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A comprehensive intergrated management approach for water resrources management

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Introduction

- Comprehensive management not only involves the management of natural systems, but also requires coordination of human activities that create water demand, identify land use and create products that cause waste of water. Access to integrated management and sustainable development must take into account the water balance components, development activities and impacts in each region, multi-purpose use, multi-sectoral linkages, and connection between human society and nature (Figure 1).
- Programs and projects have been implemented with a system of vulnerable indicators combined using hydrological models, information systems and multi-criteria analysis. This method is valuable to assist in making decisions which include stakeholder agreements, social awareness, and coordination among decision makers. That is the use of the vulnerability assessment framework and vulnerability indicators in integrated management approach at basin scale.

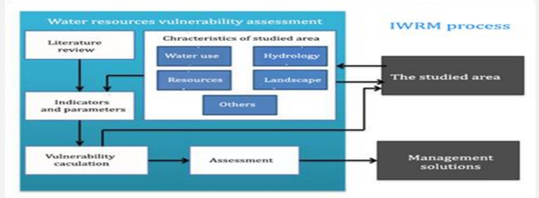


Figure 1. The relationship between vulnerability assessment and IWRM process.

Description of key terms and methodology

- Water resources vulnerability: can be defined as “the weaknesses of the water resources system make it difficult for the system to perform its functions in the face of socio-economic system and environmental changes”. Therefore, water resources vulnerability is considered in two issues: (1) the exposure of the water resources system to pressures at the river basin scale, and (ii) the capacity of the ecological system and society can cope with threats to the healthy functions of a water resource system.
- Indicators:
  Indicators may be based on physical, chemical or biological measurements associated with the quality of natural resources or the environment. They can generalize some aspects of the environment, natural resources or human activities.
  -Methodology: The author applies the method of assessing water vulnerability of UNEP for Thach Han river basin

Figure 2. Information levels and indicators tower

The vulnerability of a river basin can be expressed as:

$$\mathbf{VI = f\ (RS, DP, ES, MC)}$$

1. Resource stress (RS): the quantity and quality of water resource:

(a) Water stress parameter

$$\begin{cases} CS_s = \frac{1700 - R}{1700} & (R < 1700) \\ CS_s = 0 & (R > 1700) \end{cases}$$

(b) Water variation parameter

$$\begin{cases} RS_V = \frac{C_V}{0,3} & (C_V \le 0,3) \\ RS_V = 1 & (C_V > 0,3) \end{cases}$$

2. Water development pressure (DP):

(a) Water exploitation parameter

$$DP_{\blacksquare} = \frac{W_{\blacksquare}}{W}$$

(b) Safe Drinking Water Inaccessibility parameter

$$DP_d = \frac{P_d}{P}$$

3. Ecological health (EH)

(a) Water Pollution parameter

$$\begin{cases} EH_p = \frac{WW}{\frac{WR}{0,10}} & (WR < 0,10) \\ EH_p = 1 & (WR \ge 0,10) \end{cases}$$

(b) Ecosystem Deterioration parameter

$$EH_e = \frac{A_d}{A}$$

4. Management capacity (MC)

(a) Water Use Efficiency parameter

$$MC_E = \begin{cases} \frac{WE_{WM} - WE}{WE_{WM}} & KHI\ (WE < WE_{WM}) \\ 0 & KHI\ (WE \ge WE_{WM}) \end{cases}$$

(b) Improved Sanitation Inaccessibility parameter

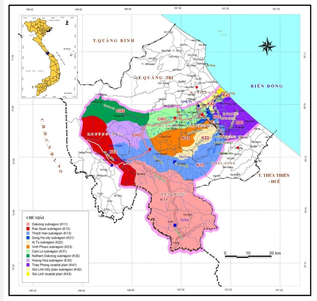
$$MC_S = \frac{P_S}{P}$$

(c) Conflict Management Capacity parameter:

overall capacity in dealing with transboundary conflicts - caculated the whole basin sociological investigations

Where: VI = Vulnerability index; R = per capita water resources (m^3 .person^{-1}); C_V = the coefficient of variation of precipitation over the last 50 year; WRs= Total water supply (capacity); WR = Total water resources (m^3); WW = total wastewater discharge (m^3); A_d= land area without vegetation coverage (km^2); A = total land area (km^2) ; WE = GDP value produced from 1 m^3 of water; WE_{WM} = mean WE of selected countries; P_d= population without access to improved sanitation; P = total population.

