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Climate Change and Its Effects on Vulnerable Population Groups

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Abstract
The study aimed to identify the health sector vulnerability due to climate change based on WHO framework that includes vulnerability. The results showed five groups of vulnerable population that are: Geographical vulnerability**,** Nutritional vulnerability, Socioeconomic Vulnerabilities, Water Scarcity and Sanitation Systems Vulnerability and Internally Displaced Population. The results also showed according to the WHO Regional Office of Eastern Mediterranean (WHO/EMRO, 2008a), the region is one of the most vulnerable regions to climate change because of its arid nature and reliance on rain-fed food production' and because of the endemic nature of many diseases and health problems which are sensitive to poverty and climate change, making the impact of climate change on the region greater than that on the world as a whole.

1. INTRODUCTION

In regard to the impact of climate change on human health, the IPCC 5th Assessment Report stated that climate change is already having an impact on the global burden of morbidity and mortality and such effects are likely to increase all around the globe. The nature and magnitude of climate change will determine the extent and nature of future health impacts (Smith, and others 2014).

The World Health Organization reported that some 2.5 million people die every year from non-infectious diseases directly attributable to environmental factors such as air pollution, stressful conditions in workplaces, exposure to chemicals such as lead, and exposure to environmental tobacco smoke. WHO also reported the death of 3.5 million from malnutrition, 1.8 million from diarrhea that largely resulted from lack of access to clean water supply and sanitation, and from poor hygiene, and approximately 60, 000 in natural disasters (WHO, 2006 and WHO, World health day 2008).

The impact of climate change on human health would occur through pathways of varying complexity, scale and directness and with different timing. However, the actual health impacts are not uniform across countries and regions. They vary in extent and nature depending on local environmental conditions, socio-economic circumstances, and the range of adopted social, institutional, technological, and behavioral measures (IPCC, 1998; Patz and Kovatz, 2002; 2007, WHO, 2008a).

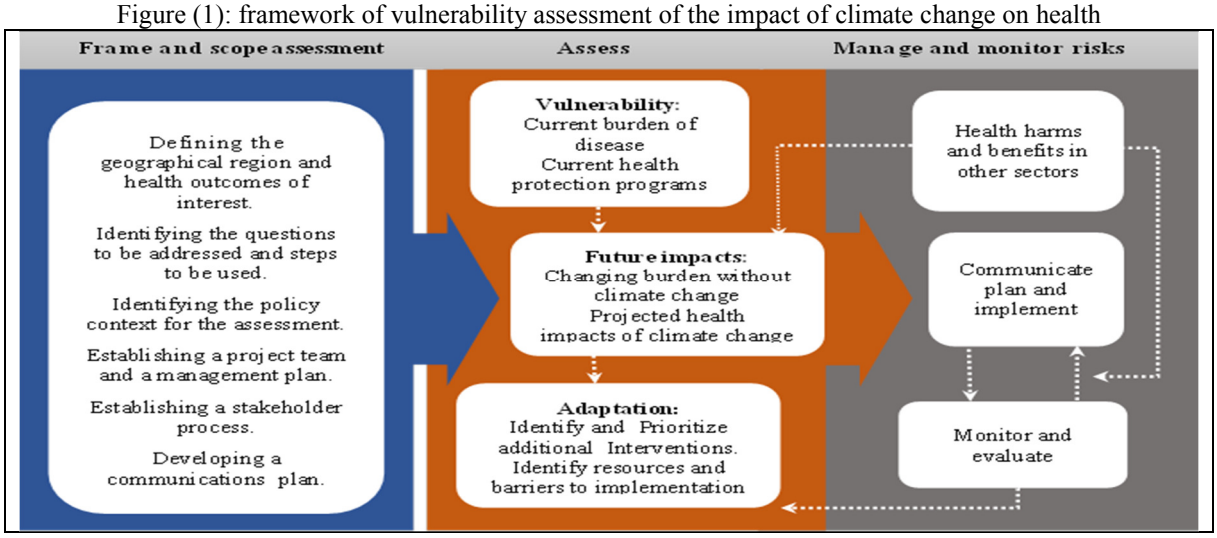
Accordingly, Climate change and its consequences is an emerging and pressing development challenges faces Yemen. In 2001, Yemen's Initial National Communication (INC) to the United Nation Framework Convention on Climate Change (UNFCCC) reported findings concerning the vulnerability of the social and biophysical environment from climate variability and climate change. The major impacts of climate change in Yemen as reported in the INC represent the starting point for the National Adaptation Program Action (NAPA) effort. These major impacts include: (1) Increased water scarcity and reduced water quality – leading to increased hardship on rural livelihoods; (2) Increased drought frequency, increased temperatures, and changes in precipitation patterns – leading to degradation of agricultural lands, soils and terraces; (3) Deterioration of habitats and biodiversity – leading to expansion of desertification; (4) Reduced agricultural productivity – leading to increased food insecurity and reduced income generating activities; (5) Increased sea levels – leading to deterioration of wetlands, coastal mangrove migration, erosion, infrastructure damage, and seawater groundwater intrusion; (6) Increased climatic variability – leading to the possibility of spread and growth of vector borne and water borne diseases; and (7) Impacts on coastal zones – leading to a loss of tourism activity due to sea level rise including loss of beaches. (EPC, 2001 &NAPA, Yemen. 2009).

