



# Wastewater reuse in Vietnam: Potential and Technologies

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# VNU University of Science

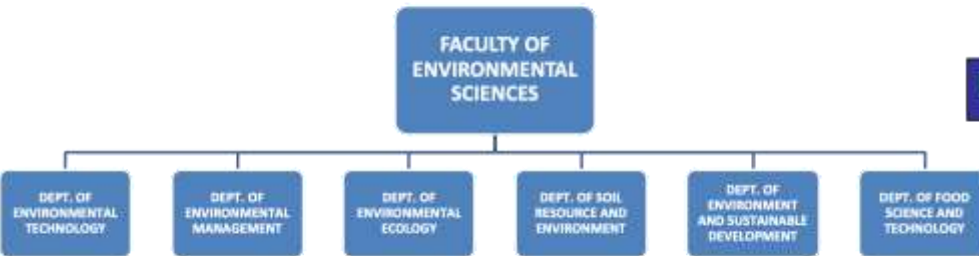
Founded in 1956

## Faculty of Environmental Sciences (FES)

Founded in 1995



## FES Structure



## FES Human Resource

- 54 staffs (16 Associate Professors, 23 Doctor of Science, 12 Masters and 3 administration assistants);



## Training course

### B.Sc Programs

- Environmental Sciences*
- Environmental technology*
- Food Science & Technology*

### M.S Programs

- Environmental Engineering*
- Soil Science*
- Environment and Sustainable Dev.*

### Ph.D Programs

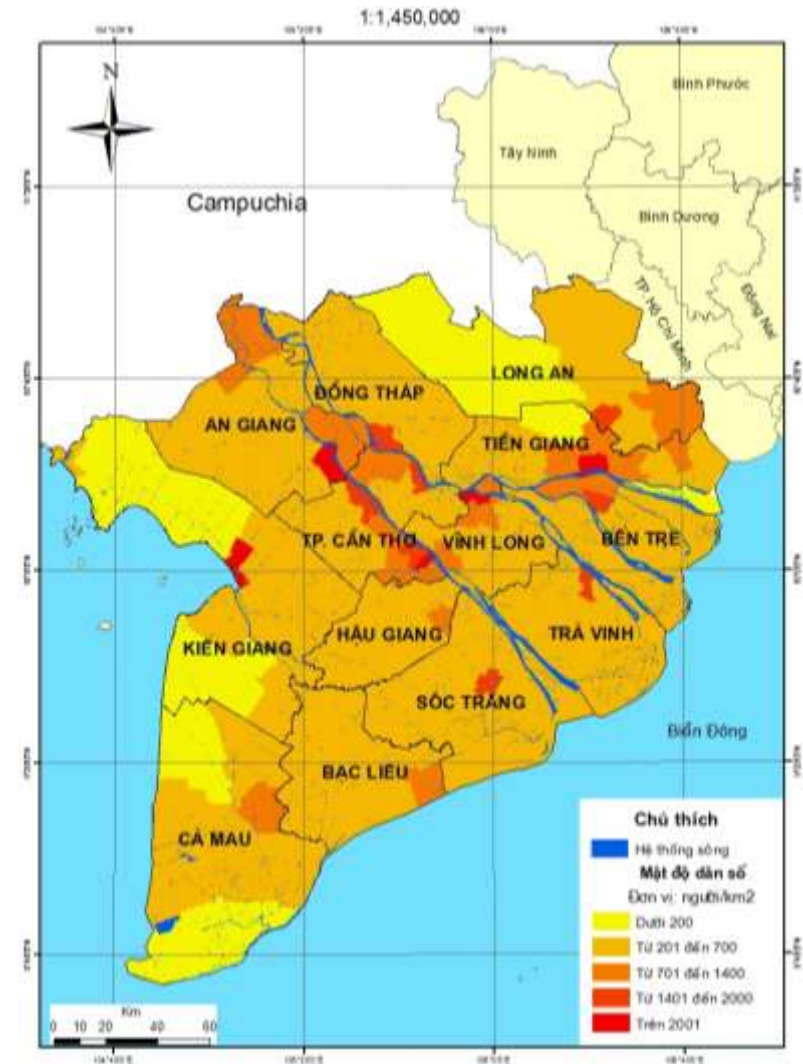
- Soil & water Environment*
- Environmental Science*
- Soil Science*

# Content

- Introduction
- Water supply demand in Mekong delta
- Effectiveness of existing water treatment technologies in the Mekong Delta
- Technological solutions to reuse wastewater
- Conclusion

# Introduction

- The Mekong Delta is the last downstream area of the Mekong River;
- The Mekong Delta is the largest producer of food and foodstuffs in the country;
- Pollution of the water environment has been posing great challenges to the Mekong Delta.



