FIG WORKING WEEK 2019

22–26 April, Hanoi, Vietnam

"Geospatial Information for a Smarter Life and Environmental Resilience"

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"Geospatial Information for a Smarter Life and Environmental Resilience"

Determine the vulnerability of surface water resources in the Rach Gia City, Kien Giang Province using GIS

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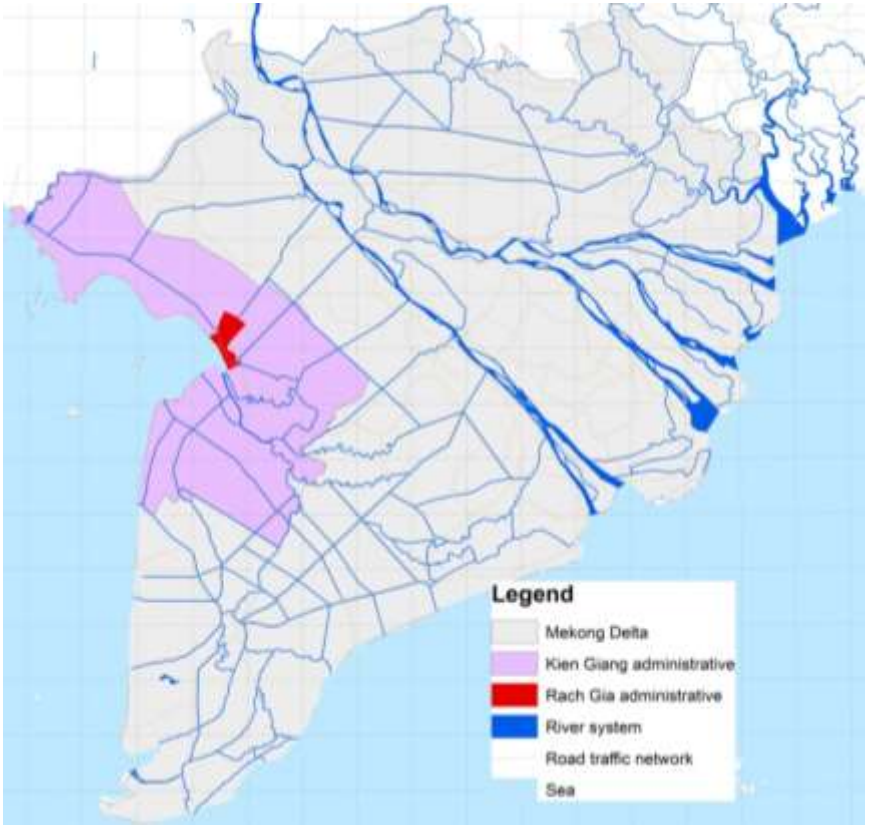
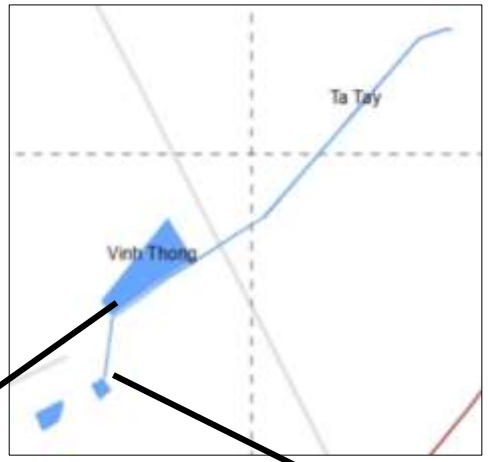
INTRODUCTION

- The Rach Gia City is located on the west coast of the Mekong Delta
- Flat and low terrain, high density of river networks
- Surface water (rivers, reservoirs) is the main sources for water supply: Vinh Thong reservoir with a total of around 600,000 m3 waters and a canal Ta Tay with 3.2 km of length
- In recent years the city suffered from a freshwater crisis due to polluted water: saline intrusion, transition of land, human activities …




