Analysis of the Water Crisis in Egypt

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Keywords: water shortage, Egypt, PSR

Abstract. In this paper, an analysis of Egypt’s water shortage problem is given based on both social and physical reasons. A practical measure model is applied to evaluate the risk of water shortage in Egypt. The potential influencing factors are turned into 15 indexes. A serial of equations are used to standardize the indexes. Meanwhile, the weight of each index is calculated based on Entropy Weight Method. PSR is adopted to ensure the rational classification of all chosen indexes.

1. Introduction

Egypt has been suffering from severe water scarcity in recent years. Uneven water distribution, misuse of water resources and inefficient irrigation techniques are some of the major factors playing havoc with water security in the country. The River Nile is the lifeline of the country as it services the country’s industrial and agricultural demand and is the primary source of drinking water for the population.

2. Social and Physical Reasons of the Water Crisis

2.1 Social Forces

A. Population growth and quality of life

Advancements in living standards together with population growth have already been reflected in expansion of water consumption levels for domestic use. [1] Domestic water use grew from 3.1 BCM in 1990 (Abu-Zeid,1991) to 5.23 BCM in 2000 (FAO Aqua- stat). Further augmentation of the life quality and the population growth will push up water demands.

B. Poverty

Often low-income levels and poverty in rural areas limit the farmers’ ability to invest in agriculture pushing them to plant the low-cost crops namely water thirsty crops (i.e. rice, sugarcane). This shift in the cropping pattern triggers the increase in water use.

C. Cropping pattern

Cropping pattern plays a vital role in determining the irrigation water demand. Some changes in cropping patterns were made favoring production of high value-added crops. Among them were the...
rice and the sugarcane with the highest water requirements among the crops cultivated in Egypt.

2.2 Physical variables

A. Water resources

Water resources in Egypt are limited to the Nile River, rainfall and flash floods, deep groundwater in the deserts and Sinai, and potential desalination of sea and brackish water. The detailed water resource distribution is shown in Figure 2.

B. Basic demand of water

Figure 2 illustrates the present water distribution among different economic sectors. Agriculture is the largest consumer of water resources worldwide and in Egypt as well.

![Figure 2: The present water distribution among different sectors](image)

3. Assessment of water scarcity in Egypt based on PSR

- Choose suitable indexes
  It is known to all that cropping patterns have an enormous impact on the agricultural water consumption and Consumer behavior contribute is closely related to both Per capita water consumption and domestic water consumption. Poverty can be linked to per capita GDP. Last but not least, population density can be used to represent population growth.

- Application of PSR
  Through collection for information and statistic, we acquired the specific statistic in population, society, economy and water resources of Egypt. The following chart can be obtained by using PSR, and weight of all the indexes can be calculated with the whole procedure programmed in MATLAB.

  Using the data of natural environment, social economy and water resources in Egypt during 2002 ~ 2012, and after the standardization, we are able to concluded risk assessment indexes of state index, pressure index and response index, as shown below.

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</thead>
<tbody>
<tr>
<td>state</td>
<td>0.40</td>
<td>0.401</td>
<td>0.401</td>
<td>0.401</td>
<td>0.402</td>
<td>0.40</td>
<td>0.403</td>
<td>0.40</td>
<td>0.404</td>
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<td>0.404</td>
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<tr>
<td>pressure</td>
<td>0.38</td>
<td>0.387</td>
<td>0.390</td>
<td>0.394</td>
<td>0.401</td>
<td>0.40</td>
<td>0.41</td>
<td>0.422</td>
<td>0.43</td>
<td>0.444</td>
<td>0.449</td>
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<tr>
<td>response</td>
<td>0.21</td>
<td>0.224</td>
<td>0.223</td>
<td>0.232</td>
<td>0.246</td>
<td>0.26</td>
<td>0.28</td>
<td>0.303</td>
<td>0.31</td>
<td>0.327</td>
<td>0.340</td>
</tr>
</tbody>
</table>

Analysis of the obtained data
As it is indicated in the data, in 2012 the risk of state achieved its peak 0.404. So they are the risks of pressure and response.

Via studying the yearly change of the comprehensive risk index, we can draw the conclusion the trend of it is increase.

- **Ecological risk analysis of water resources**
  According to the general statistical principles, comprehensive water resources ecological risk level is divided into three categories, as shown in Table 2, the comprehensive ecological risk index less than 1.00 is considered as low risk, while index higher than 1.10 is considered as high risk, and between them is medium risk.

**4. Conclusion**

Based on the classification criteria, the comprehensive ecological risk of water resources in Egypt from 2002 to 2012 was evaluated, as shown in Table 2.
Table 2: classification criteria and comprehensive risk index

<table>
<thead>
<tr>
<th>Level of risk</th>
<th>Parameter of risk</th>
<th>year</th>
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<tbody>
<tr>
<td>Low risk</td>
<td>&lt;1.00</td>
<td>2002</td>
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<tr>
<td>Medium risk</td>
<td>1.00-1.10</td>
<td>2003-2008</td>
</tr>
<tr>
<td>High risk</td>
<td>&gt;1.10</td>
<td>2009-2012</td>
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</table>

References

[1] Xiangjuan Zhang, Xin Li, Xiuxia Li, etc. With the analytic hierarchy process to establish the Beijing-hangzhou grand canal in suzhou high-tech zone section of the water environment bearing capacity index system research [J]. Journal of environmental protection and circular economy, 2011, 31 (2) : 42-44.
