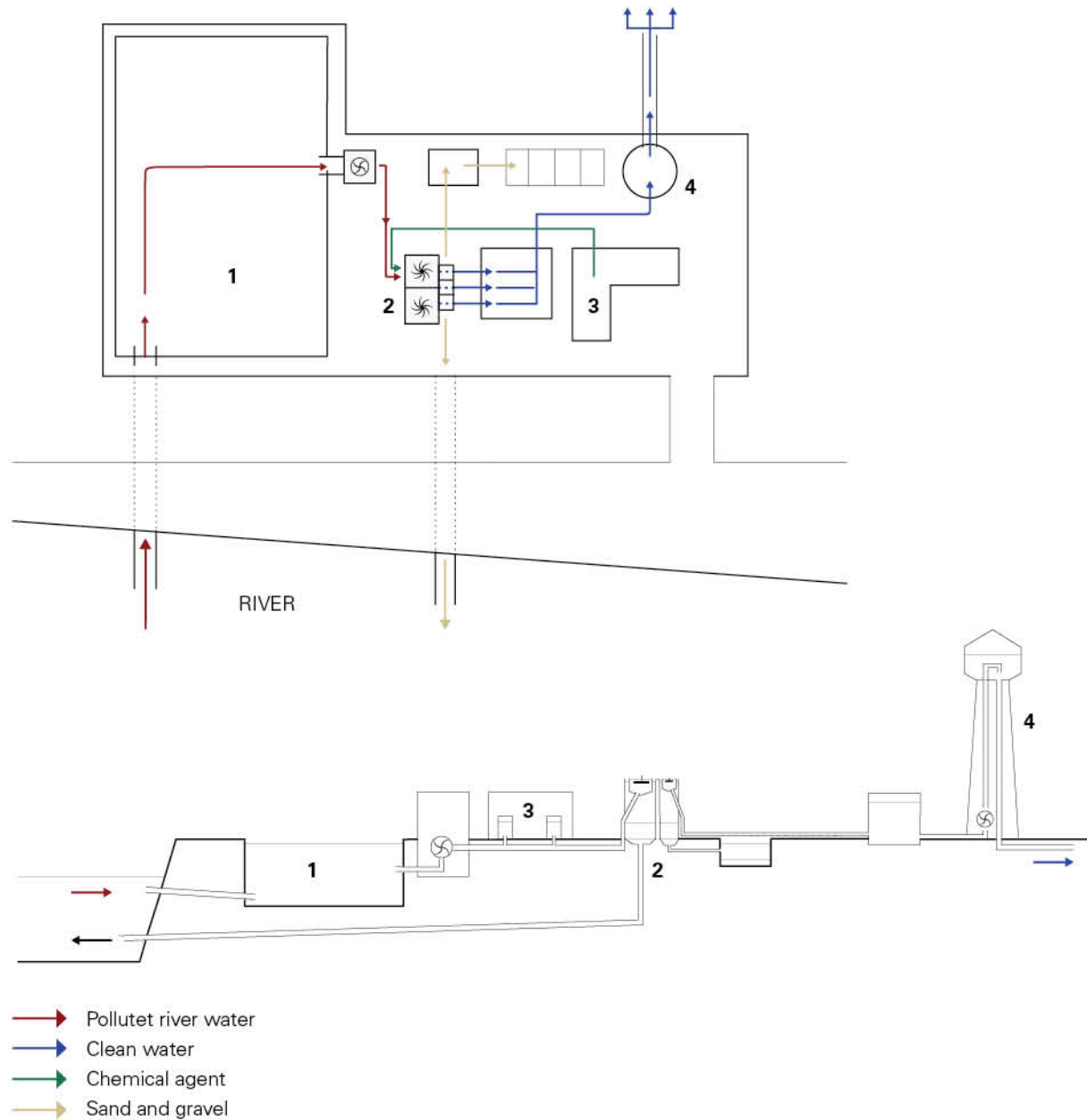
Ground water well

### Access to polluted groundwater

Many people in rural regions still use groundwater drilled by groundwater wells. Private wells primary pump groundwater from the upper aquifer at 12 to 45 metres depths. Due to the growing urbanization and industrialization and the lack of treatment plants, groundwater will be more and more polluted by insufficient disposed industrial waste, solid waste and garbage dumping. Urban clean water plants pump water from the lower aquifers at 30 to 70 metres depths.