An Giang
Đồng Tháp
Kiên Giang
TP. Cần Thơ
Hậu Giang
LEGEND
Administrative Provincial
Rach Gia administrative
River system
Rach Gia river system
Sea


Ta Tay
Vinh Thong


RACH GI

Vinh Thong lake in drying up

Water supply vehicle

METHODOLOGICAL APPROACH

- No standard method for assessing surface water vulnerability to pollution
- Previous studies applied to assess the water reservoir vulnerability to pollution: Eba A.E.L., 2013; Schoen R., 2001; Anoh K.A., 2009. The method integrate topographic, geological, hydrological and land-use data
- To achieve this, a methodological approach based on weighting the selected factors according to their rating then integrated into a geographic information system
- Availability of data: slope, land use, soil type, runoff, drainage network density and saline intrusion levels

METHODOLOGICAL APPROACH (cont.)

Steps	Methods	Processes
1	Identification of parameters	Choice of used parameters to calculate the pollution vulnerability index
	Thematic mapping	Mapping each parameter at the scale of the studied watershed
	Reclassification of parameters	Each parameter is subdivided into 3 or 4 classes according to the ratings or weights assigned
2	Weighting of parameters	Prioritize the parameters relative to each other by Saaty method
3	Vulnerability assessment	The combination of the different thematicmaps by weighting to obtain a final map of the vulnerability index distribution

Identification of parameters and thematic mapping

- Schoen R., 2001 on mapping risk of surface and groundwater contamination caused by plant substances, the selected elements include slope, land use, soil, rainfall, drainage network density
- For this study area, surveyed in addition to the above factors, the saline intrusion is a great source of water pollution
- The classification and rating of the elements identified in the assessment of water surface vulnerability are based on the guiding of Schoen, R., et al. (2001)

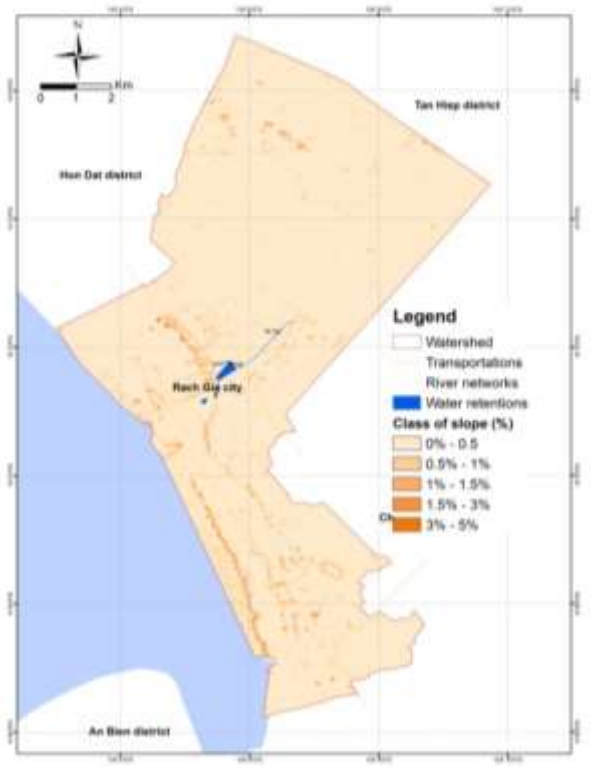
Parameters	Classes	Ratings
Slope (Sl) (%)	<3	1
	3 - 9	2
	>7	3
Land use (Lu)	Forest	1
	Habitats, public constructions,…	2
	Rice fields	4
	Land for business (restaurants, hotels,...)	3
	Land of technical infrastructure (landfills...)	3
	Brackish aquaculture	4
Soils media (S)	Soil feralit strongly desaturated	1
	Soil feralit moderately desaturated	2
	Hydromorphic soil	3