Aim of Study: To identify the health sector vulnerability due to climate change on the basis of WHO framework that include vulnerability.

Subjects and Methods:

Because such information is often not easily represented geospatially the key goal is to identify the health sector vulnerability due to climate change based on WHO framework that include vulnerability, impact and adaptation as shown in the below figure.

Figure (1): framework of vulnerability assessment of the impact of climate change on health



Also, because climate change is not the only factor affecting the geographical range and incidence of climate-sensitive health outcomes, and because non-climatic factors, social determinants of health, can have a strong or even dominant effect, either independently or by modifying climate effects, it is important to understand the various causal pathways from climate change through health outcomes, in order to identify opportunities to address the environmental determinants of poor health outcomes.

A modified Driving Force, Pressure, State, Exposure, Effect, Action (DPSEEA) Framework will be used also in the current assessment to describe the actions of various causes that act, more or less directly, on health outcomes from environmental or related behavioral conditions and the various levels of actions that can be taken to reduce health impacts (Corvalan et al., 2000). Key driving forces such as agriculture, transport policies, land use change and urbanization process of DPSEEA framework will not be investigated.

Results

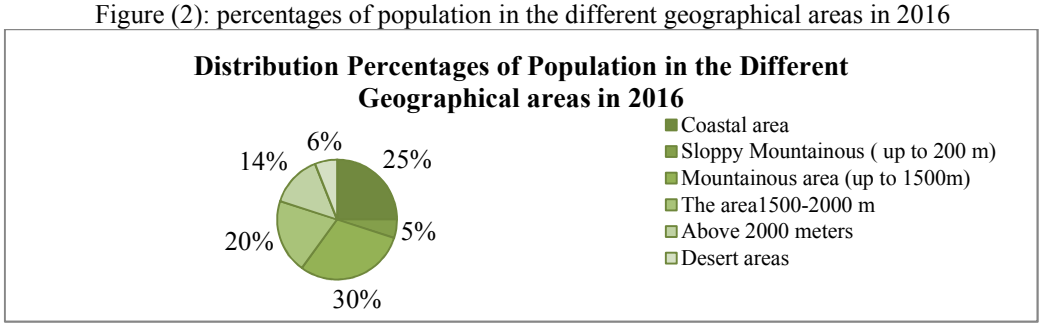
Identification of Vulnerable Population Groups

Geographical Vulnerability

Yemen topography renders the different geographical regions susceptible to various natural disasters, and for the last twenty years Yemen had at least one natural disaster every year such as floods. The dispersed population over more than 130,000 localities makes it so hard for the government to cover the whole population with the needed and essential services. Low – lying governorates are more sensitive to flooding events, contamination of freshwater reservoirs due to sea level rise, and salination of soil, all of which may have important effects on health (Fankhauser and Tol, 1997).

People living in rural and remote areas, which are characterized by very hard geographical terrains, lack of essential social services and with no system of social protection, are at increased risk of ill health because of limited access to all type of services including health services and because of the low levels of social and economic standards (UNDP, 2015). The figure below shows the percentages of population in the different geographical areas in 2016.

Figure (2): percentages of population in the different geographical areas in 2016



Source: UN Population Division, 2015.

In addition, population living in the western humid and temperate regions and in the high lands that are less than 1500 meter above sea level are highly susceptible to vector-borne diseases as a result of rising temperatures and altered patterns of rainfall, especially when disease control systems are weak (NMCP Annual Report, 2013).