## Introduction

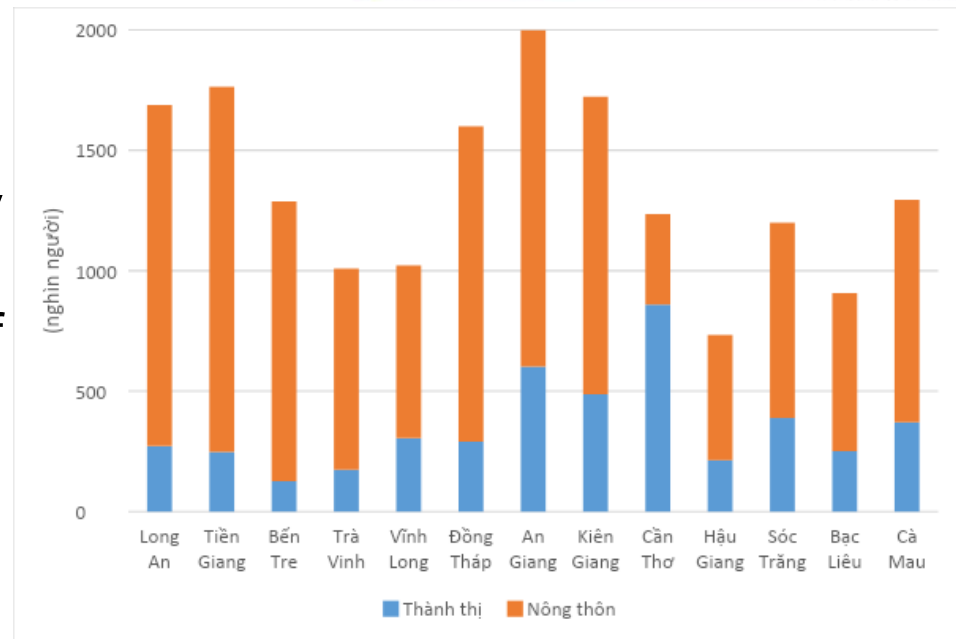
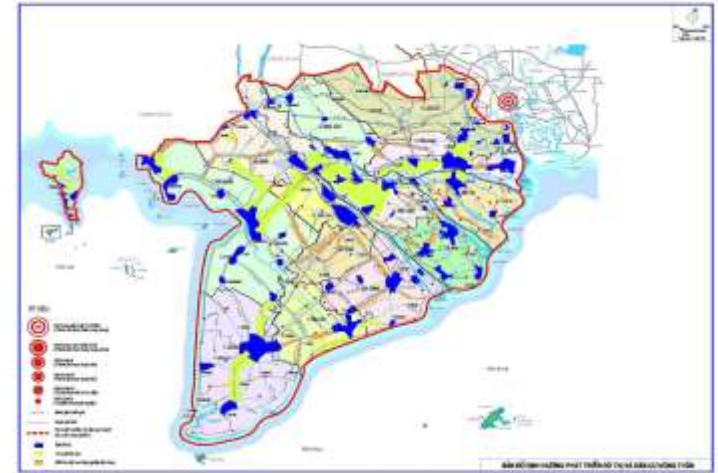
- The Mekong Delta has a large water demand for agricultural production and daily life
- The Mekong Delta has low terrain and is divided by interlaced rivers and canals
- Due to the impact of climate change, sea level rise of surface water and underground water is increasingly saline (especially in the dry season) causing serious impacts on production and daily life.



# Introduction

## Population:

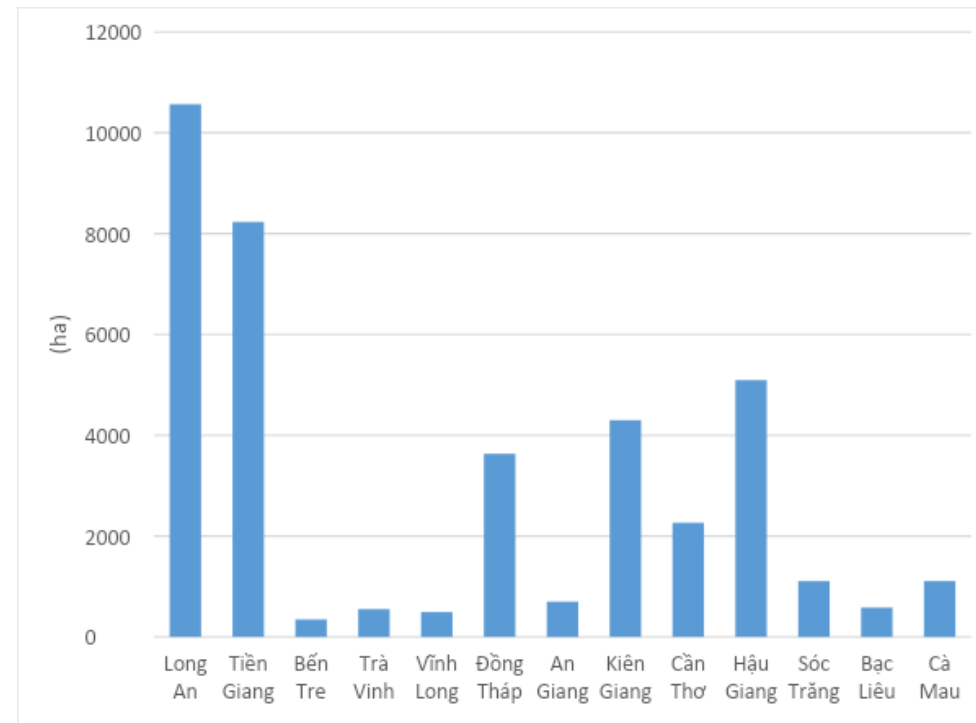
- In 2019, population in Mekong delta was app.17,4 million people, made up 18,1% country population
- Population density: 485,6 người/km<sup>2</sup>
- Population is unevenly distributed: 1/8 of the territory has a population density of over 1,000 people/km<sup>2</sup>, 1/3 of the territory has a population density of less than 200 people/km<sup>2</sup>



# Introduction

Industry:

- 117 industrial zones, 118 industrial clusters with area 6400 ha.
- Industrial products of the Mekong Delta are very diverse such as: energy, cement mining, mechanical-electronic, chemical, agricultural processing, coconut processing, aquaculture and seafood processing

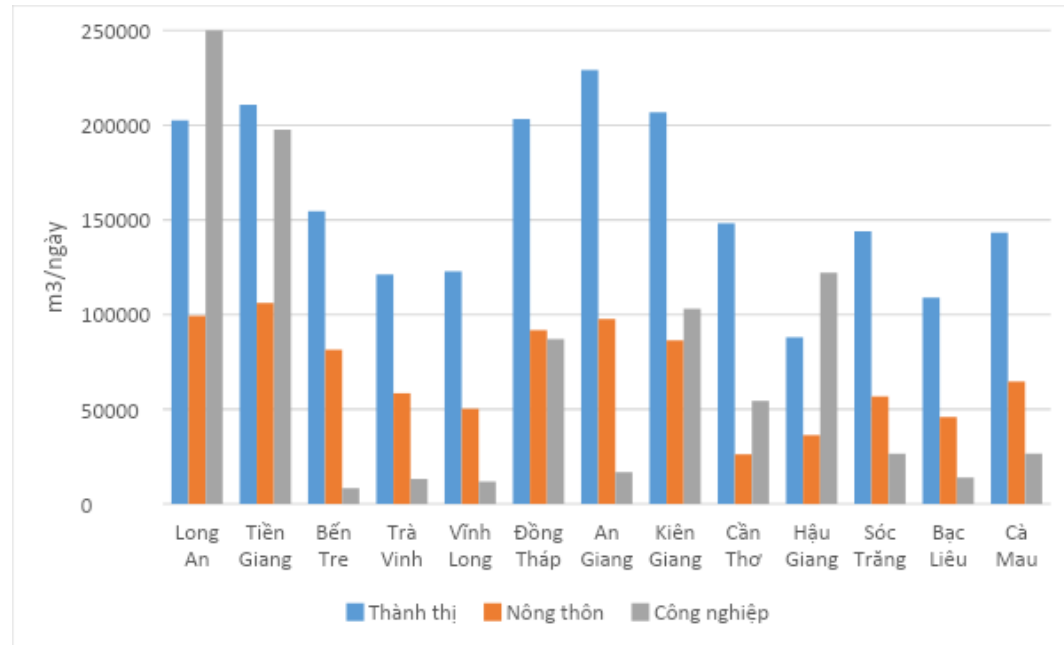




# Water supply demand in Mekong delta

Calculated water supply demand in Mekong delta

- The standard of domestic water supply for urban areas is 120l/person.day
- The standard of domestic water supply for rural areas is 70l/người.ngày
- The standard of industrial water supply is 30 m<sup>3</sup>/ha.ngày



# Water supply demand in Mekong delta

## Urban area

- 350 centralized water supply treatment plants (WSTPs) with capacity of 1.264.620 m<sup>3</sup>/day,
- In which, 126 WSTPs using ground water source, 224 WSTPs using surface water source.
- 10% of urban population used other water sources such as: drill well, rain water...

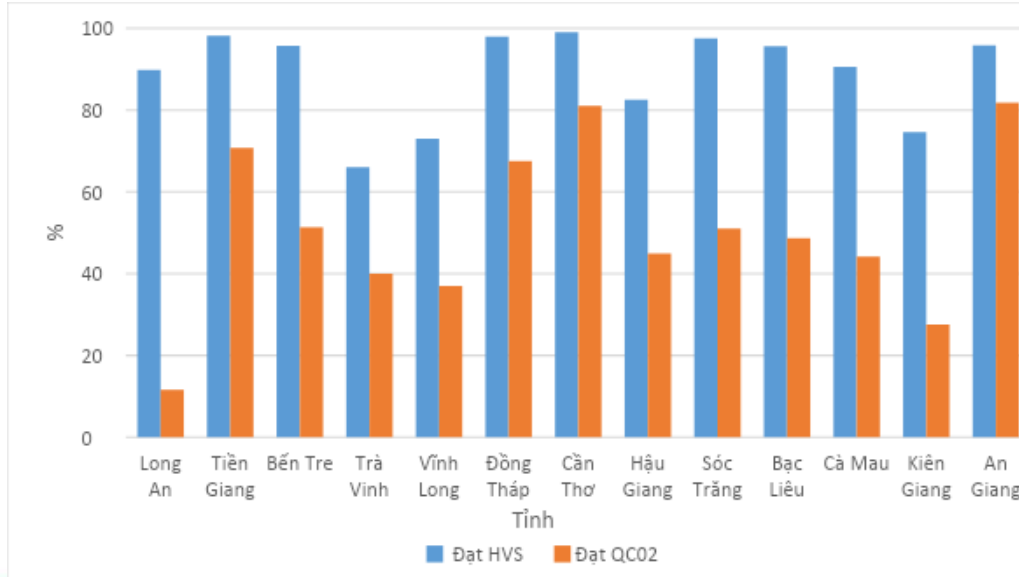
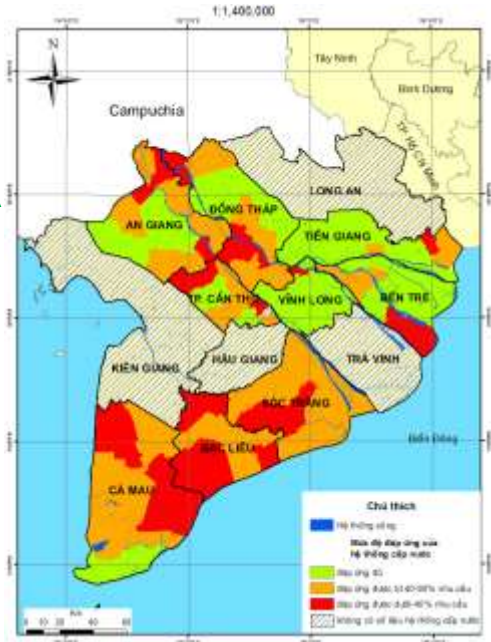
STT	Địa phương	Nhu cầu sử dụng nước sạch cho sinh hoạt tại thành thị (m <sup>3</sup> /ngày)	Công suất cấp nước của các nhà máy nước tại đô thị (m <sup>3</sup> /ngày) (*)
1	Long An	202.625,64	205.700
2	Tiền Giang	210.835,44	172.940
3	Bến Tre	154.584,72	51.500
4	Trà Vinh	121.100,16	30.120
5	Vĩnh Long	122.734,92	59.800
6	Đồng Tháp	203.196,00	94.830
7	An Giang	229.002,24	114.150
8	Kiên Giang	206.768,04	103.600
9	Cần Thơ	148.220,52	176.100
10	Hậu Giang	87.962,04	26.200
11	Sóc Trăng	143.958,36	88.400
12	Bạc Liêu	108.868,32	38.600
13	Cà Mau	143.337,12	102.680
	<b>Tổng cộng</b>	<b>2.083.193,52</b>	<b>1.264.620</b>