### Inorganic Arsenic

In some regions of the Red River Delta groundwater contains amounts of iron, manganese and arsenic. Arsenic originates from sediments in aquifers and releases to the groundwater through a geochemical process. The consumption of highly contaminated water leads to health problems or death. Safety limits for arsenic in drinking water are 10 to 50 µg per liter and 400 micrograms per liter for manganese. Drilled groundwater has therefore to be filtered before lead into the water supply system.



Clean water treatment plant - Mai Son Commune

### Treatment of river water as an alternative solution

Even if there is no official monitoring system existing, the danger of contaminated groundwater with inorganic arsenic is known and in affected regions the treatment of river water is pushed as an alternative solution.



1 River water reservoir



2 Treatment basins with filter

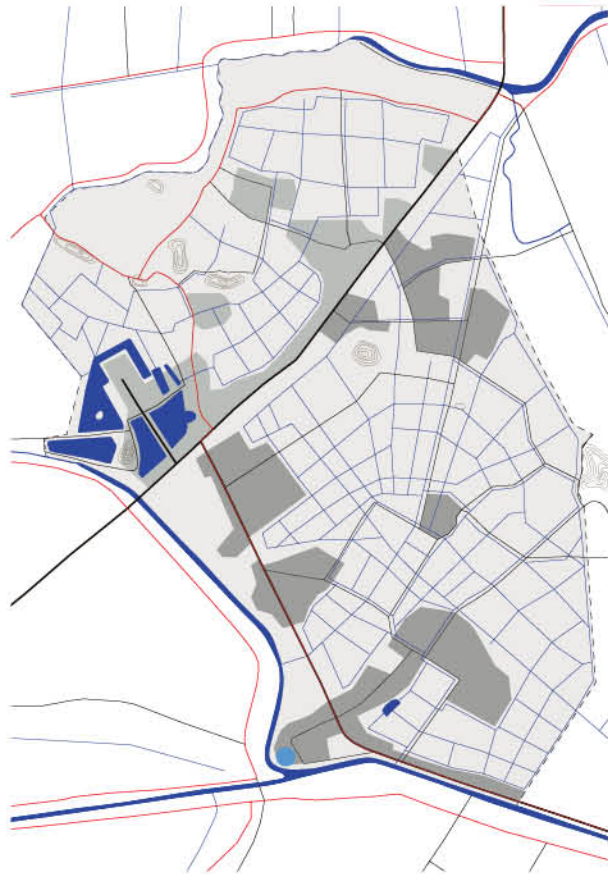


3 Chemistry depot



4 Water tower tank

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- Villages unconnected to the supply system
- Villages connected to the supply system
- Clean water supply factory