Parameters	Classes	Ratings
Runoff (R) (mm)	<0	1
	0 - 150	2
	> 150	3
Drainage Network Density (D) (km/km²)	<1.04	1
	1.04 – 1.33	2
	>1.33	3
Saline intrusion levels (g/l)	<0.3	1
	0.3 - 1	3
	>1	4

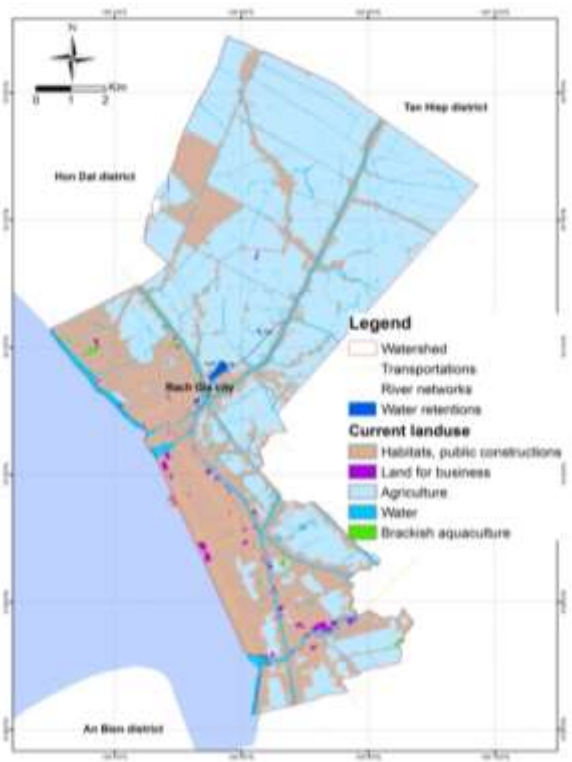
DATA CAPTURE

No	Content	Format	Issued by
1	Rach Gia city elevation data in scale 1:10,000	Microstation (*.dgn)	Kien Giang province Department of construction
2	Rach Gia existing land use map in 2012	Microstation (*.dgn)	Rach Gia City People's Committee
3	Saline intrusion in the Mekong Delta map	Image (*.JPG)	Report of salinity intrusion in Mekong Delta in 2012 _ Southern Institute of Water resources research
4	Soil map	Arcgis (shape file)	Open Development Mekong (ODM)
5	Statistical Year Book of Rach Gia City and Kien Giang province from 2003 to 2016	Statistical Year Book (hard copy)	Kien Giang Statistics Department

