



Water stress and human migration: A global, georeferenced review of empirical research

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Patterns of human movement have always been affected by the continuous changes in climate and weather patterns, in addition to the availability of and access to natural resources, including water. Today, concerns over how these changes might affect migration are growing and there is a need to understand the relationship between water stress and migration. Therefore, our analysis looks at the latest study of FAO Land and Water Division (CBL) and GWP Technical Committee (TEC) on "Water stress and human migration: A global, georeferenced review of empirical research." The study in question assessed 184 peer-reviewed, empirical research articles selected for their focus on linkages between water stress and human migration. The literature studied in great detail the relationship between dryland crops and water stress. Crop water stress is discussed as a result of a lack of access to water for irrigation, water stress and migration in sending areas, and water stress and migration in receiving areas. In general, the literature reveals a strong consensus that increased water stress can cause people to decide to migrate.

Furthermore, this review maps the geographic distribution of water stress-migration research at the sub-basin level and compares it with expected changes in water stress that are likely to occur as a result of climate change over the next 30 years, identifying places where future research efforts could produce useful information. Historically, political, economic and demographic contexts can help in explaining the factors that influence the migration options when changing environmental conditions make livelihoods more difficult. The papers discussed in this review focused on a direct relationship between four categories of water problems and migration:

1) agricultural problems (i.e. drought, changes to growing periods); 2) flooding vulnerability (i.e. rivers, coastal inundation); 3) water infrastructure problems (i.e. water scarcity or water quality); and, 4) water conflict (i.e. social conflict over access to or use of water resources).

The studies show that there are clear instances in which conditions of water stress affect livelihood expectations, destroy assets and alter rates at which people change residences on a temporary, seasonal, cyclical or permanent basis. Nevertheless, migrant networks and corridors are not new, and when water stress drives new patterns of migration, they usually fold into existing spatial, temporal, seasonal and economic patterns of migration. water stresses, such as drought, dry spells, and rainfall extremes, may accelerate migration patterns. However, migratory responses to water stress remain context-dependent and can vary from region to region. In addition, heat exposure can be identified as a stronger predictor of migration than drought, increasing climate variability or extreme rainfall and flooding. Finally, the studies discussed emphasized the strong link between institutional and policy failures on the water stress-migration link.

The results of these papers were geocoded and plotted on watershed sub-basin level maps as an indicator of the water crisis. The maps contrast the indicators to project changes in temperature degrees and annual cumulative precipitation in order to identify geographic disparities between existing water stress migration studies. Identifying these differences leads to the disclosure of the trigger points that demonstrate water stress-migration relationships. Despite the fact that the analytical findings discussed in this paper were enormous and the in-



formation provided in the review covered most aspects of social, economic, political and environmental changes and their influence on migration from different perspectives, they were not sufficient to provide a comprehensive illustrative of the global phenomenon of migration in association with climate variables especially in relation with water-stress. Although the papers analyzed in the review covered numerous countries, the annual projection of the population growth of each discussed community has been underestimated, leading to a lack of analytical views on which the paper is based. There could have been more effort put into linking the consequences of the migration with the actual time of study to insure the accuracy of the data and analytical discussion given.

In addition, the state of depending the geographic disparity on the number of reviewed papers in a particular community as an evidence of the greatest impact of massive rates of migration currently underway globally is not a scientific method followed that may indicate there is a possibility of existing other literary studies not written in the English language, which have covered part of the gap.

The reviewed paper acknowledges the positive impact of organized migrations, whether internal or external on development planning of both home and host countries, which was intensively covered as indicated through this report. In contrast, the paper only mentions five research papers that have covered aspects of irregular migrations (caused by natural disasters or civil or regional wars). Irregular migrations adversely affect all socio-economic, political and environmental perspectives of both home and host countries because of the influx of immigrants in huge numbers at once, not to mention the abandonment of people from their home and political instability. Furthermore, the lack of transparent data documenting the wars and their effects, and the lack of sufficient research in the time led to the imbalance of knowledge, which we saw in the report. There is a need for more research on these themes in order to build explicit strategies related to conflict over natural resources, conflicts and wars to be able to produce more balanced results. Despite this, however, a solution was offered in the discussion paper to overcome these obstacles by giving priority to research that uses spatially disaggregated time-series data generated from non-typical sources, such as mobile phones and social media activity.

The discussed paper offered an overview of what has been studied in relation to water and migration. The study, however, must be more specialized and compre-

hensive; that is, to include case studies and perhaps offer a follow up on the issues of water and migration by interviewing the affected migrants while involving all stockholders in future and further studies. More could also be done by looking at different patterns of human movement including internal or external migrations, regulated or unregulated migration, and draw recommendations accordingly by applying best practices for adaptation.

The paper concluded that changes in migration patterns, within countries and between countries, can be used as an indication of agricultural problems. Therefore, rural agricultural adaptation and livelihood diversification programmes (i.e. drought and heat tolerant crop varieties and sustainable intensification technologies) are given as possible examples for attenuating environmental stress as a determinant of migration. Rural agriculture adaptation, however, was never a solution, because in case of a water shortage, agriculture could not exist. For this reason, it is usually taken into consideration the the Water-Food-Migration nexus. However, this solution may be efficient if the root causes of migration is the youth unemployment. Moreover, a model for sustainable agriculture should be more specified.

Furthermore, to be able to define relationships between phenomena, one should base them on clear and direct indicators. For example, the use of the case of marriage movements of women as an indicator to prove that water scarcity contributes to furthering poverty as shown in the paper is not a reliable indicator. This indicator could be related to social or biological causes rather than environmental ones.

We find the reference made in the paper to migration as "adaptation" misrepresentative. For example, during last decades in which the migration has shown a peak, the principal causes for migration were wars, climate changes and economic crisis (youth unemployment). These three factors had different causes mainly poor governance (war and economic crisis), industrial activities causing pollution and thus inducing climate change. The paper does very little to discuss such causes and therefore does not address the roots of the problems but rather the results of such problems, water-stress and migration.

Moreover, the paper shows a huge empirical gap in the global coverage of water stress and human migration. It suggests that further hypothesis should be more detailed in systematic ways for predicting migration rates under different climate scenarios as well as to achieve a global contribution and update strategies in this concern. The socio-economic, policies and environmental



factors that shape the framework of each country differ among countries. The latter will result in insufficient evidence data to explain the magnitude of the change if no scientific regression is used based on statistical evidence for each country and linked it to the rate of annual migration.

Considering the multiple categories of the relationship between water scarcity and migration (sometimes cause and sometimes consequence), further study of this theme is recommended which takes into consideration the root causes of migration and water scarcity. Moreover, it is necessary to develop a model guide to cope with this phenomenon in order to urgently react to water scarcity and limit the impact of this eternal link between these two socio-environmental poles.

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