**Supply area Mai Son Commune**

**Scarce resource water has a market price**

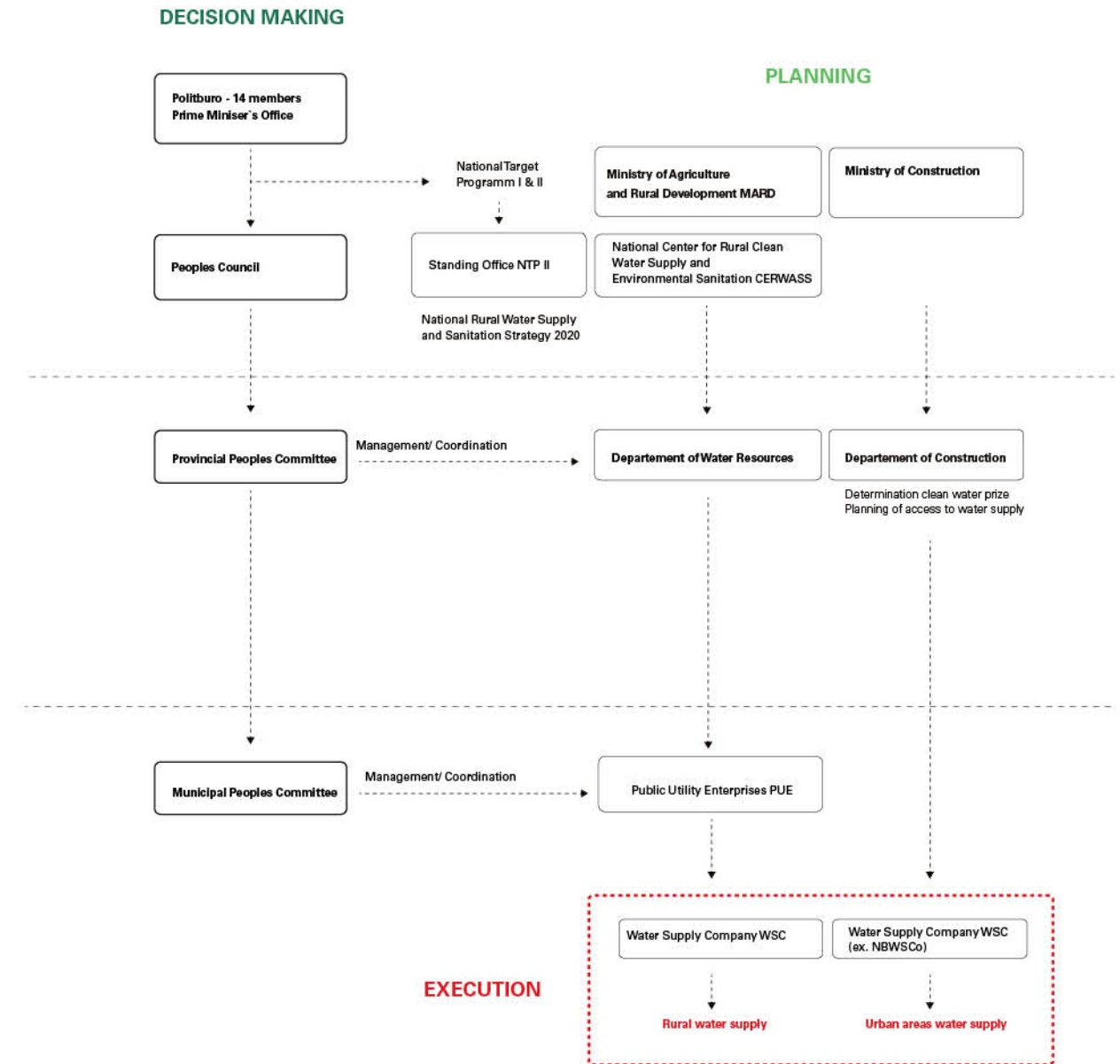
In the past, Vietnam hasn't invested enough money into the water supply and sanitation sector. Clean water has become a scarce resource. Most companies ensure water supply for 14 to 20 hours a day, and 3 or 4 cities are only able to operate for 8 to 10 hours per day. Experts think, that the low water price and the lack of tax income are the main problems incurring insufficient investments. Many people, mainly in rural regions believe in water as a free good, which can be used free of charge, and are therefore unwilling to pay for it. Vietnamese water prizes are one of the lowest in South Asia.

**Water price Mai Son Commune**

850 households connected to the water supply system  
 Total consumption of clean water per day 400m<sup>3</sup>  
 Households pay for 1m<sup>3</sup> = 4500 Dong  
 Household of 4 pers. pays 15m<sup>3</sup> / month = 180m<sup>3</sup> / year

**Water price Nam Dinh Province**

70% of households connected to the water supply system  
 30% use groundwater or rainwater  
 Nam Dinh Town (8000 households)  
 100% of households are connected to the water supply system  
 Households pay for 1m<sup>3</sup> = 0.25 Dollar  
 Industries pay for 1m<sup>3</sup> = 0.60 Dollar



**Excerpt water management organigram**

**Water supply management**

The management of clean water supply is divided into two different groups, urban areas and rural areas. For each group a different Ministry is responsible. The department of water resources under the Ministry of Agriculture and Rural Development MARD is managing the rural water supply and the Ministry of Construction MoC is managing

ing the urban areas water supply. The Rural Water Supply and Sanitation sector RWSS is very complex, an efficient coordination between ministries, donors and between the different levels of provinces, districts and communes is very important, but yet not sufficient. Responsible for the distribution are water supply companies WSC.