(\*) Nguồn: Quy hoạch cấp nước DBSCL đến năm 2030 và tầm nhìn đến năm 2050

# Water supply demand in Mekong delta

## Rural area

- Rural people have difficulty accessing clean water supply systems
- 46-50% rural population in Mekong Delta receiving water from WSTPs
- Most rural WSTPs in 13 provinces and cities are small and medium-sized, managed by many units, so the ability to meet the demand for clean water is still not high



# Water supply demand in Mekong delta

## ***Current status of exploitation and use of water resources***

- Groundwater resources have also been exploited and used in the Mekong Delta;
- Rainwater is a resource mainly exploited in rural areas and coastal areas;



# Water supply demand in Mekong delta

## *Current status of exploitation and use of water resources*

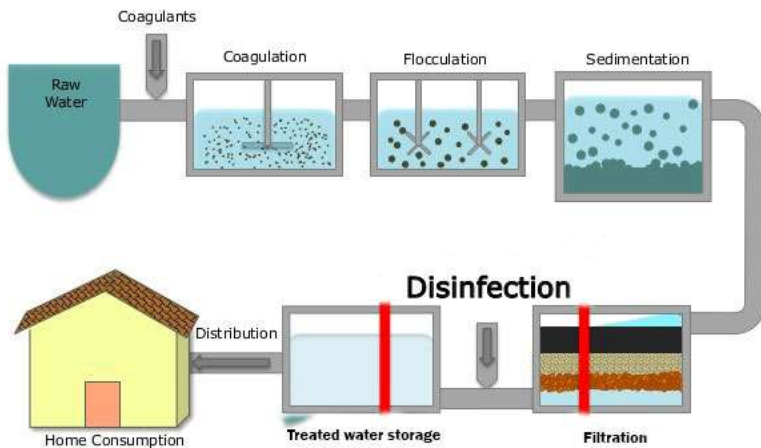
- Surface water is a common resource in water exploitation and use;
- However, the quality of surface water and the current method of exploiting surface water resources (Decentralized) are the limiting factors affecting the health of communities.



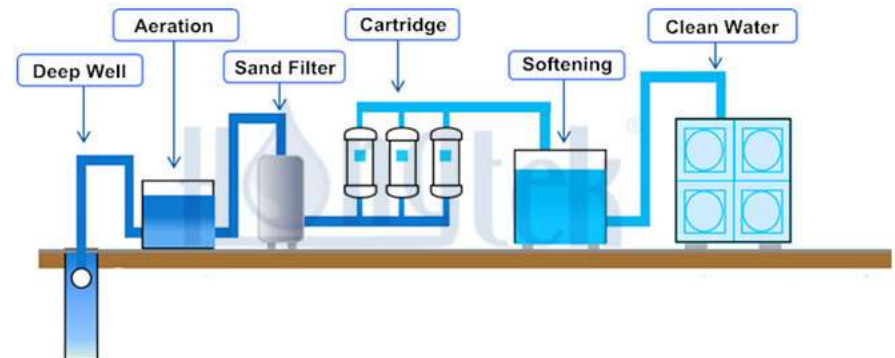
# Effectiveness of existing water treatment technologies in the Mekong Delta

Urban area

**Water Treatment Process**



**Groundwater Treatment Process**



# Effectiveness of existing water treatment technologies in the Mekong Delta

## Rural area

- Most rural areas use groundwater.



