Comprehensive Water Stress Indicator

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WATER STRESS

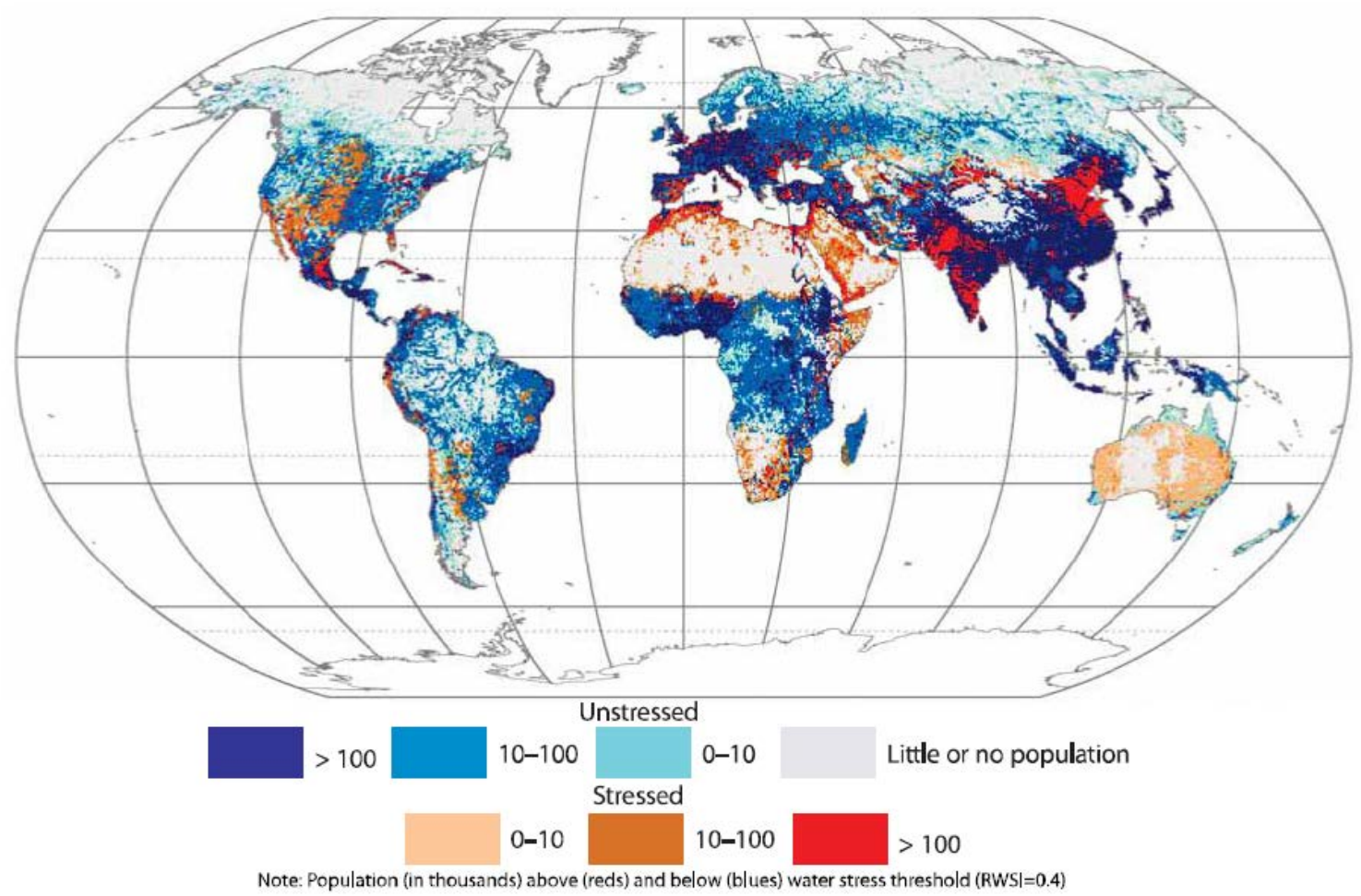
- Water stress refers to economic, social, or environmental problems caused by unmet water needs.
- Water stress and water scarcity occur when the demand for water exceeds the available amount during a certain period or when poor quality restricts its use.
- Scarcity can be absolute, such as in environments of low precipitation and large evapo-transpiration rates.
- Scarcity can also be induced by economic or political constraints, which do not permit the adequate development of water resources.