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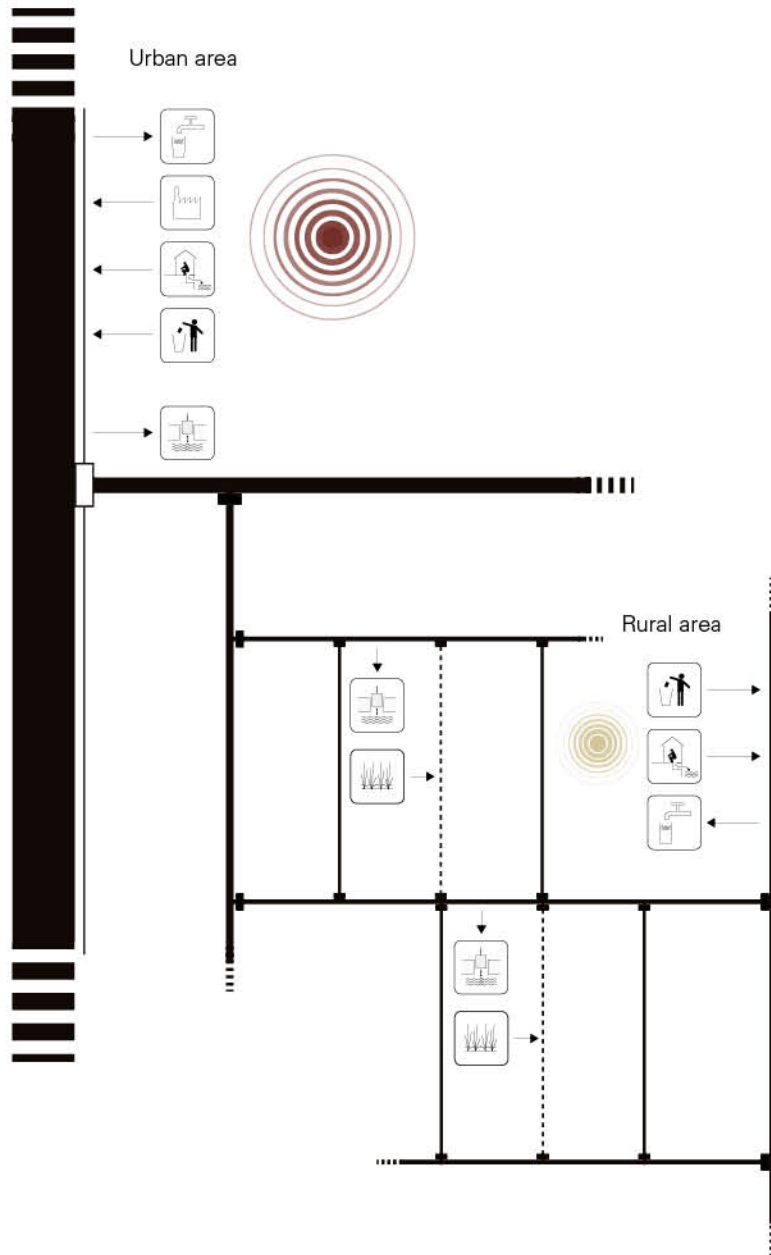
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## OPPOSITE INTERESTS JEOPARDISE WATER QUALITY

Water resources in Vietnam get still too little attention, because there is enough available. Clear warning signs due to ecological circumstances are abundant, but change is not yet required. Vietnam's water management still works and is kept running with very low costs and efforts. In this situation urban settlements can easily develop into former agricultural land. Also the phenomenon of urban flooding due to sealed ground has been only known for the last couple of years. In Vietnam the economic growth and the upgrading to a modern civilization has more priority than water resources and all the low finance resources are used for those. As a result, some regions already have access to high-speed Internet, but no access to the clean water supply system. In the case of water, Vietnam highly depends on international support.



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River - collection pool for everything

### Rivers and canals are threatening to collapse

The drainage system is not a closed system, but connected to the irrigation system. Human wastewater, but also industrial wastewater is directly let into the canals, from where the farmers take the water to irrigate their fields. Synthetic pesticides, which are used for rice cultivation, are then drained into the canals. Water factories take water out of the canals and rivers to supply it cleaned into the pipelines. The more polluted the river water is, the more chemical additives are needed to clean the water. While upstream river water still has good quality, downstream water is, after passing the big cities and most of the industrial zones, highly polluted. Especially during dry season, when natural water flow is low, the proportion of wastewater in the river system is very high.



Drilling boat on the Red River

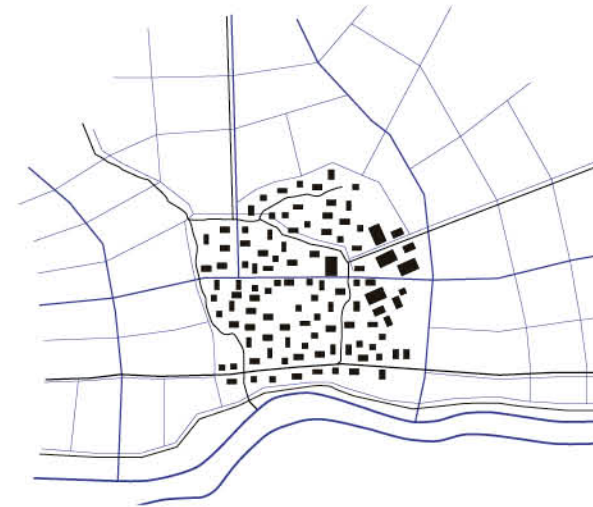
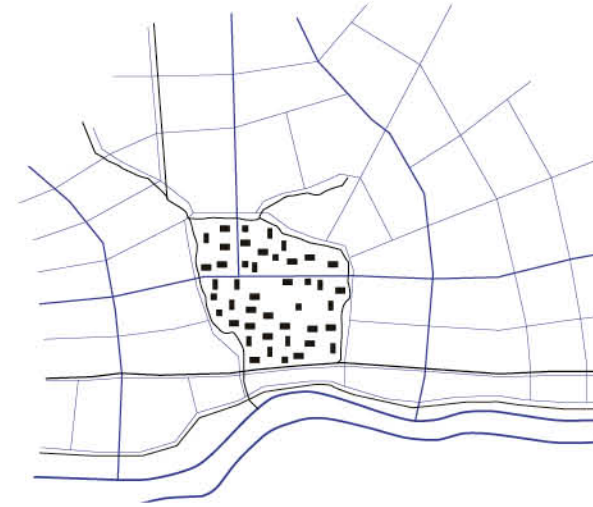


