Climate Resilience and Sustainable Communities in Asia: Emerging Issues at the Land-Water Interface in Vietnam

Do Hoai Nam

Vietnam Academy for Water Resources

Hà Nội 8/2025

1

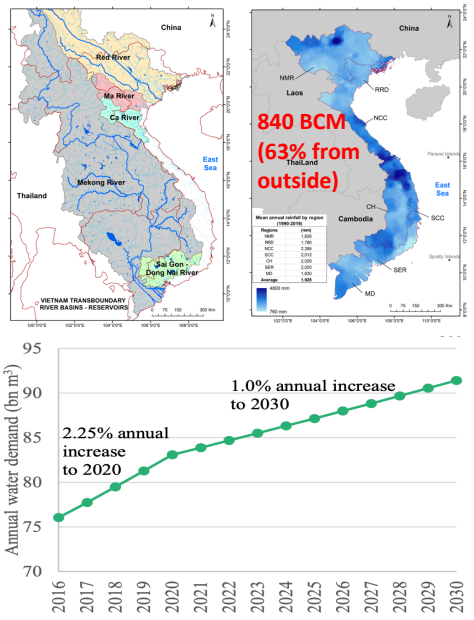
Outline

1. Country context
2. Emerging challenges on water security in the Mekong Delta
3. Projection of salinity intrusion
4. Remarks

2

Country context

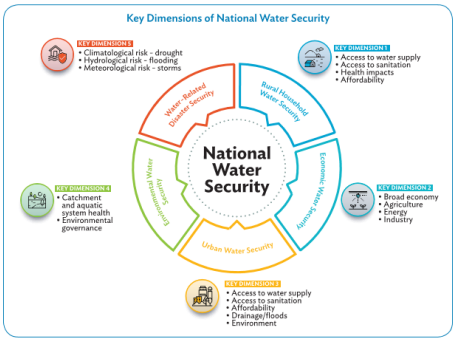
- Viet Nam is endowed with abundant annual rainfall (1920mm on average).
- However, the country faces water security challenges:
  - A high reliance on transboundary flows.
  - An uneven distribution of water resources across the country.
  - Agriculture uses over 80% of all available surface water, but with low productivity.
  - High economic growth rate and expanding populations cause additional demands for water.
  - Water pollution is a major problem in many river systems.
  - Most at risk from water related disasters including floods, droughts, typhoons and saline intrusion. Climate change will impact all of these.
- Water security has become a focal point of attention for the Government of Viet Nam.



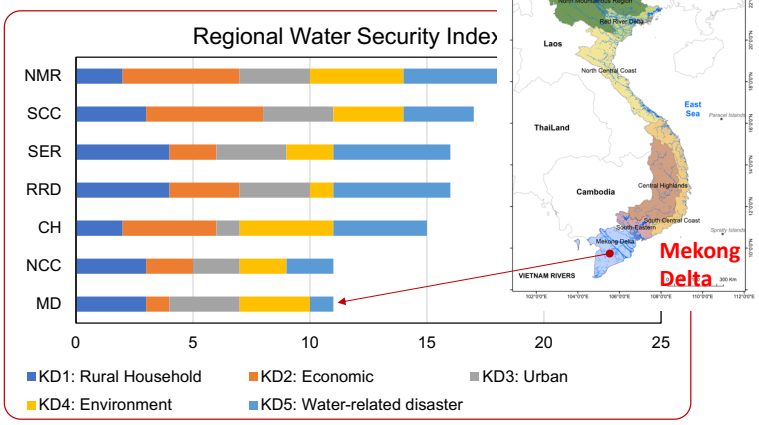
(Source: WB 2017)

3

Country context



Framework for Measuring Water Security (ADB 2020)

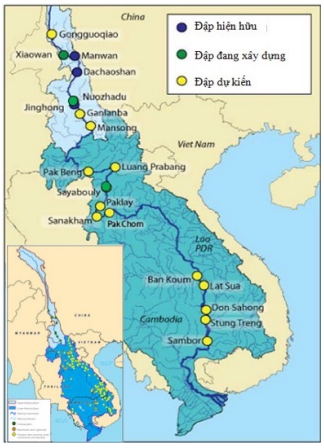


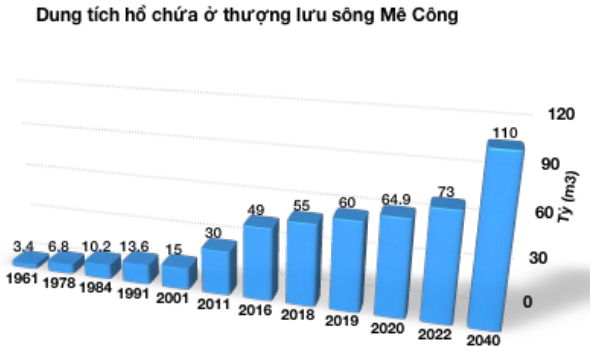
(Source: ADB 2021)

4

Emerging challenges on water security in the Mekong Delta

Development of dams in the upper reaches of the river



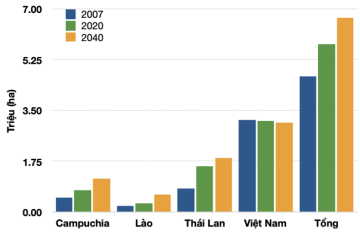


Development of reservoirs in the upper Mekong River (Source: Southern Institute of Water Resource Planning, 2023)

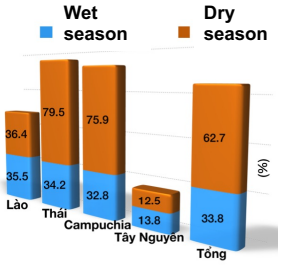
5

Emerging challenges on water security in the Mekong Delta

Irrigation development

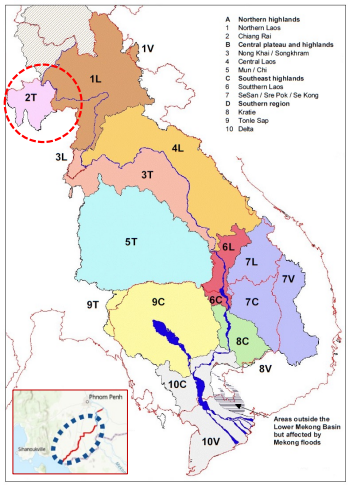


Irrigation area (mil. ha)