# Effectiveness of existing water treatment technologies in the Mekong Delta

## *Industrial zones*

- Industrial zones have actively sourced water for production
- The formation of many small water plants leads to difficulty in controlling the quality of input and output water
- It is difficult to ensure investment in technology and modern equipment  
It is difficult to ensure safe and sustainable water supply for industrial zones



# Technological solutions to reuse wastewater

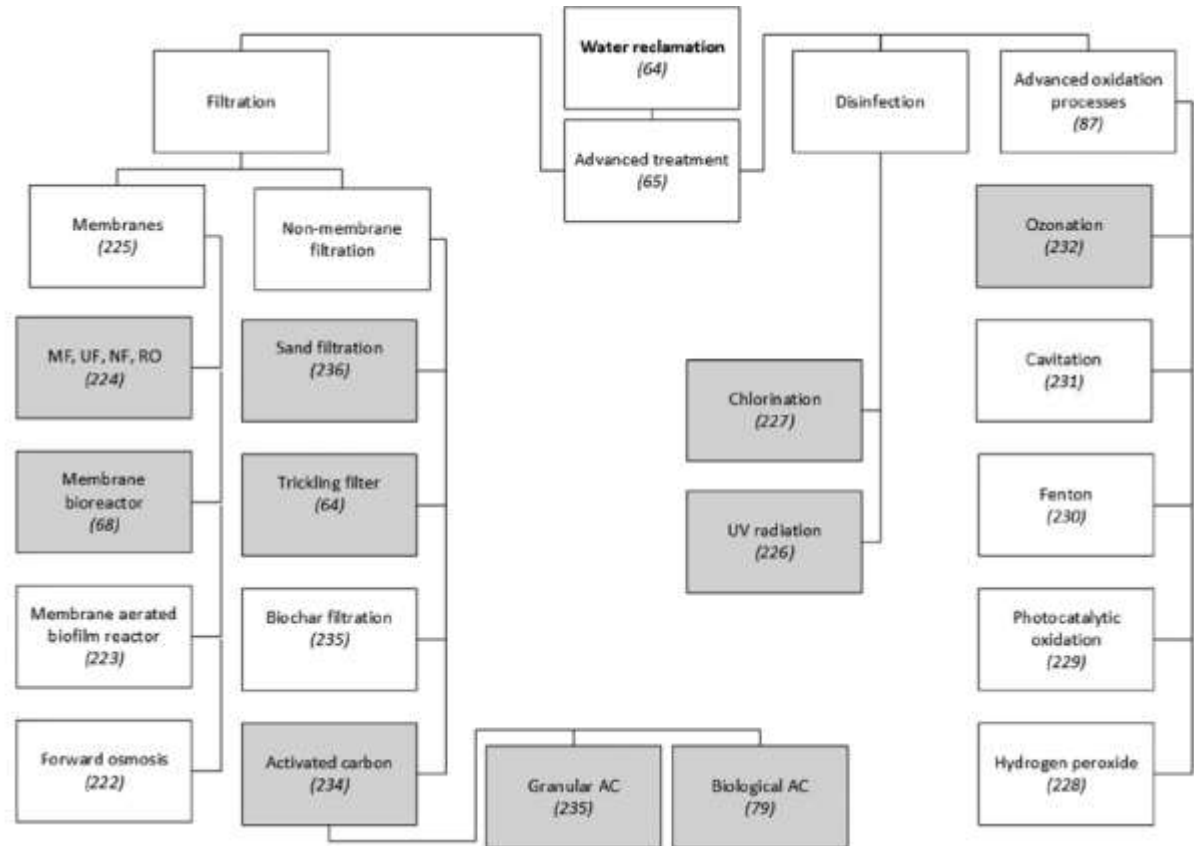
## *Municipal wastewater*

- Reusing water from municipal wastewater can significantly reduce the urban's water supply demand
- Reuse municipal wastewater for irrigation
- However, the wastewater entering the urban WWTPs is only partly domestic wastewater, the rest is industrial wastewater and rainwater.

# Technological solutions to reuse wastewater

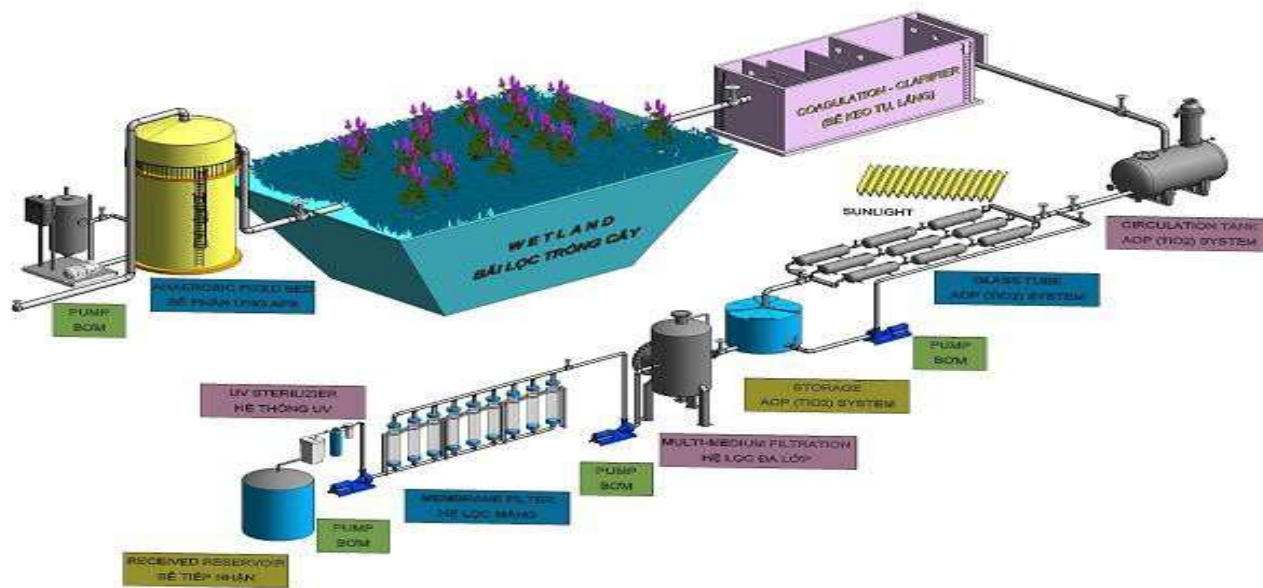
## Reuse municipal wastewater technologies:

- Membrane filter
- Activated carbon filter
- Advanced oxidation



# Technological solutions to reuse wastewater

*Reuse municipal wastewater technologies:*



# Technological solutions to reuse wastewater

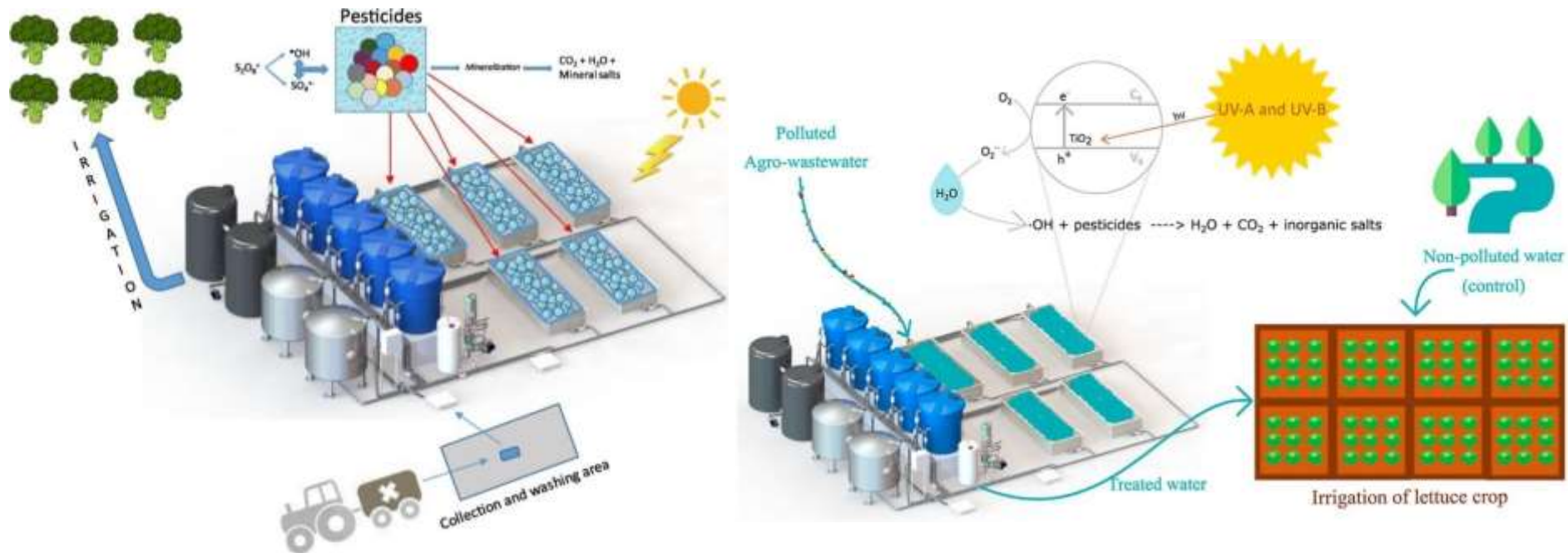
## ***Agricultural wastewater:***

- Irrigation wastewater
- Aquacultural wastewater
- Agricultural products processing wastewater
- Breeding wastewater