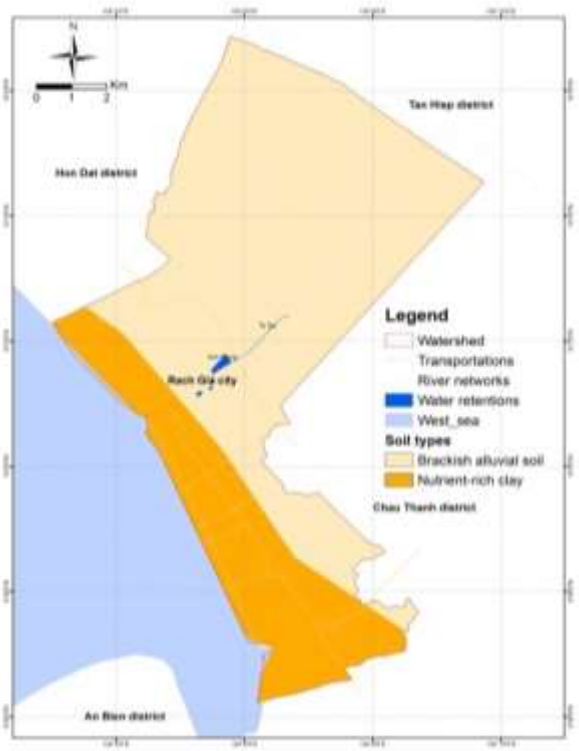
Thematic mapping



Slope map

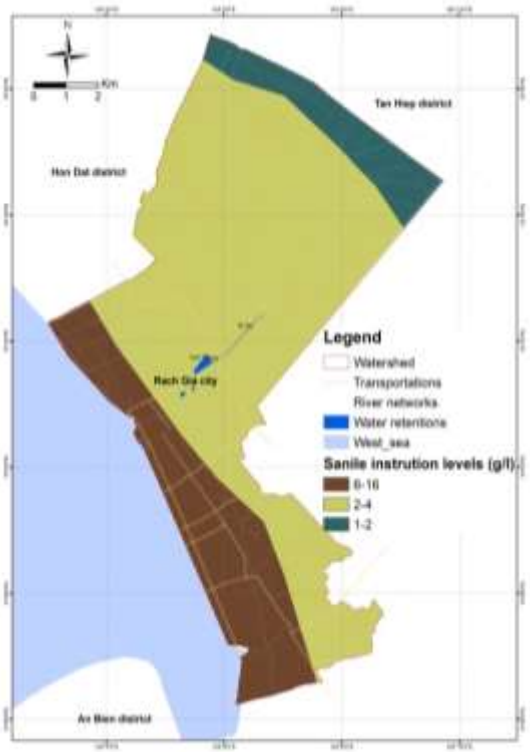


Land use map

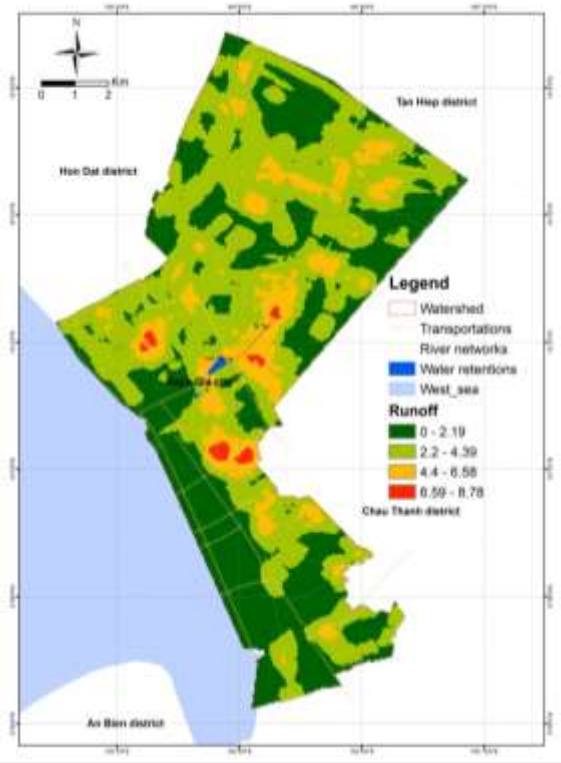


Soil map

Thematic mapping



Saline intrusion map



Drainage network density map

Weights Determination by AHP Method

STT	Parameters	S	DD	Sl	R	Si	Lu	Vp	Cp
1	S	1	1/3	3	1/2	1/5	2	0.5	0.07
2	DD	3	1	5	2	1/3	4	1.6	0.20
3	Sl	1/3	1/5	1	1/5	1/8	1/2	0.3	0.04
4	R	2	1/2	4	1	1/4	3	0.8	0.10
5	Si	5	3	8	4	1	7	3.7	0.45
6	Lu	1/2	1/4	2	1/3	1/7	1	1.2	0.14
	Σa_i	11.83	5.28	23.00	8.03	2.05	17.50	8.1	1.00

Parameters	Results
Number of parameters	6
Maximum eigenvalue λ_{max}	6.12
Consistency index IC	0.02
Random consistency index IA	1.24
Consistency ratio RC	0.02

Research results

The magnitudes (flow network density) are also factors that influence the vulnerability assessment.