Dự tính nhu cầu nước tăng thêm cho nông nghiệp theo mùa

Increase (%) in WD by 2040 compared to 2020 in the lower Mekong River

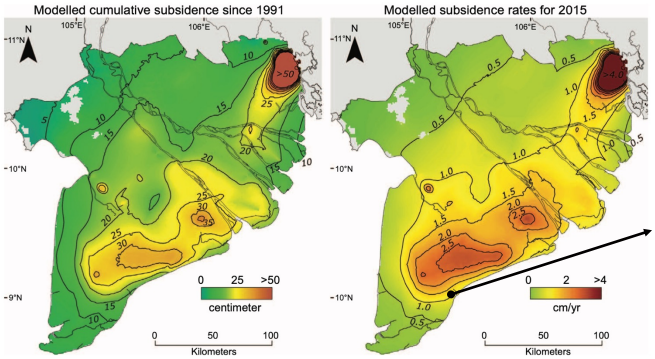


Transferring water in and out of the basin

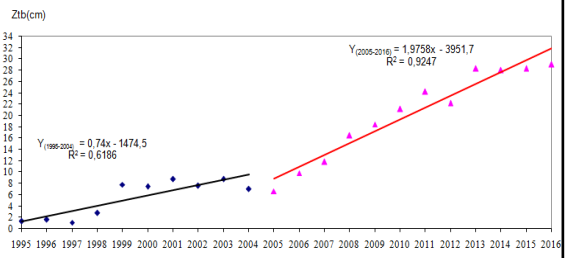
6

Emerging challenges on water security in the Mekong Delta

Land subsidence



Land subsidence in the Mekong Delta since 1991 (Minderhoud et al., 2017)



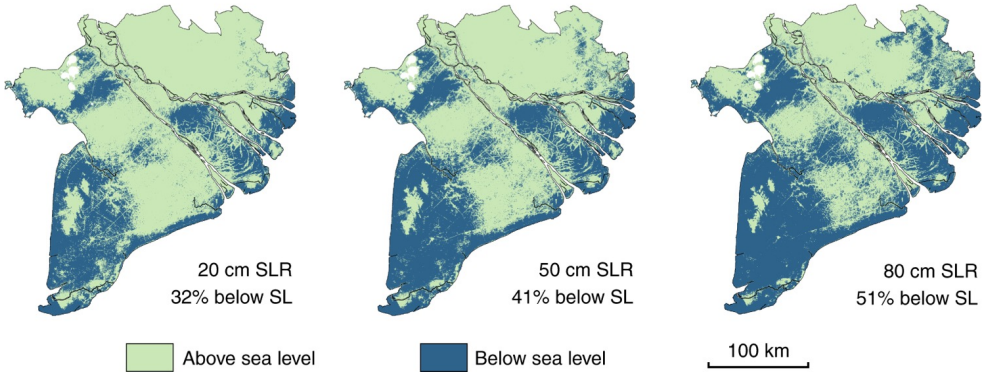
Subsidence monitoring at Ganh Hao ~17 mm/year (2005-2016) (Thang TD, et al., KC25.08/16-20)

VAWR MICHIGAN STATE UNIVERSITY Asia Hub

7

Emerging challenges on water security in the Mekong Delta

Land subsidence



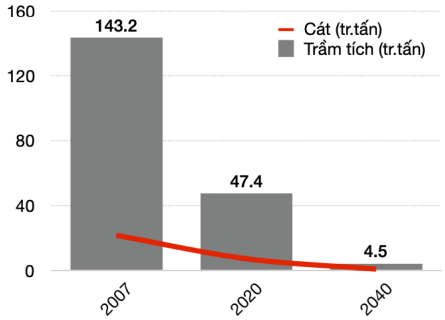
Scenario for the Mekong Delta corresponding to sea level rise of 20cm, 50cm and 80cm (Minderhoud et al., 2019)

VAWR MICHIGAN STATE UNIVERSITY Asia Hub

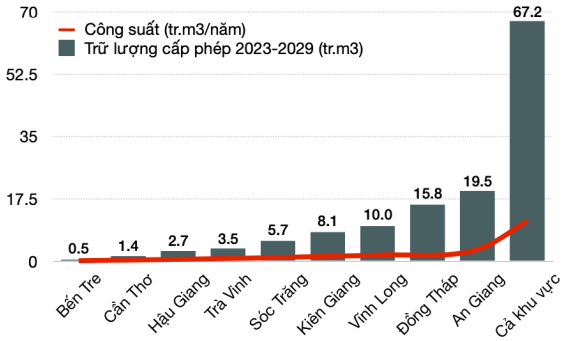
8

Emerging challenges on water security in the Mekong Delta

Mining of sand resources



Sediment from the Mekong River to the Mekong Delta, of which sand accounts for about 15% (source: MRC)

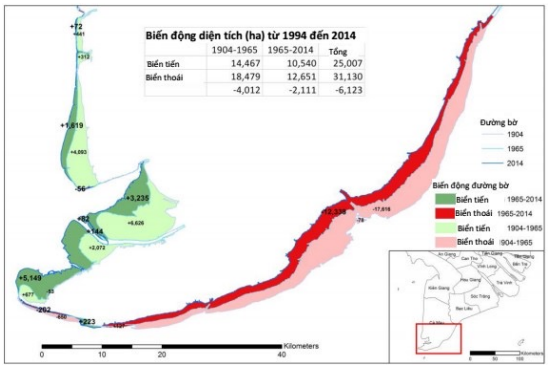


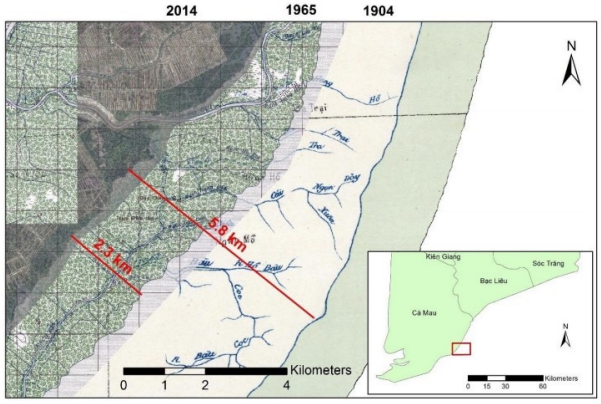
Licensing sand mining in the Mekong Delta in the period of 2023-2029