Processing of drilled sand for the market

### Informal sand digging business

During dry season sand digging business flourish in the rivers. Everybody who can afford a drilling boat digs sand and sells it for a good price to the likewise flourishing construction companies. The business is mainly informal. By digging the sand, dykes can be eroded and damaged. On the other hand during dry seasons sand and gravel are settling on the ground of the riverbed, which traditionally resulted in the raising of the river. By digging the sand, this phenomenon gets avoided and the dykes haven't to be heightened any more. In addition channels for boats doesn't need to be dredged anymore. This is another reason, why the informal business is tolerated.

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Settlement expansion

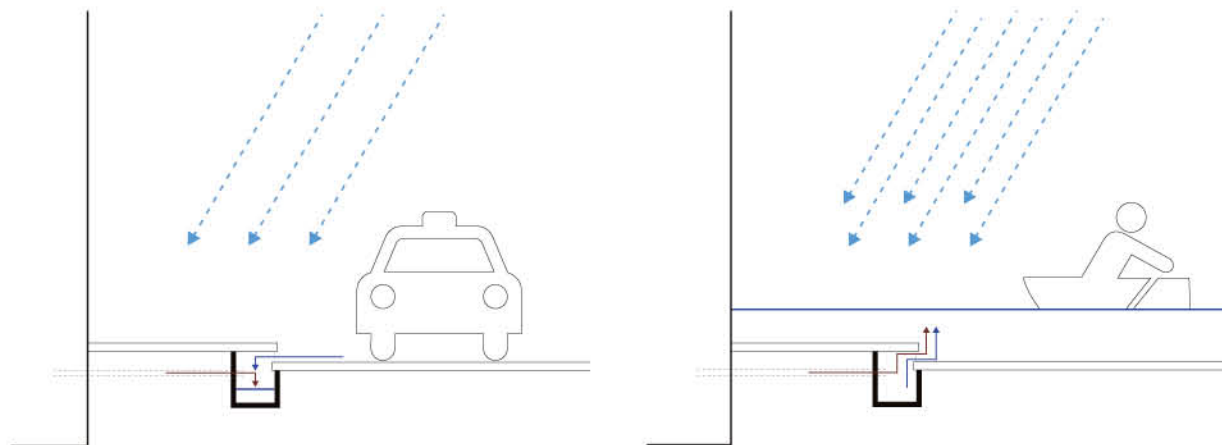


Examples of urbanized villages

### Influence of urbanization and settlement growth

The urbanization and the expansion of the settlements into the agriculture zones have almost no influence on the water system. The net of canals has a high-density and according to them the paddy fields are very small scaled, so single canals can easily be removed. The system will still function, as long as no main canals are affected. Problematical is just the resulted loss of land for agriculture.

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- - - - - Rain water
- - - - - Sanitary waste water
- - - - - Surface water
- Water level
- Sewerage tunnel

**Urban flooding**

**Ground sealing leads to urban flooding**

Due to the growing city, the problems of urban flooding in Hanoi and other big cities has been increasing in the last years. Ground surface has been asphalted and sealed over large parts of the city. Seepage surfaces and green spaces are rarely part of the development processes.

During monsoon season with heavy rainfall, the drainage canals can't take the masses of water anymore.

