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THE OVERVIEW OF BIO-PHYSICAL VULNERABILITY IN KALPITIYA PENINSULA, SRI LANKA

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Abstract
Being an island, Sri Lanka retains an unavoidable possibility of facing potential calamities associated with sea level rise. One of the major issues in this regard is the depletion of ground water resources due to salt water intrusion especially in the coastal regions. The inhabitants of these coastal regions are highly vulnerable to be pushed in to environmentally-driven migration due to the bio physical vulnerability associated with ground water stress where the salt water intrusion caused by sea level rise will multiply the potential threats. This study presents a futuristic overview on the possible issues related to ground water stress in Kalpitiya Peninsula of Sri Lanka based on the results of an Integrated Bio-Physical Vulnerability Index calculation developed upon data collected during 3 years from year 2015 to 2018, interpreted utilizing qualitative data on socio-economic vulnerability of the resident communities. It was expected to obtain 0 to 6 range as the Index results, and the values received were ranging from 2.79 to 5.4 indicating more than 75% Grama Niladhari divisions of Kalpitiya peninsula falls under more than 3.8 Bio-Physical Vulnerability level. Therefore, the future of these communities is uncertain confirming that necessary actions necessitate immediate attention before the worst scenarios seize to happen.

Key words: Bio Physical Vulnerability Index, Environmentally-driven migration, Sea Level Rise.

Introduction

Water has gained the position of the most valued resource as the primary need of living (UNESCO; IHP, 2011). In terms of the geomorphological aspect, Coastal Environments are particularly dynamic as systems fronting for recurrent disturbances and changes over time and space (McGranahan et al., 2007). Especially, when considering the dry zone coastal area of Kalpitiya Peninsula, the inhabitant population primarily relying on the available ground water resources of the area, since usable surface water sources are largely limited. With the increasing water scarcity, the factor that accelerate the pertaining issues is the mismanagement of the available water resources (Ding et al., 2014). Undeniably, all the bio-physical factors are typically bound with water, hence the threat of ground water stress will direct to severe levels of Bio-physical Vulnerability which will cause the coastal regions are extremely uninhabitable at the worst scenario. Biophysical vulnerability is defined in literature as the exposure of human systems to natural extreme events and, as a consequence, to a particular hazard (Macchi et.al; 2008) which in this context the threat of salt water intrusion due to sea level rise.

Study area

The study area, Kalpitiya peninsula is located in the North Western coast of Sri Lanka between 79° 40′*50 °79 –′* Eastern longitude and 7° 50'– 8° 30' Northern latitude. Kalpitiya Peninsula falls within the Puttalam district of North Western province in Sri Lanka and comprises with two District Secretarial Divisions (DSD), Kalpitiya and Mundalama. The study area bounded to the North and West by the Indian Ocean, East by the Puttalam lagoon and South by the Mukkuthoduwawa seasonal river (figure 01). Kalpitiya peninsula comprised with Shallow aquifers on coastal spits and bar type as a "compound spill" and shaped like a beckoning finger (Panabokke, C. R., 2007). This groundwater aquifer recharge only during the South-East Monsoon seasonal rainfall Period. The Indian Ocean situated on the left side and Puttalam lagoon situated on the right side of the water lens. Very less usable surface water bodies available in this region hence the inhabitants use the ground water for drinking, domestic usage and mass scale crop cultivations constantly stressing the available aquifer resources. Holocene deposits mainly consist with alluvial and lagoon- estuarine deposits, unconsolidated sand (of the beaches and dune) and beach rocks (Cooray, 1984). Southern part of the peninsula (Daluwa area) comprised with very shallow and very thick layer of soft mud. The western part of the Puttalm lagoon covered with alluvial, lagoon and estuarine deposits.