9

Emerging challenges on water security in the Mekong Delta

Riverbank and coastal erosion





The coastline was degraded from 1904 to 2014 in the Ca Mau cape (Source: SIWR)

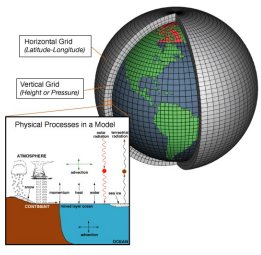
10

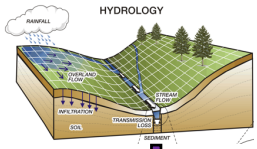
Emerging challenges on water security in the Mekong Delta

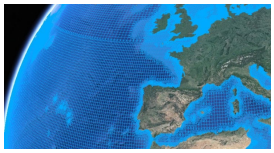
Encroachment on canal/canal corridors

11

Projection of salinity intrusion



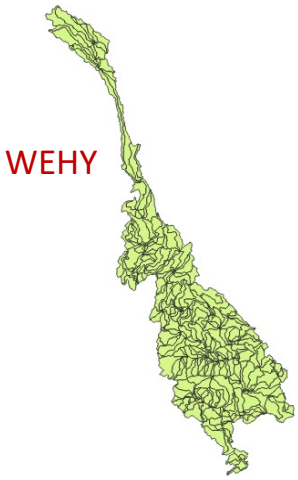




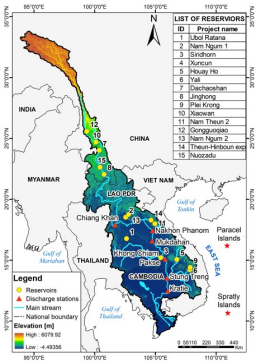
RegCM model + **WEHY model** + **DELFT3D model**

12

Projection of salinity intrusion

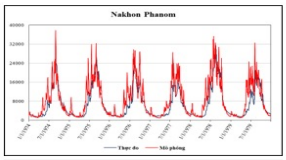


WEHY

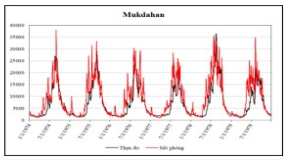


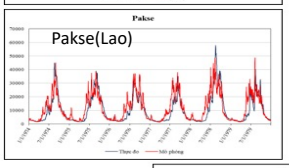
Reservoir Operation

Nakhon Phanom (Thailand)

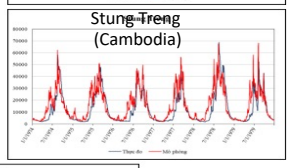


Mukdahan (Thailand)

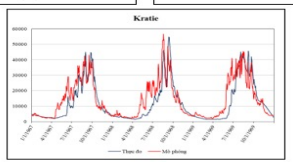




Stung Treng (Cambodia)



Kratie (Cambodia)