WATER STRESS INDICATORS

- The difficulty of characterizing water stress is that there are many equally important facets to water use, supply and scarcity.
- Selecting the criteria by which water stress is assessed can be as much a policy decision as a scientific decision.
- The indices existing can be broadly grouped into the following categories:
  - **Indices Based on Human Water Requirements**
  - **Water Resources Vulnerability Indices**
  - **Indices Incorporating Environmental Water Requirements**

Indices Based on Human Water Requirements

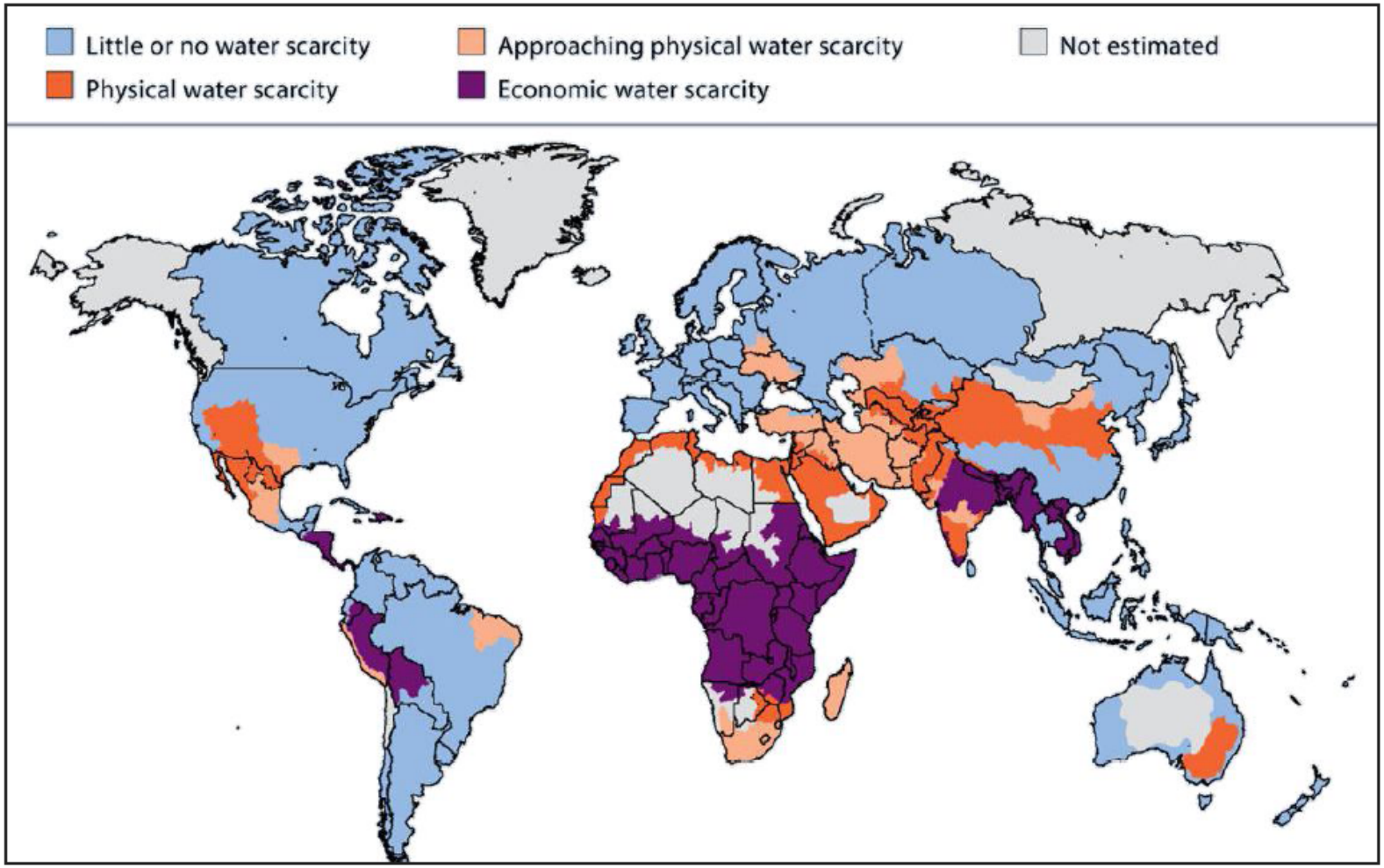
- Logic: If the water necessary to meet human demands is known, then the water that is available to each person can serve as a measure of scarcity.
- Example: Relative water stress index as prepared by Water Systems Analysis Group, University of New Hampshire (UNH) proposed water stress to be computed as ratio of product of domestic water demand (km3/yr), Industrial water demand (km3/yr) and Agricultural water demand (km3/yr), to water supply (km3/yr).
- Value less than 0.4 implied Population exposed to water stress .
- Number of people exposed to water stress was typically presented as number of people (in thousands) per grid cell.