# Technological solutions to reuse wastewater

## Reuse agricultural wastewater technology:

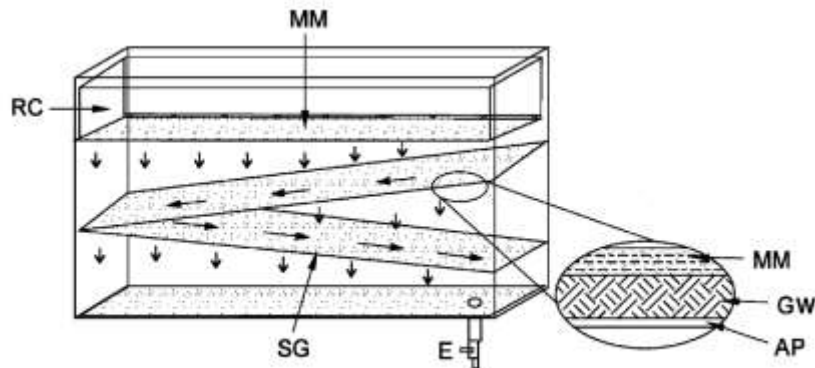
- Photo catalysis



# Technological solutions to reuse wastewater

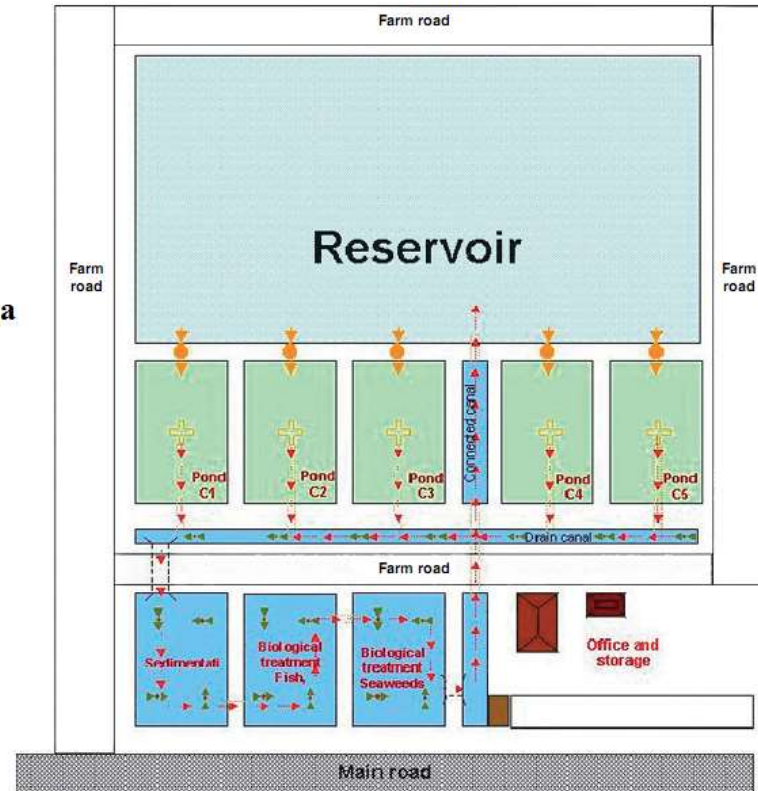
## Reuse agricultural wastewater technology:

- Tectonic microbial mats
- Combining biological and natural process



MM: Thảm vi sinh vật RC: Buồng lưu E: Van xả SG: Vùng tưới nước AP: Tấm acrylic

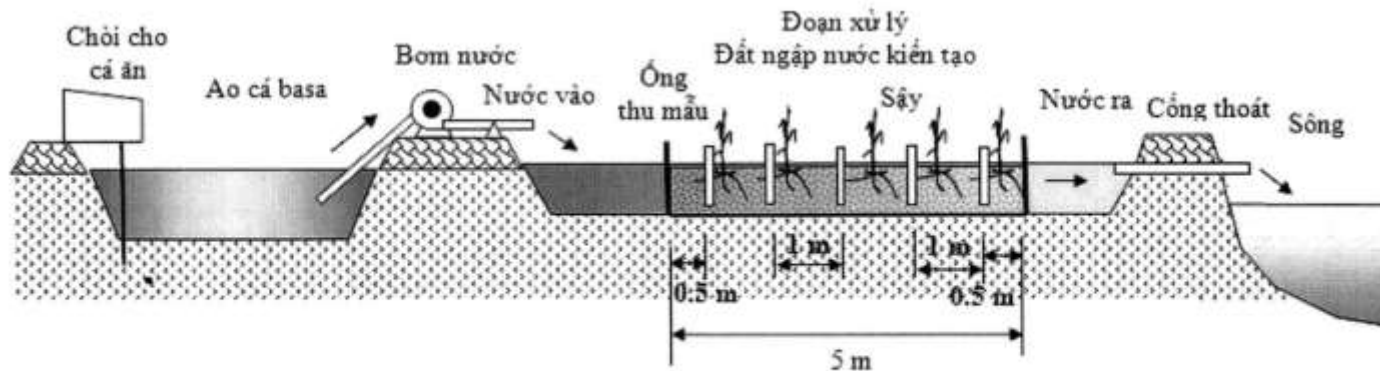
-  : Bơm
-  : Bơm sinh khí
-  : Ống xả nước ra
-  : Dòng chảy
-  : Đường ống
-  : Ao nối nhau