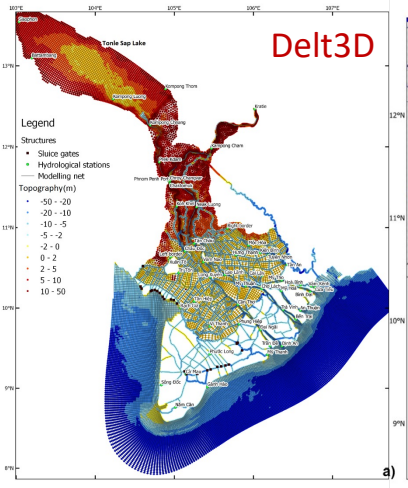
Streamflow simulation

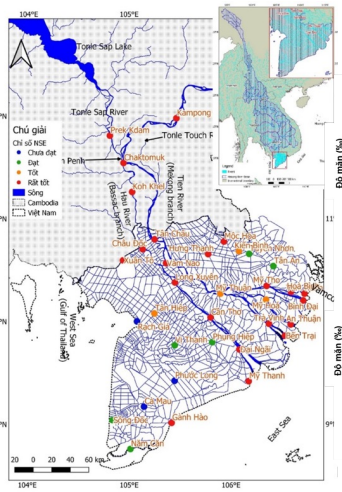
VAWR MICHIGAN STATE UNIVERSITY Asia Hub

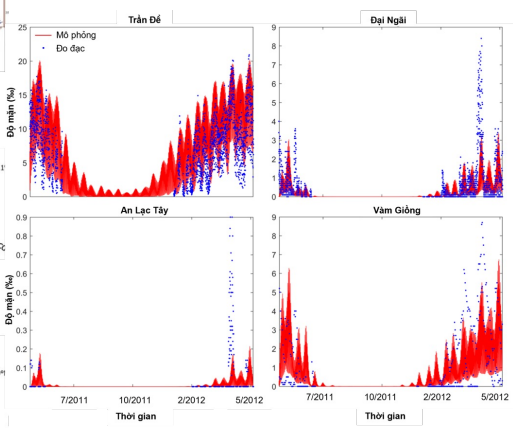
13

Projection of salinity intrusion

Delt3D



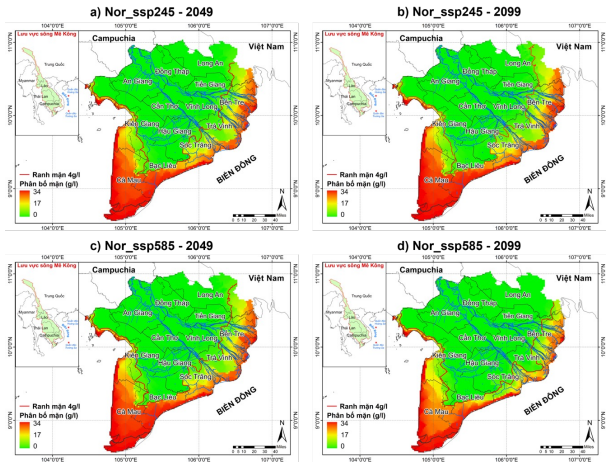


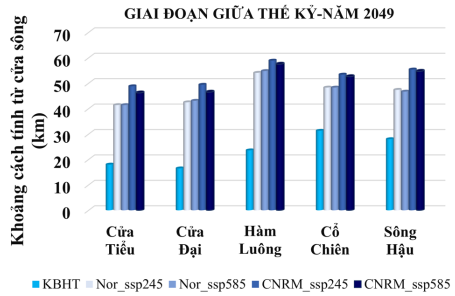


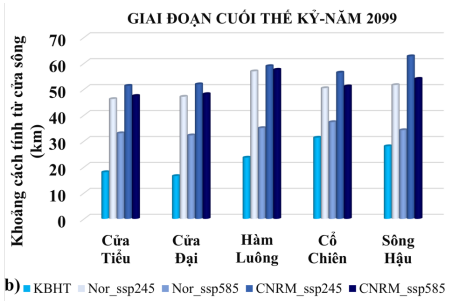
VAWR MICHIGAN STATE UNIVERSITY Asia Hub

14

Projection of salinity intrusion







15

Remarks

- Impacts of **upstream development**: e.g. hydropower, agriculture
- **Land subsidence**
- Reduced sediment transport, but **high demand for sand mining**
- River bank and coastal **erosion**
- Sea level rise and **salinity intrusion**

16

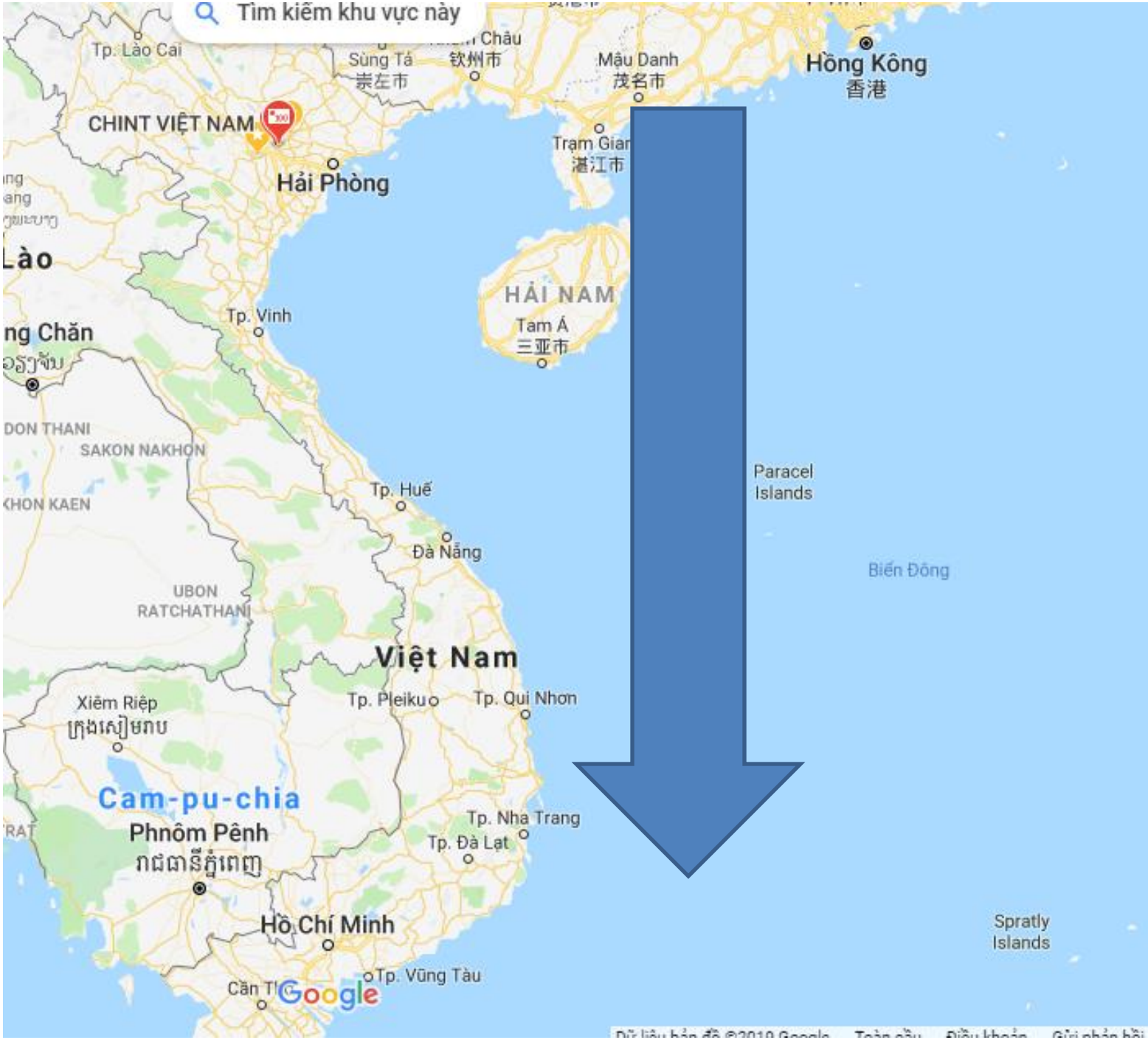
Thank you for your attention

17

THE RICE– CLAM WORM–MUDFLAT CRAB ECOSYSTEM IN TIDAL-INUNDATED WETLANDS: AN INTEGRATED AGROECOLOGICAL MODEL

沿海地区的水稻-禾虫- 蟹属生态系统因潮汐而被淹没

周英捷（CHU ANH TIEP）博士
越南国立农业大学农学院


Tìm kiếm khu vực này
Tp. Lào Cai
Sùng Tá
崇左市
钦州市
Mậu Danh
茂名市
Hồng Kông
香港
CHINT VIỆT NAM
Trạm Giang
湛江市
Hải Phòng
Lào
HẢI NAM
Tp. Vinh
Tam Á
三亚市
ng Chăn
ວຽງຈັນ
DON THANI
SAKON NAKHON
KHON KAEN
Paracel
Islands
Tp. Huế
Đà Nẵng
Biển Đông
UBON
RATCHATHANI
Việt Nam
Xiêm Riệp
ក្រុងសៀមរាប
Tp. Pleiku
Tp. Qui Nhơn
Cam-pu-chia
Phnôm Pênh
រាជធានីភ្នំពេញ
Tp. Nha Trang
Tp. Đà Lạt
Hồ Chí Minh
Spratly
Islands
Tp. Vũng Tàu
Cần Thơ
Google

1. Area of rice cultivation land inundated due to sea level rise

- With a coastline extending more than 3,260 km, Vietnam is among the ten countries with the highest ratio of coastline length to land area globally.