Since rainwater and drained wastewater have the same system, everything is mixed and pushed up and gets

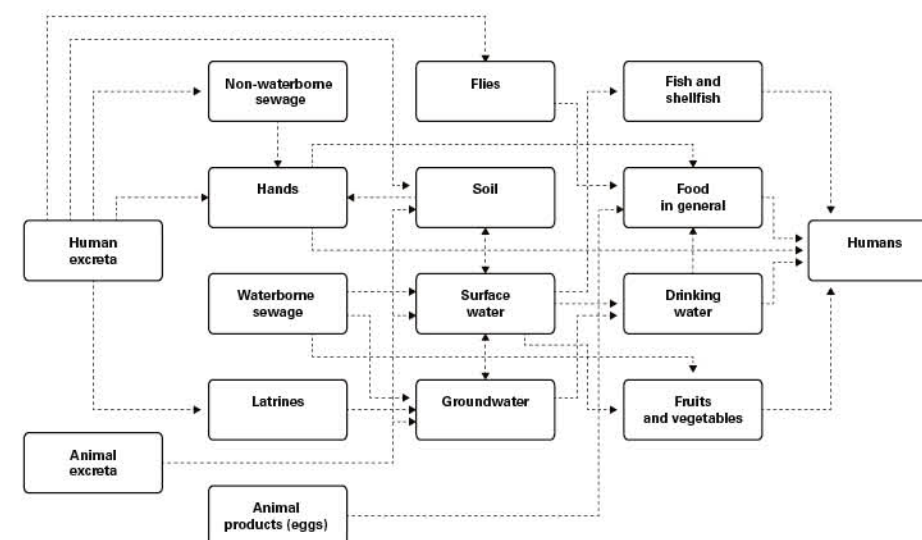
dispersed over the streets. Since the city is lower than the river, subsequently the water needs to be pumped out. In the growing city Hanoi the main pumping station has not enough capacity anymore.

During the last years a shift of standards has taken place. While cities get flooded every couple of years, dams in upstream areas can now control the outlet of water into the rivers and the land beyond the dykes get hardly flooded anymore.

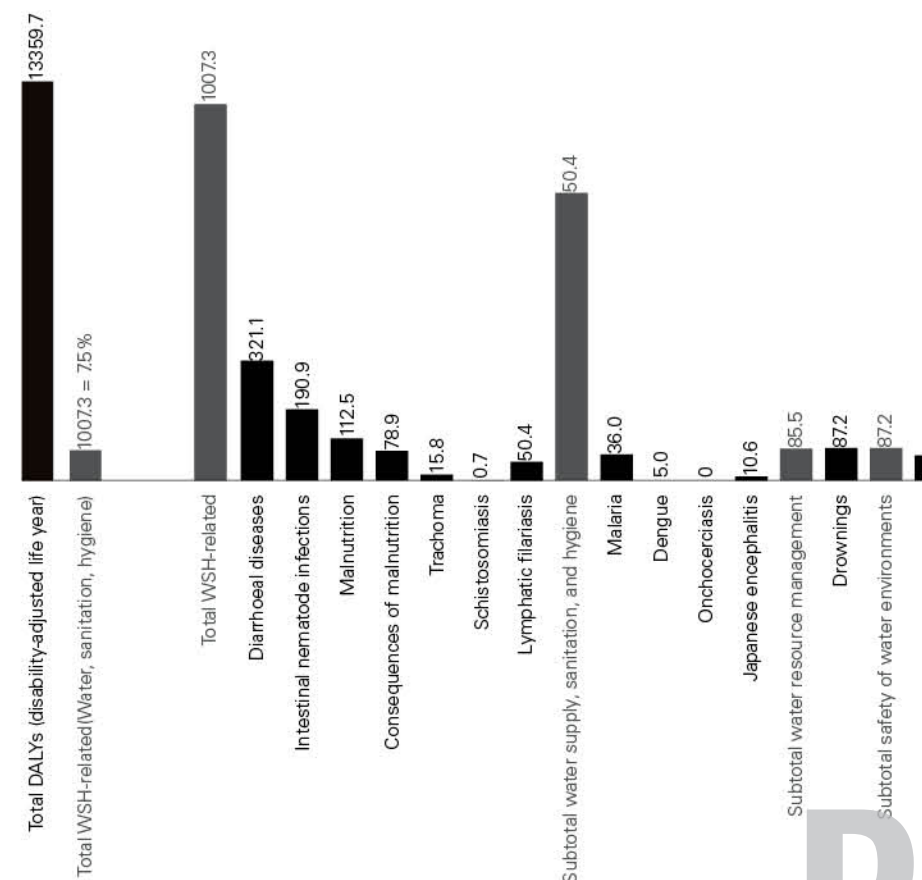


Ground sealing and drainage system - Nam Dinh Town

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Estimating the diseaseburden related to water, sanitation and hygiene