The studied area



The Thach Han River: length: 150km, basin area: 2660 km2.
Based on the topographic elevation criteria, the study area is divided into 4 regions, and 12 sub-regions (based on the criteria of rainfall, discharge, groundwater level, water quality and population density).
K1- the low mountainous area upstream Thach Han River including K11, K12 and K13 sub-regions
K2 - the middle area of Thach Han River including K21, K22 and K23 sub-regions
K3 - low mountainous region of Cam Lo River basin including K31, K32, K33, K34 sub-regions
K4 - downstream delta area of Thach Han River including K41, K42, K43, K44 sub-regions.

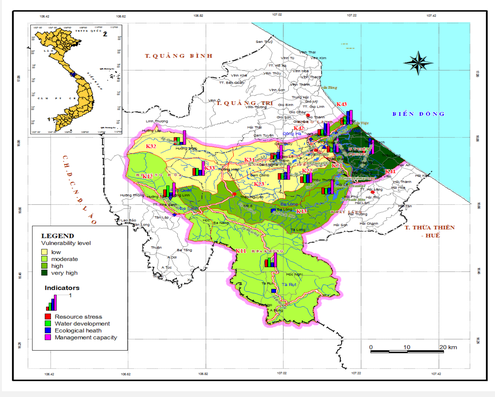
Results

All sub-regions : range from 0, 4 - 0.7. Although the whole basin is generally in good condition (water availability is abundant), the amount of clean water provided for each sub-region is almost sufficient, the amount of water provide to other industries relatively). The sub-regions K13, K31 and K32 are affected the lowest vulnerability in the whole basin. The reason is due to this area receiving abundant water every year is plentiful and under water pressure for water use industries, the demand for clean water is not good people in the area. The remaining basins are under high pressure, so efforts are needed to build a mechanism to provide technical and political assistance to alleviate these pressures. Sub-region K41 with a vulnerability of 0.62, which near the sea so that the hydro-meteorological elements are more variate than the other sub-regions, so the demand for water and its impacts to water resources has a significant impact on the development of water resources in the region. The sub-regions K42 and K43 are all coastal plains or midland, water resources are susceptible to salinity or pollution due to civil activities and economic development, the status of poor environmental sanitation. The remaining sub-regions are all highly vulnerable, this is one of the numbers alarming managers to implement appropriate development policies suitable for each region.

The author proposes a number of solutions to manage water resources issues for the sub-regions as follows:

-Region 1 (The upland mountainous area of upstream Thach Han river - K1). Low economic development level, limited underground water. It is necessary to build more water collection works and reservoirs to store surface water for the dry season. Water collection facilities are located in river and lake beds, with sufficient depth to facilitate the arrangement of other auxiliary works.

- Region 2 (Middle area of Thach Han river - K2): fertile soil, is very convenient for cultivation crops, should encourage the cultivate of industrial crops, timber trees in combination with cash crops, food crops and develop farm economy, encouraged to build breeding facilities hygienic environment, apply animal waste treatment by dry composting, and forest protection



Region 3 (lowland mountainous region of Cam Lo - K3 river basin) average level of socio-economic development such as animal husbandry and fisheries should be encouraged, develop the capacity of preserving and propagating aquatic products, and at the same time, limit the excessive exploitation of the allowed levels.

- Zone 4 (the lower delta of Thach Han river - K4) with relatively crowded population, shallow groundwater level, change the farming season structure. It is essential to grow suitable crops such as crops demanding less water (corn, peanuts, etc) in the dry months andadjust the production season and change farming techniques. For water sanitation, it is necessary to build a system of rainwater drainage systems that are reasonable and renovate and treat waste water by natural constructions such as biological lakes and wetlands in order to combat minor floods (in May and June).

Results

The integrated management of water resources for basins is an effective management method that has been studied and applied by many countries. Assessing the vulnerability of water resources to a basin is a scientific basis for policy makers, managers, and experts to access and exploit information on water resources related to the decision making of environmental and natural resource protection policies.

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