+ Currently, Vietnam has approximately 4 million hectares of rice cultivation land. If the sea level rises by one meter, the country is estimated to result in the loss of over 2 million hectares – accounting for 50% of rice-growing area.

1. Area of Rice Cultivation Inundated Due to Sea Level Rise

- If sea levels rise by one meter, it is estimated that approximately 40% of the Mekong River Delta, 11% of the Red River Delta, and 3% of the coastal areas in other provinces will be **submerged**.
- Secondly, saline intrusion reduces the cultivable land area, decreasing the land use intensity from 3–4 cropping cycles per year to only 1–1.5 cycles per year. If the sea level rises by an additional one meter, approximately 1.77 million hectares of land are expected to become salinized.

2. Rice–Clam worm–Mudflat-Crab Model in Tidal Flooded Land

被潮汐淹没的土地上的 水稻-禾虫- 蟹属 模型

- **Rice** is a staple food crop in Vietnam and plays a crucial role in global food security, impacting approximately 40% of the world's population. It is also one of Vietnam's key agricultural export commodities.

+ 大米是越南的关键食物，影响了世界40％的人口。 这也是越南的强大出口农业出口

- **Clam worm**（*Tylorrhynchus heterochaetus.* J Biol Chem.） is a species of polychaete worm that thrives in brackish water conditions (tolerating tidal salinity from 0% to 10%; alkalinity between 80–120 mg/L). Rươi is a highly nutritious food source. On average, 100 grams of rươi contains 12.4 grams of protein, 81.9 grams of water, 1.3 grams of ash, and 4.4 grams of lipids, providing approximately 87 kilocalories. In addition, rươi is rich in essential minerals such as iron (1.8 mg), phosphorus (57 mg), and calcium (66 mg).(The area suitable for rươi farming in Vietnam is concentrated in approximately 137 hectares.)

+ 禾虫（*Tylorrhynchus heterchaetus*.J Biol Chem.）禾虫生活在咸水条件下（可以承受0％至10％的盐度, 碱度 80-120 mg/L ）。 来自高营养含量的产品。 平均而言，该图案的100克将包含12.4克的Protid，81.9g的水，1.3克灰分，4.4脂质，并为人体提供87卡路里的热量。 此外，有许多其他矿物质，例如铁1.8mg，磷57mg和66mg钙。

Clam worm - 疣吻沙蚕（禾虫）

在水稻有机田发现有禾虫升高

Clam worms have been observed in organic rice fields

禾虫在土壤里面生活；晚上爬上

2. Rice–clam worm–Mudflat Crab Model in Tidal Flooded Land

- **Mudflat Crab (Cáy):** This is a common name used to refer to several species within the family Sesarmidae, such as Sesarma dehaani (commonly known as the hairy crab), Sesarma sinensis or Sesarmops sinensis (Chinese sesarma), and Perisesarma maipoense.

+ 蟹属名称用于三个侧面家庭（sesarmidae）的某些物种，例如羽毛（sesarma dehaani），中国蟹属（sesarma sinensis或sesarmops sinensis），蟹属(perismarma maipave）.

- The harvest period for mudflat crabs extends from late April to early October each year. According to estimates by local households in An Thanh commune, the average crab yield reaches approximately 30 kg/ 360m^2 of land/ year.