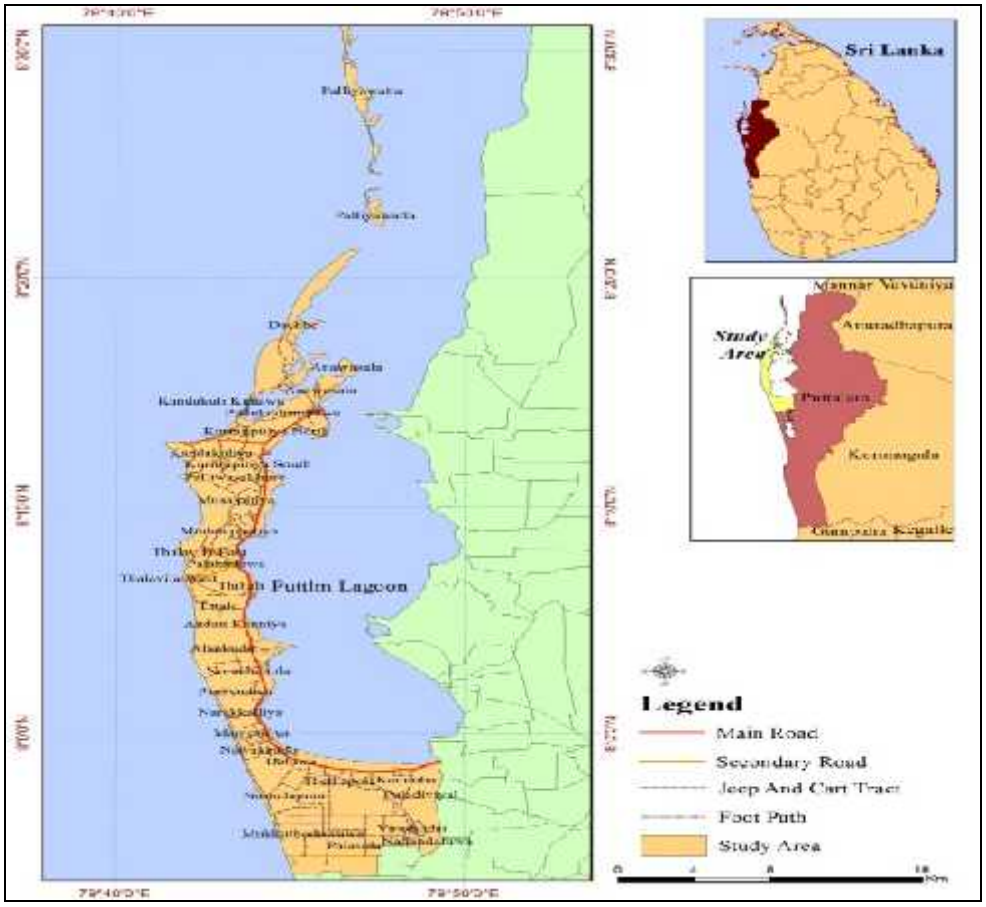


Figure 1. Study area - Kalpitiya Peninsula

Methodology

The Integrated Bio-Physical Vulnerability Index was developed using the Arc GIS 10.3 Model builder tool. The containing criteria in the seven Bio-Physical parameters considered were reclassified using in to 1 (lowest) to 9 (highest) scale according to their level of importance and combined by assigning weights to each parameter on importance considering which factors are most vulnerable if the bio-physical environment of Kalpitiya Peninsula is exposed to sea level rise and its effects. The following equations were utilized to calculate the index.

Integrated Bio Physical Vulnerability Index =

(a*0.12)+(b*0.12)+(c*0.14)+(d*0.16)+(e*0.13)+(f*0.16)+(g*0.17)