# Technological solutions to reuse wastewater

## *Reuse agricultural wastewater technology:*

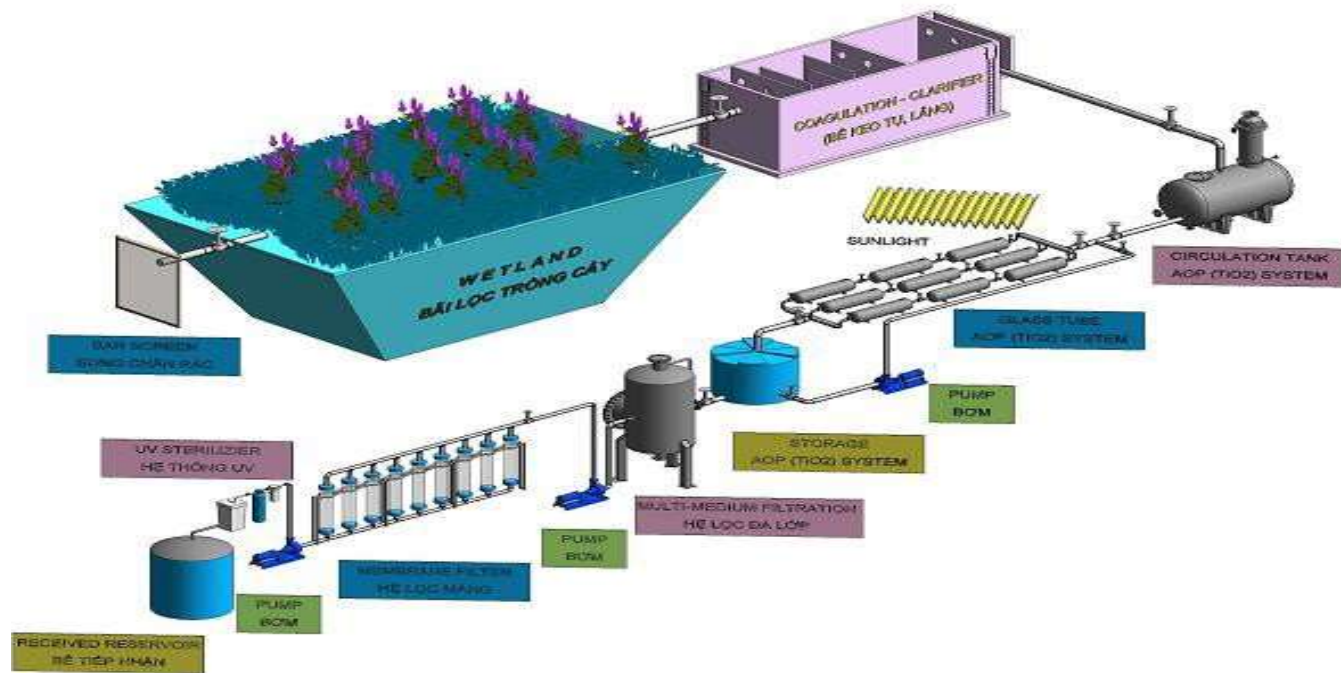
- Wet land



Hình 3: Sơ đồ khảo nghiệm xử lý nước ao cá basa bằng đất ngập nước kiến tạo chày ngầm theo phương ngang

# Technological solutions to reuse wastewater

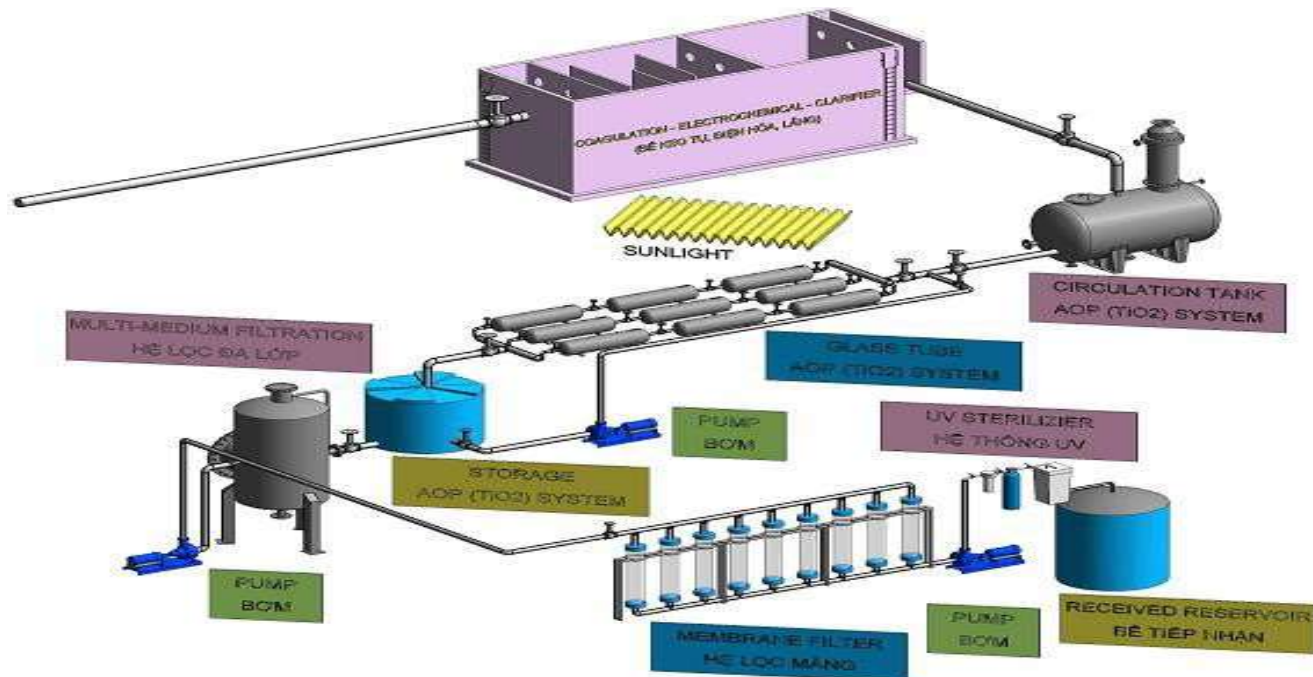
## *Reuse agricultural wastewater technology:*





# Technological solutions to reuse wastewater

Reuse industrial wastewater



## Conclusion

The water supply technical infrastructure system has not met the water demand of the Mekong Delta. Therefore, the distributed clean water supply solution is a suitable model to apply in the Mekong Delta.

The technologies currently used in centralized water supply systems in urban and rural areas in the Mekong Delta are all traditional technologies, ensuring safety water supply.

Depending on the type of wastewater, it is necessary to develop a treatment model including wetland techniques, multi-layer filtration (adsorption, ion exchange..), photochemical treatment of  $\text{TiO}_2$ , electrochemistry, electrolysis and membrane filtration. UF, NF).



Thank you!