+ 蟹属：收获期每年4月底到10月初。 据 An Thanh 家庭估计，这里的蟹产量约为 800 公斤/公顷/年

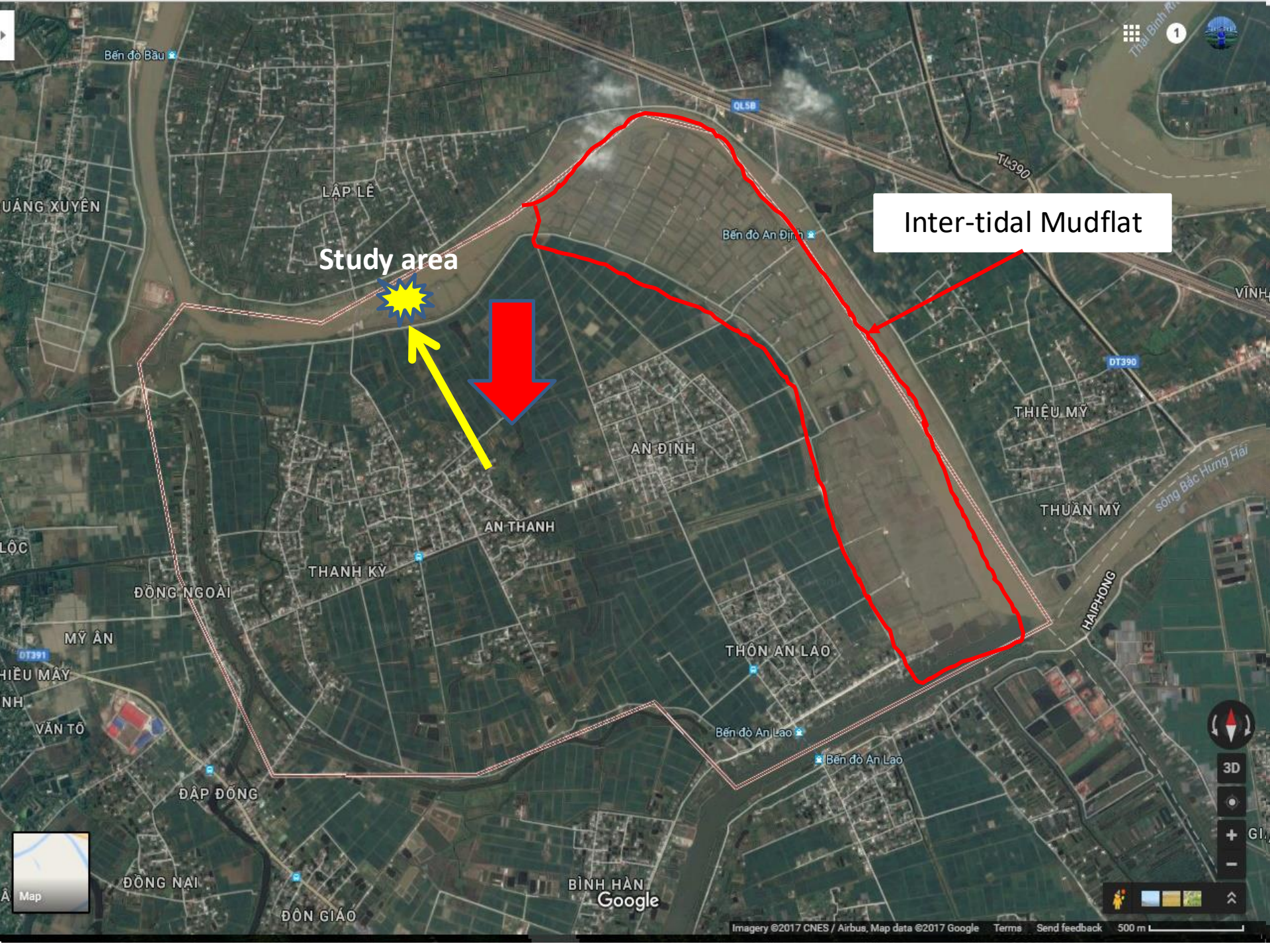
Con Cáy
(*Sesarma dehaani*)
蟹属

2. Rice–Clam Worm–Mudflat Crab Model in Tidal Flooded Land

被潮汐淹没的土地上的 水稻-禾虫- 蟹属 模型

- The research site located in An Thanh commune, Tu Ky district, Hai Duong province comprises 137 hectares of Rice–Clam Worm–Mudflat Crab land outside the dyke. Later, this model has been expanded by adding 214 hectares *of* land inside the dyke, bringing the total area to 351 hectares. 。
  + 海阳省（Hai Duong）四岐县（Tu Ky） 安清乡（An Thanh）的研究点有水稻-禾虫- 蟹属模型在海滩降落在堤防外是137公顷，扩大、改善更多稻田面积为214公顷
- https://www.youtube.com/watch?v=f1PkY2MO9mU

研究地点 (Study area)


Inter-tidal Mudflat
Study area
Bến đò Bầu
LẬP LÊ
QL5B
TL390
Bến đò An Định
AN ĐỊNH
AN THANH
THANH KỲ
ĐỒNG NGOÀI
MỸ ÂN
VĂN TỐ
ĐẬP ĐỐNG
ĐỒNG NAI
ĐÔN GIÁO
BÌNH HÀN
THÔN AN LẠO
Bến đò An Lạo
THIỆU MỸ
THUẦN MỸ
DT390
DT391
HAIPHONG
sông Bắc Hưng Hải
Map
3D
Google
Imagery ©2017 CNES / Airbus, Map data ©2017 Google
Terms
Send feedback
500 m

模式: 水稻 – 禾虫 - 蟹属

Model: Rice-Mudflat worm-Crab

Spring rice cultivation

Mudflat worm

3. 研究技术路线

Research Technical Approach

DT80品种

HD8品种

J02品种

BH9品种

CNC品种

Rice Varieties

好稻米品种

有机肥量: 9 吨/ha

J02 and BH9 rice varieties

6 吨/ha

9 吨/ha

12 吨/ha

有机肥量

Amount of Organic Fertilizer

种植密度

Planting Density

20 Palnts/m2

25 穴/m2

31 穴/m2

Organic Rice Production

- J02.BH9品种
- 有机施肥量
- 密度种植合适

- Improve soil organic matter content and fertility
- Soil reduces pesticide residue
- Soil reduces pollution

Soil Improvement

禾虫产量和质量提高

Sandworm Cultivation

Organic Sandworm

4. 结果和讨论
Results and Discussion

(1). Using biological products as a supplement for rice cultivation enhances the rate of residual organic matter in the soil. This process not only supports the efficient nutrient cycling in the soil but also creates a more favorable environment for the roots of rice, clam worms, and mudflat crab, contributing to ecosystem sustainability.

使用微生物制剂为水稻植物，有助于更快地促进土壤中的有机物质，以有益的方式为水稻根，禾虫和蟹属的环境进行代谢

用鸡粪、猪粪、牛粪来做农家有机肥

Utilizing chicken, pig, and cow manure to produce traditional organic fertilizers

手工除草，为做有机水稻

Weeding as part of organic rice farming practices

During the spring season, two high tide peaks occur each month. At night, the water level in the rice fields rises along with an increase in salinity, whereas during the daytime, the tide withdraws.