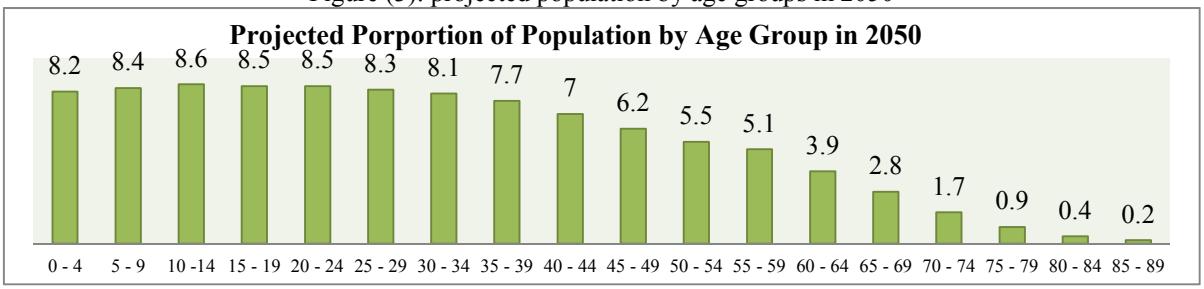
Demographic Vulnerability

In 2016 more than 40% of the population is below the age of 15 years, of whom 14.51% under the age of 5 year and 3.44% are infants, which means that 40% of the population are more vulnerable to climate sensitive related illnesses such as water and vector borne diseases. Children are more vulnerable to the adverse health effects associated with climate change due to factors associated with their immature physiology and metabolism, their unique exposure pathways, their biological sensitivities and limits to their adaptive capacity. Though in 2050 and 2100 the proportions of children below 15 years will be decreased markedly to 25% and 16% respectively, yet the incidence of climate sensitive diseases might be increased because of weak health care system and due to the weak and poor socioeconomic living standards that are manifested by high poverty rates and undernutrition all of which would be exacerbated markedly by climate change.

Perera (2008) highlighted that the fetus and young child are at increased risk of developmental impairment, asthma, and cancer from fossil fuel pollutants and from the predicted effects of climate disruption such as heat waves, flooding, infectious disease, malnutrition, and trauma. In addition, Kovats and Hajat (2008) indicated a substantial impacts from climate change on the incidence of diarrheal disease and the associated mean projected increases of relative risk of diarrhea in their six study regions were 8–11% by 2010–2039 and 22–29% by 2070–2100.

Women in age group (15 - 49 years) are at increased vulnerability to a range of environmental hazards, including extreme heat. Strand, Barnett and Tong (2012) found a strong evidence of an association between increased temperature and increased risk of stillbirth and shorter gestation. The hazard ratio for stillbirth was 0.3 at 12°C relative to the reference temperature of 21°C. The projected population in 2050 is shown in the below figure.

Figure (3): projected population by age groups in 2050

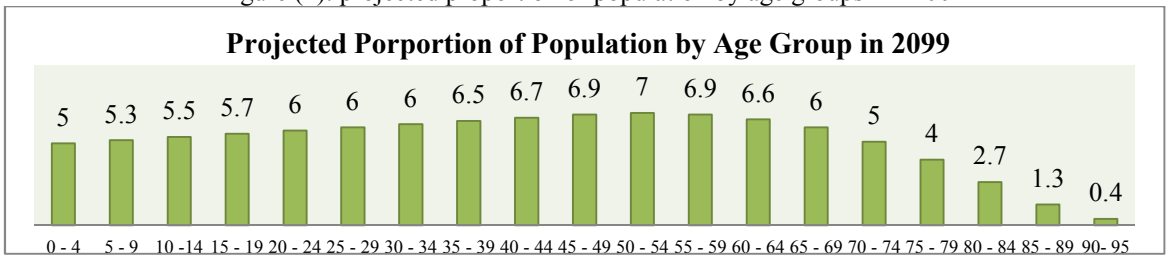


On the other hand, the proportion of population in the age group (15- 64 years) for both male and female account for 57.1% in 2016 population estimates and they will form 69% and 64% of the projected population in 2050 and 2100 respectively. This age group is called the working force age group and it is a measure of dependency ratio. In Yemen, the dependency ratio is already very high in 2016 due to the high population in age groups below 15 years in 2016 added to the older age groups 65 years and above (http://worldpopulationreview.com/countries/yemen).

In 2050 and 2100 the dependency ratio will be decreased due to increase in the working force age group to 69% and 64% respectively. However, most members (male) of this working age group are outdoors workers and hence climate change may increase the prevalence and severity of known occupational hazards and exposures, as well as the emergence of new ones due to increase in the numbers of workers in one hand and the potential absence of coping strategies or work regulations laws on the other hand (https://health2016.globalchange.gov/populations-concern). Moreover, the economic and nutritional status are not expected to be improved on the near term and hence unemployment rate will be high leading to high poverty rate and its consequences mainly food insecurity and undernutrition among children.

Older population group aged 65 years and above form only 3.2% of the estimated population in 2016 (1.2% above 70 years), and they are projected to form 6% (2.83 million) of the population in 2050 with 3.2% above 70 years of age and in 2100 they will form 20% of the population.

Figure (4): projected proportion of population by age groups in 2100



These older population age groups are generally suffering from non-communicable diseases and they will be

at greater risk of death or injuries from storms, floods, heat waves, and other extreme events of climate change. Older population with chronic diseases such as diabetes and ischemic heart disease are at greater risk of death from elevated average ambient temperature.