Country data on water, sanitation and hygiene-related disease burden

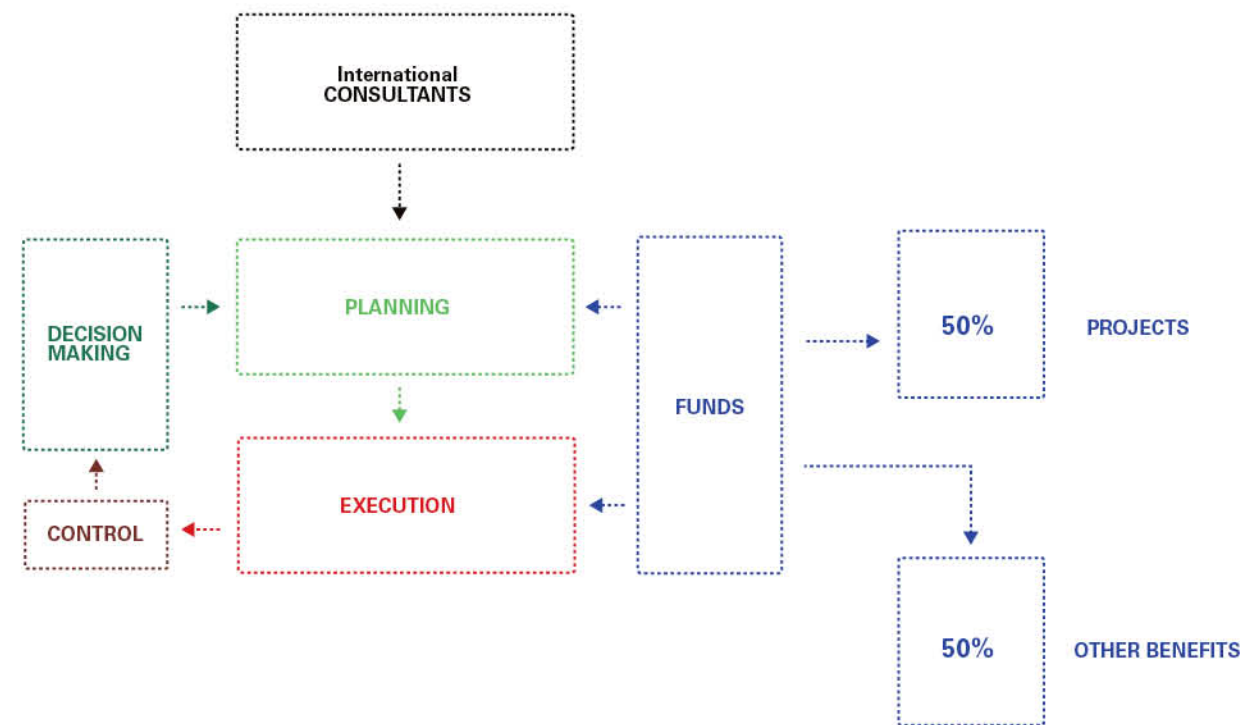
### Health risks due to polluted water

In Vietnam general data about the quality of surface water is very poor. Some regions, such as Nam Dinh Province have been part of research projects and the influences of polluted water as health risk could be pinpointed. Polluted water can affect humans on different ways, diseases can be transmitted through poor personal hygiene and poor sanitation, through food in general, vegetables and fruits irrigated and washed with polluted water, but also through animals or animal products, which have been in contact or bred with polluted water, such as fish and shrimps.

Clean and better-managed water resources can reduce the transmission of diseases and have a direct or indirect influence on the economic benefits on different levels.

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Position of international consultants

### The two faces of knowledge transfer

But the interest of international organisations and developing partners has two sides. On one side, the Vietnamese water management is supported on the governmental level by expats, which promote cooperation and offer their knowhow. They act in the function of a mentoring and controlling system. In the current Vietnamese water management those functions are not or only insufficient established. On the other hand, international organisations function in it self as a closed system. International organisations and researchers inform and communicate in English, but the Vietnamese language uses terms of water in a much more differentiated manner as the English. Unclear formulations due to translation work leads to different points of view.