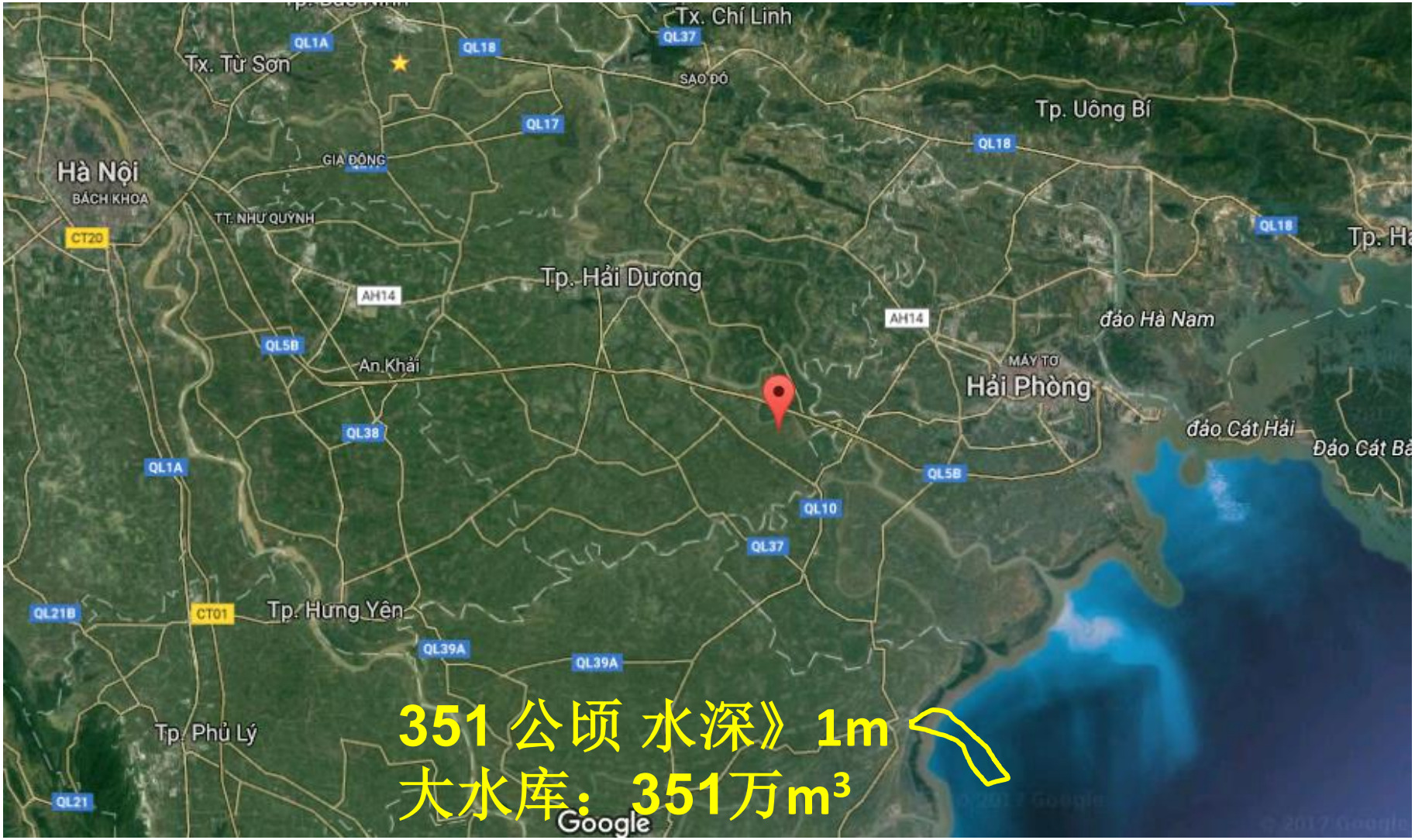
2. The model helps to improve food production to meet the food demand, contributing to ensuring food security, as well as producing high-quality rice products (organic rice)

增加食物以满足人们的粮食要求，为确保粮食安全和创建高质量的稻米产品（有机大米）做出贡献

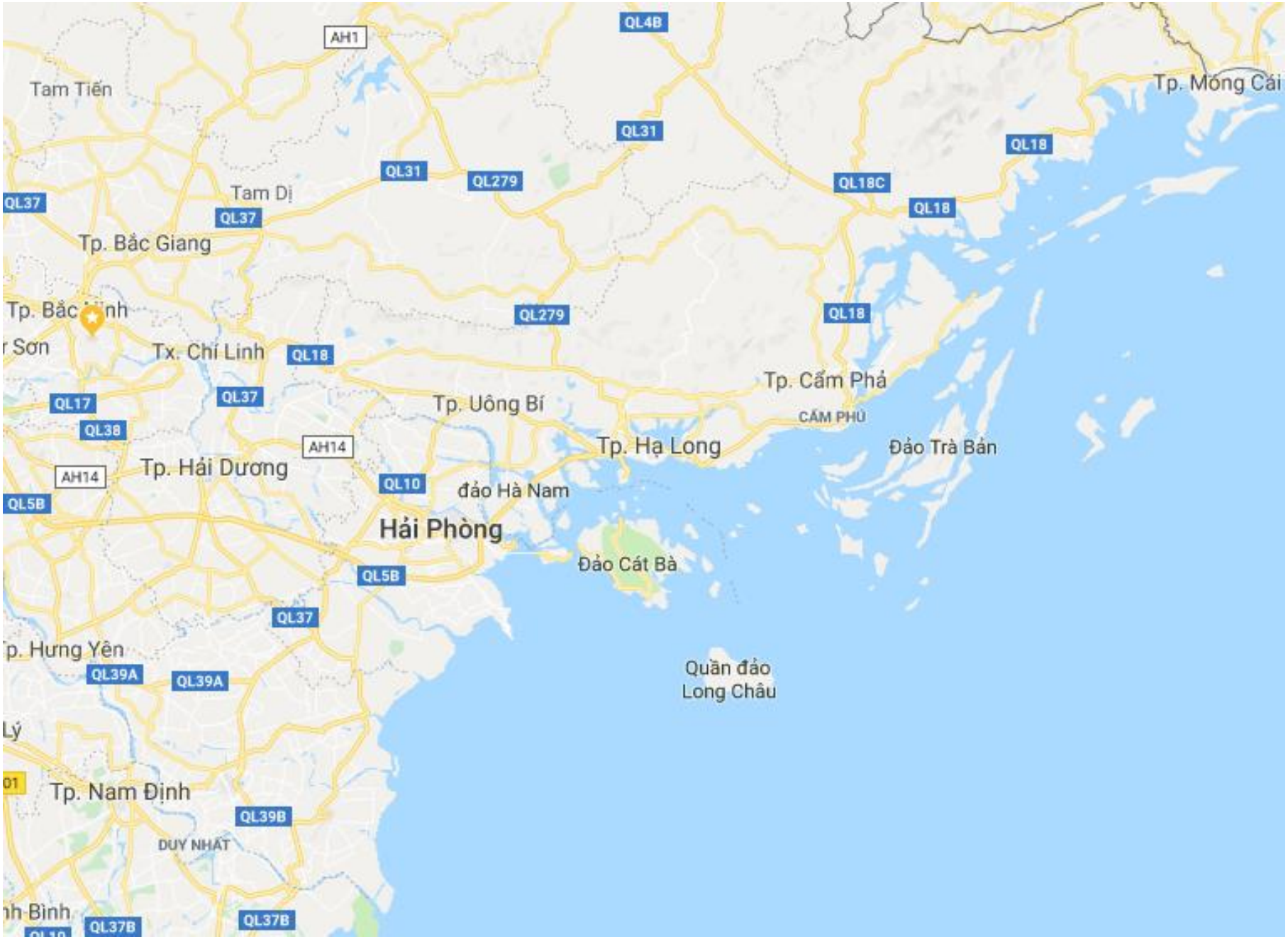
(3). Clam Worm–Mudflat Crab are the two valuable products, which contribute to increasing the income of farmers in tidal-inundated land areas.
禾虫，蟹属是高价值食品的两种来源，同时增加了沿海田地区农民的收入。