Water Stressed Areas as determined by Relative water stress indicator proposed by Water Systems Analysis Group, University of New Hampshire (UNH)

Water Resources Vulnerability Indices

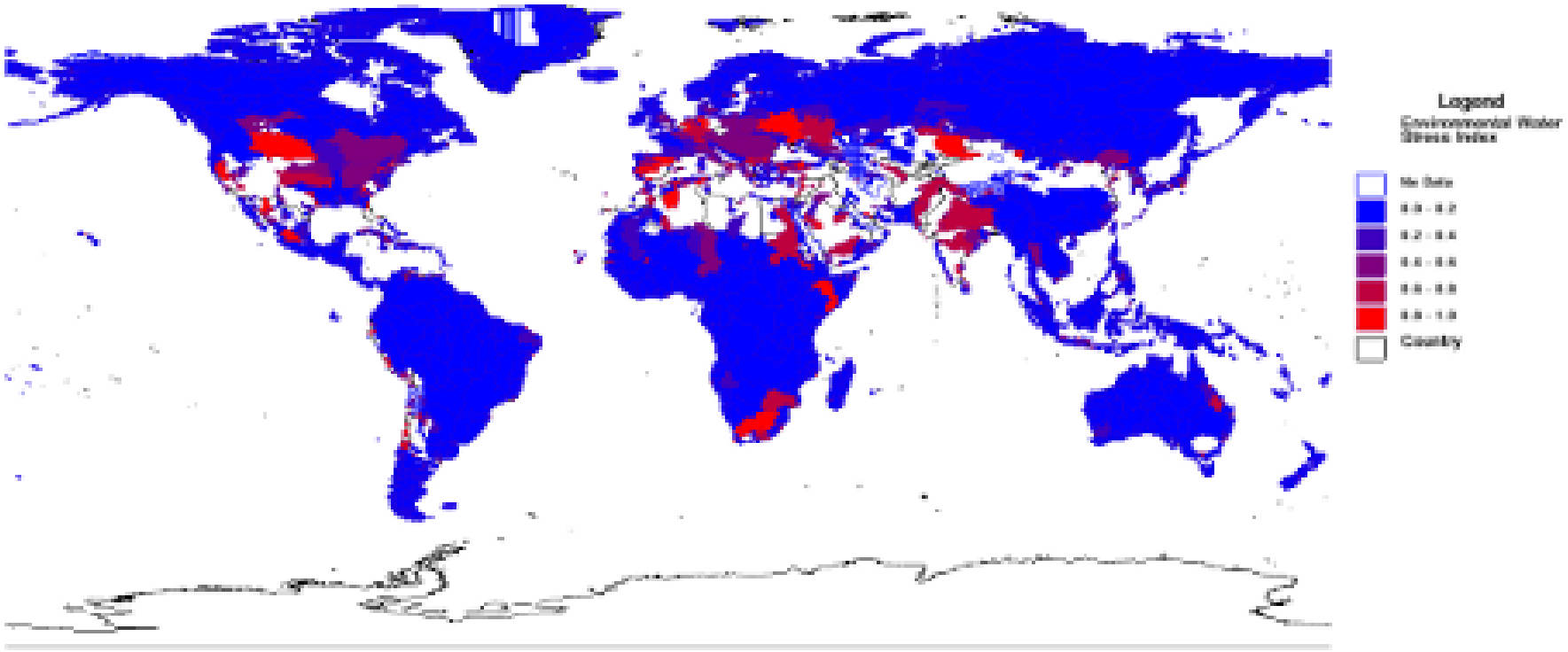
- These indices go one step further than considering human water requirements and water availability and incorporate renewable water supply and national, annual demand for water.
- Example: International Water Management Institute (IWMI) evaluated the portion of renewable freshwater resources available for human requirements (accounting for existing water infrastructure), with respect to the main water supply.
- The Analysis labeled countries as “physically water scarce” when more than 75% of river flows are withdrawn for agriculture, industry, and domestic purposes. This implies that dry areas are not necessarily water scarce.
- Countries having adequate renewable resources with less than 25% of water from rivers withdrawn for human purposes, but needing to make significant improvements in existing water infrastructure to make such resources available for use, were “economically water scarce”



Areas of physical and economical water scarcity on a basin level in 2007 (Comprehensive Assessment of Water Management in Agriculture, 2007)

Indices Incorporating Environmental Water Requirements

- This indicator takes into account the environmental demand to sustain ecological processes
- Example: Environmental Water Stress Indicator has been proposed based water required for the maintenance of freshwater-dependent ecosystems per river basin.
- The water stress indicator provides information/ analysis on the proportion of the utilizable water in world river basins currently withdrawn for direct human use and where this use is in conflict with environmental water requirements.



Water Stressed Areas as determined by Environmental Water Stress Indicator

Do we need another water stress indicator?

- Although several indices have been developed to indicate water stress affected areas, there is a need to modify these to relate more effectively to the urban growth centres.
- In the context of a an urban or a peri-urban centre of developing nations like India, the water stress indicator has to effectively take into account practical conditions such as intermittent supply hours and increasing use of grey/ recycled water for non potable uses.
- The current study builds up from the available indices to suggest a comprehensive indicator for urban and peri-urban growth centres of developing nations like India.
- The index can provide the authorities with a scientific basis to suitably phase out the proposed revamping/ rehabilitation of water supply projects.