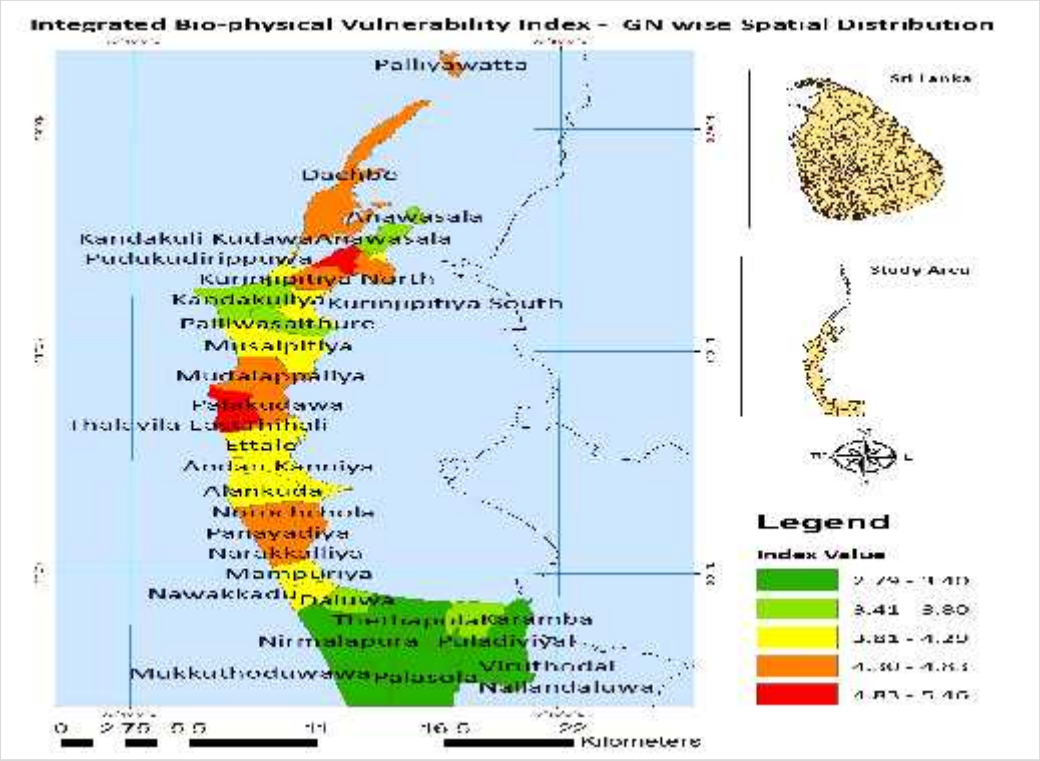
Equation 01: Integrated Bio Physical Vulnerability Index

(a = NDVI – Normalized Difference Vegetation Index; b = NDWI – Normalized Difference water index; c = Soil Types of Kalpitiya Peninsula; d = Level of Salt water intrusion; e = Coastal Elevation; f = WQI – Water Quality Index; g = Ground Water changes and all the parameters multiplied with respective Percentage influence level weight of each parameter).

Results and Discussion

The results of the Index values were expected to be between 0 -6 range and the obtained values for Grama Niladhari divisions range from 2.79 to 5.46. According to the results the highest vulnerable areas are

Pudukudiiruppu, Thalavila East and Palakudawa GN divisions. Other than these areas 75% areas of Kalpitiya peninsula includes in more than 3.8 Bio-Physical Vulnerability level. Therefore, the Bio-Physical Factors in these areas are more vulnerable in terms of facing devastating impacts of sea level rise. The consequences of this overall vulnerability would definitely will be far beyond just water stress. When considering the employment diversity of the Kalpitiya area the income-generating pattern of the people mainly depends on two major sectors namely agriculture (40%) and fisheries (35%) according to the recent statistics of Kalpitiya Divisional Secretariat. Since the area does not have surface water resources other than very few small lakes including Ethalai, 95% of the mass scale agriculture depends on the ground water resources.



The salt water intrusion in to ground water will cause the agriculture severely decline letting the families who depend on this livelihood be forced in to depreciation. Even for the other inhabitants, drinking water stress will become the most severe threat in their lives and the communities who can afford will seek refuge in other habitable regions while majority will necessarily need immediate assistance of decision makers to be resilient to the potential impacts.

Conclusion

It is unescapable that the ground water table of Kalpitiya Peninsula is at higher vulnerability level for depletion and salinity contamination. Possible impacts of Sea Level Rise may completely increase the damaging phenomena on the inhabitant population with the increasing level of bio-physical vulnerability. Northern portion of the case study area where the mass scale crop cultivations are operated tends to have very high vulnerability levels. Hence it must take direct measures to regulate mass scale extraction of ground water while introducing a mechanism of a properly maintained common ground water extraction system to the area. . It should appropriately control usage of ground water resources in any upcoming developments. Should prohibit any new mass scale (industrial/ agricultural) development based on ground water in the areas with unsuitable water quality according to identified seasons. The ground water lens of the area is in critical state where over exploitation may enable salinity intrusion which is an irreversible phenomena if once done.

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