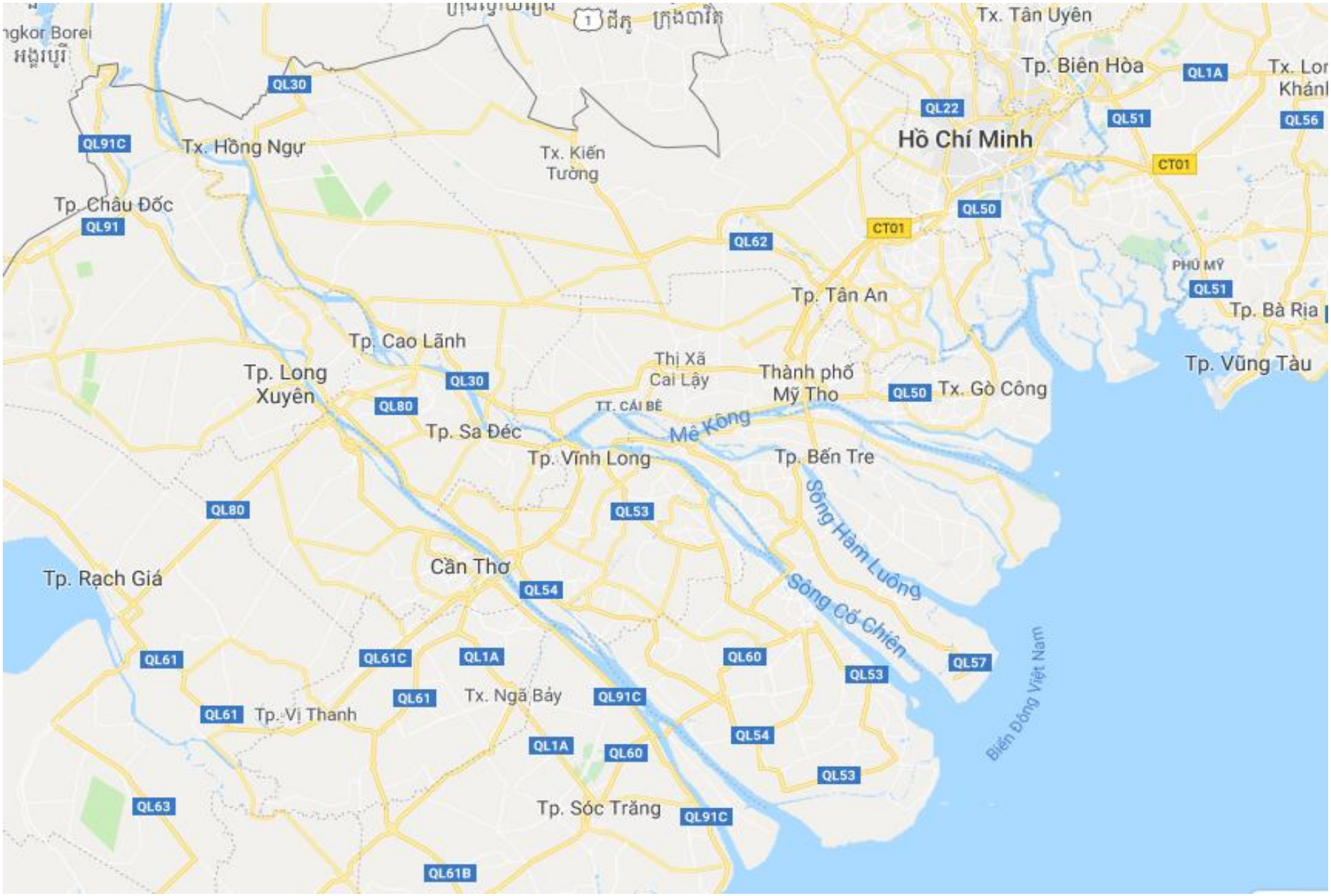
(4). The area used for this model also serves as a reservoir for tidal water during high tide, helping to reduce saltwater intrusion further inland. It could potentially become a source of accumulated energy for conversion into electricity in the future

模型地区也能存潮水的地方，有助于减少大陆深处的盐度，并可以成为未来积累的能源转化为电力的来源



The highlighted reservoir covers an area of **351 hectares** with a water depth **exceeding 1 meter**, resulting in a **total water volume of approximately 3.51** million cubic meters.


AH1
QL4B
Tam Tiến
Tp. Móng Cái
QL31
QL18
QL31
QL279
QL18C
Tam Dị
QL37
QL18
QL37
Tp. Bắc Giang
QL279
QL18
Tx. Chí Linh
QL18
Tp. Cẩm Phả
QL17
QL37
Tp. Uông Bí
CẨM PHẢ
QL38
AH14
Tp. Hạ Long
Đảo Trà Bản
AH14
Tp. Hải Dương
QL10
đảo Hà Nam
QL5B
Hải Phòng
Đảo Cát Bà
QL5B
QL37
Quần đảo
Long Châu
QL39A
QL39A
Tp. Nam Định
QL39B
DUY NHẤT
QL37B
QL37B



Mekong River Delta region in southern Vietnam

THANK YOU!

谢谢大家!