IV = $\sum_{i=1}^{i=n} C_{pi} \times R_i$

where,

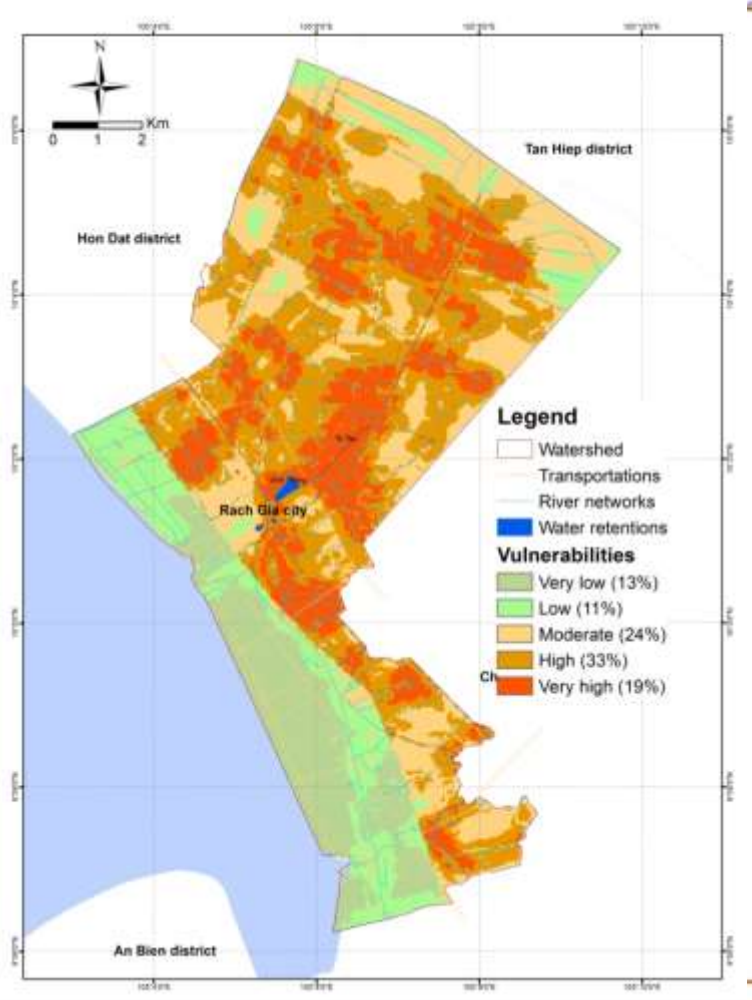
IVg is global vulnerability index

Cpi is weighting coefficient of parameter i

Ri is class of parameter i

n is number of parameters

IV = 0.07 * S + 0.2*DD + 0.04*SI + 0.1*R + 0.45*Si + 0.14*Lu



Vulnerability indexes

No.	Classes of vulnerability indexes	Index intervals	Degrees of vulnerability	Percentage (%)
1	0.87 - 1.29	0% -14%	Very low	13
2	1.29 - 1.8	14%-31%	low	11
3	1.8 - 2.3	31%- 48%	Medium	24
4	2.3 - 2.7	48%-62%	High	33
5	2.7 - 3.8	62%-100%	Very high	19

- Although the western coastal wards (residential land and public) is a high salinity intrusion area, the lesion is very low and occupying 13%.
- The area has the key technical infrastructure (landfill and waste treatment ...) that is the source of water pollution but it is low vulnerability layer (11%)
- The average vulnerability (24%) is scattered all over the paddy land
- High and very high vulnerability concentrated in areas with drainage network density dense, occupying 33% and 19%
- Since this is flat terrain, it does not have much impact on the introduction of pollutants into the lake, so the soil type and drainage network density cause great vulnerability to the surface water.

CONCLUSIONS

- This result is corroborated by studies that show that a contaminated map offers an idea of sensitive areas that need special attention. As well as assessment of vulnerability to pollution of the resource.
- However, vulnerability assessment accuracy depends essentially on the nature, quantity, and reliability of data used. Its characterization is generally based on the estimation of a certain important parameter number.
- This could be a reference source in the plan to build more freshwater reservoirs for the city or the management and prevention of pollution.