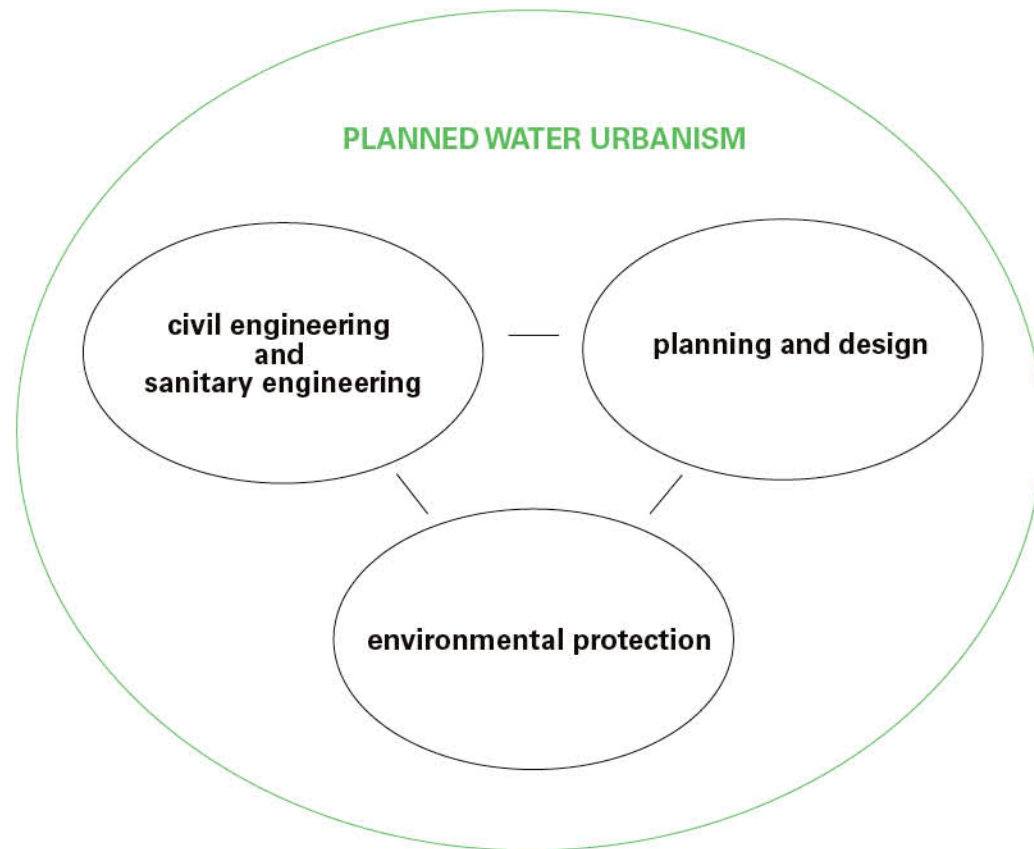
### Missed opportunity by corruption

Both the public wastewater and the clean water systems are mainly financed with credits from international finance institutes. As long as financial resources are limited, Vietnamese institutions will hardly do a step towards an independent position. Furthermore many international, but also national credits never reach their destination. Corruption is not a topic discussed in the public, but according different sources up to 50% of financial funds of every project are used for other benefits. As a result, some provinces tried to eliminate corruption by the decentralisation of the financial system and hope that directly spend money on local level cannot be used for other purpose than intended.

### Support of international organizations and development partners

The international community is highly interested in developing countries, which have recently experienced an explosive economic growth and especially in the case of Vietnam has a vast reserve of water resources. Those resources are threatened because of the fast urbanisation processes. International organisations and governments of developed countries are sensitized and specialized to sustainable use of water. Moreover are they aware of the potential risk when ecological balance will be disturbed and what impact it can have to the affected society.

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### Sustainable acting demands change of awareness

In the near future the pollution of the rivers will increase once more and will be a risk for human beings, animals but also will lead to potential ecological damage. Polluted water will also lead to a lack of clean water both in rural and urban areas. This palimpsest of different water users urgently needs new solutions. A fundamental rethink away from the polder-centralized management to a networked sub-basin water management system must be the first step. On local level, this can also work through planned water urbanism, which means the cooperation and interaction of planning and design, civil and sanitary engineering and environmental protection. The water system was once the core of the deltas cultural development, today it plays only a sub-role in the developing country. The emotional attachment of the water topic need to be brought back to the people living in the Red River Delta.



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## IMAGE CREDITS

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Dinh Duyet, Nguyen Nhat Linh, Khan Linh, students NUCE - University of Civil Engineering of Vietnam

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Mr. Nils Fuehrer, IWRM-Vietnam/Integrated Water Resources Management Vietnam

Ms. Ha Nguyen, arb east architects, Hanoi

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### INSTITUTIONS

NUCE - University of Civil Engineering of Vietnam

IWRM-Vietnam/Integrated Water Resources Management Vietnam

Hanoi University of Science / Vietnam National University

EFEQ / Ecole française d’extrême-orient