Proposed Water Stress Indicator

- Three major sectors exerting water demand in urban and peri-urban areas are domestic, agriculture and Industry.
- Each country / region has a different allocation pattern to each of these sectors depending on the landuse and economy. However, it would be incorrect to assign equal weightage/ significance to each of these sectors while computing water stress.
- The current study proposes computation of three sector wise water stress indicators which could be integrated to arrive at a single stress indicator.

Domestic Water Stress Indicator (DWSI)

- This could be estimated as ratio of domestic water supply of potable quality to domestic water demand.
- Domestic water demand could be estimated as product of population (in numbers) and the per capita water supply norms as specified by the concerned authority (e.g, CPHEEO in India).
- Domestic water supply could be classified as water supply available with desirable quality and that of acceptable quality (refer IS 104500).
- Water supply meeting the acceptable quality criteria but failing to meet the desirable quality parameters could be multiplied by a factor (say 0.9) to suitably account for water of lower quality standards.
- Water supply failing to meet the acceptable water quality criteria should not be taken into account as available.

Agriculture Water Stress Indicator (AWSI)

- As the demand for agriculture in a region varies significantly with season, this index could be calculated for each prominent crop season.
- This could be estimated as ratio of seasonal water supply for irrigation (including the supply from both fresh and recycled water meeting the norms for use in irrigation) to the ratio of irrigation demand in that season.
- Owing to the psychological nature of impacts associated with water scarcity, the least of the values for all seasons should be taken as an indicator of water stress wrt to agriculture in the area

Industrial Water Stress Indicator (AWSI)

- This could be estimated as ratio of water allocated for industrial applications (including the supply from both fresh and recycled water) to the ratio of industrial demand in that area.

Sector-wise (Domestic, Agriculture & Industrial) Water Stress Indicators

- A value of 1 for the sector-wise indicators implies NIL water stress. A value more than 1 implies surplus water availability and less than 1 implies a condition of water stress (the lesser the value the more the degree of the water stress is implied).
- Even though water is a basic need for mankind, there is a general unwillingness to pay for the same. Perception of affordability of water supply also governs the quantum of water stress and hence needs to be taken into account.
- Being a developing nation with a large population on the negative side of the poverty line, economic water scarcity (limited access to fresh water due to lower affordability) assumes equal, if not, greater importance as that of physical water scarcity.
- The threshold of affordability needs to defined specific to a sector and can be designated as a value equal to 1 for reasonably affordable level, ranging from 1 to 2 for easily affordable level and 0.5 to 1 depending on the degree of difficulty perceived in affording the allocated supply.

Sector-wise (Domestic, Agriculture & Industrial) Water Stress Indicators

- The other significant factor which affects the magnitude of water stress is the reliability of water supply.
- The stress induced by intermittent supply with fixed/ reliable supply hours is less as compared to intermittent supply with unreliable supply hours.
- The factor could be taken as 1 for 24 x 7 supply, 0.8 for intermittent but reliable supply for more than 6 hours per day and 0.7 for intermittent but reliable supply of less than 6 hours per day.
- The factor could be taken as 0.5 for unreliable and intermittent supply.
- The sector wise water stress indicators could be multiplied by affordability and reliability factors specific to their sectors to effectively take these practical considerations into account.

Comprehensive Water Stress Indicators

- After determining the individual indicators, an overall indicator can be arrived at after assigning suitable weightages to each sector. For example, the weightage assigned to DWSI, AWSI and IWSI could be 40%, 35% and 25% respectively.
- The advantage of segregating the index sector wise at the initial stage is to get an indication of the sector wise deficit/ surplus to adequately plan for addressing the issue. For example a surplus in agriculture sector should be utilized preferentially for domestic sector as it has more influence on the overall water stress in a region.
- Also the current water stress indicator needs to be read in conjunction with future projected/ envisaged water stress, wherein the analysis could be done taking into account the forecasted population, forecasted increase/ decrease in per capita demand for water and forecasted resource availability.
- This should be done at the sectoral level, before integration into one single future water stress indicator.

Summary and Conclusions

- There is a increasing awareness that our freshwater resources are limited and need to be protected both in terms of quantity and quality.
- This water challenge affects not only the water community, but also decision-makers.
- With urbanization and changes in lifestyle, water consumption is bound to increase. The key focus areas are:
  - Preserving existing water resources
  - Improving access to potable water
  - Improving transboundary cooperation
- Proposed Comprehensive water stress indicator can help enable efficient sector specific micro level planning considering practical constraints such water quality, affordability and supply frequency.

Thank You