Basu and Ostro (2008) found that each 10°F (~4.7°C) increase in mean daily apparent temperature corresponded to a 2.6% (95% confidence interval) increase for cardiovascular mortality, with the most significant risk found for ischemic heart disease. The elevated risks were also found for persons at least 65 years of age (2.2%, 95% CI), infants one year of age or less (4.9%) and the Black racial/ethnic group (4.9%) and no differences were found in relation to gender or educational level. To prevent the mortality associated with ambient temperature, persons with cardiovascular disease, the elderly, infants, and Blacks among others should be targeted by preventive measures.

Brunkard, Namulanda, and Ratard (2005) have identified that forty-nine percent of Katrina-related deaths in Louisiana were people 75 years old and older of whom fifty-three percent were men. The major causes of death among Louisiana victims were drowning (40%), injury and trauma (25%), and heart conditions (11%), and this is because older people tend to be less mobile than younger adults and so find it more difficult to avoid hazardous. In addition, older people are more likely to suffer from health conditions that limit the body's ability to respond to stressors such as heat and air pollution (Gamble et al., 2013).

It has been found that mortality due to natural disasters, including droughts, floods, and storms, is higher among women than men (WHO, 2011). The excess of flood deaths among males often related to rural farming (Abuaku et al., 2009). In Bangladesh, females are more affected than males by a range of climate hazards, due to differences in prevalence of poverty, undernutrition, and exposure to water-logged environments (Neelormi et al., 2009).

Nutritional vulnerability

In Yemen, hunger and undernutrition are widespread and as they require urgent intervention, children especially girls are generally at greater risk of adverse health outcomes (DHS, Yemen, 2013). With restricted food supplies, with nearly five children per family, (more in rural areas), with lower household's income and with high poverty rate and food insecurity, the adverse health outcomes related to climate change will be so severe and the effect of food insecurity on growth and development in childhood may be more damaging for girls than boys (Cook and Frank, 2008).

Socioeconomic Vulnerabilities

Due to the deteriorated economic status of the country, Yemen is highly susceptible to damages caused by climate extremes and climate variability. In Bangladesh, a study of the impacts of flooding found that household risk reduced with increases in both average income and number of income sources. Poorer households were not only more severely affected by flooding, but they also took preventive action less often and received assistance after flooding less frequently than did more affluent households ((Brouwer et al., 2007).

Water Scarcity and Sanitation Systems Vulnerability

Because Yemen is suffering from severe water scarcity and current scarcity of water resources are becoming increasingly precious, the provision of water for drinking and washing, waste management, and sanitation will highly influence the health risks of the population. Yearly epidemics of dengue fever in Shabwa, Taiz and Hodeida governorates were due to poor supply of save drinking water and wrong storing of water in containers that become suitable breeding sites for the disease vector Aedes egypti. The increased temperature in May – June 2016 above average and lack of electricity power supply in Hodeida have led to the appearance of different varieties of skin diseases and many human fatalities forcing people to use mosques that have air conditioning and electricity supply as shelters from excessive heat waves because there houses were without electricity. Certainly, women would not be able or allowed to use such facilities due to cultural constraints and hence will be more affected by these extremes of heat waves together with their younger child's (MoPHP report, 2015).

Internally Displaced Population

With a total number of IDPs that raised to 3 million by July 2016, half of whom are in Aden, Taiz, Hajjah and Al Dhale'a governorates, their living conditions will be even so hard than the rest of the population. Living conditions are poor due to poor socioeconomic standards of living and poor building structures since they settle schools and health facilities in addition to the lack of proper public infrastructure that would be manifested by water shortages, contaminated water supplies and poor sanitation. These conditions will result in a higher risk for water-borne disease transmission. Climate change may worsen the situation by threatening livelihood, food and water security of refugees.

Conclusion

In Yemen, health data and information are characterized by fragmentation and distortion and they lack a unique pattern of occurrence and changes when compared with the previous year's neither for the same diseases nor for the same places and seasons of occurrences making them unreliable source for drawing causality relationship (Annual Health Statistical books, 2000 to 2015). Climate data also have the same defective characteristics as for the health data. Climate data for precipitation, temperatures and humidity records lack adequate spatial coverage, poor quality and long-term systematic records are very scarce. Climate data collection is fragmented between different institutions with little cooperation between these agencies (Wilby, R. 2009).

The efforts to adapt to the health impacts of climate change can be categorized as incremental, transitional, and transformational actions. Incremental adaptation includes improving public health and health care services for climate-related health outcomes, without necessarily considering the possible impacts of climate change (IPCC, 2013). Rebuilding and maintaining of public health infrastructure are often viewed as the "most important, cost-effective and urgently needed" adaptation strategy to climate change in the human health sector (IPCC, 2001). These include public health training, effective surveillance and emergency response systems, and sustainable prevention and control programs (WHO & UNEP, 2003).

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