COMMENTARY

Agricultural Productivity, Health, and Climate Change: A Public Health Perspective

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INTRODUCTION

Anthropogenic climate change poses unprecedented threats to our planet and population. The average global temperature has increased by 0.4°C since the 1970s and is expected to increase by approximately 2 to 6°C by 2100. This change is primarily attributable to human production of greenhouse gases.[1,2] The evidence for, and mechanism of, this climate change is well-known and well-documented[2] and will therefore not be discussed here. Instead, this paper will provide an introduction to the health impacts of climate change; in particular, it focuses on the effects of changing agricultural productivity on malnutrition. The predicted outcomes of climate change—heat waves, extreme weather and changes in precipitation—will impact health in a number of ways, from increased pollen production exacerbating respiratory disease to an increased burden of malarial disease.[1,3-5] The global scale of these impacts demands a population-level response. Although there may be positive population health benefits from climate change, such as a decrease in winter-related deaths in temperate regions, it is predicted that the overall impact will be negative.[1] The severity of these outcomes is difficult to foresee, creating a serious challenge for policymakers trying to address these changes at a population level. The difficulty is further increased by the fact that climate change will disproportionately affect those with the poorest public health infrastructure.[5] That is to say, low- and middle-income countries (LMICs), despite contributing the least to greenhouse gas emissions, will face the greatest climate change-triggered public health challenges.[6]

Key Points

- Warmer temperatures and increased atmospheric carbon dioxide will result in increased agricultural production at high latitudes. The ensuing oversupply of food can exacerbate overnutrition and obesity.
- Drought, flooding, and desertification will result in decreased agricultural production at low latitudes. The ensuing decreased supply of food can worsen undernutrition and concomitant macro- and micronutrient deficiencies.
- Malnutrition (both over- and undernutrition) are major public health concerns. Thus, public health has a role to play in addressing climate change to avert these problems.
- Public health's roles, with respect to climate change and nutrition status, can include provision and interpretation of data concerning malnutrition and climate change; lobbying for health concerns to be considered in the creation of environmental policy; creation of emergency preparedness plans; and continuation of current strategies to address malnutrition.

EFFECTS OF CLIMATE CHANGE ON AGRICULTURE

One such challenge for public health is to reduce the impact of changing agricultural productivity. Although the health impacts of disrupted food production will not be as immediately obvious as, for example, increased hurricane activity, it is a major concern that requires attention now to prevent future famine.[3] The first step to addressing this challenge is to understand the hypothesized patterns of agricultural disruption, demonstrated in Figure 1. Climate change is predicted to affect crop production through four mechanisms: 1) increased temperature, improving yields in cooler climates and worsening yields in warmer climates; 2) changes in precipitation, through both drought and flooding; 3) increased atmospheric carbon dioxoide, which increases plant growth; and 4) increased sea level, which increases risk of flooding and decreases area of arable land.[7] Due to these changes, it is estimated that global cereal grain production will decrease between 2 to 4%, with food-insecure regions bearing the brunt of the decrease.[1] At low latitudes, even a 1 to 2°C increase in average temperature will have a

negative impact on cereal crop yields,[8] which currently account for approximately 50% of global food consumption.[9] Other changes that threaten crop production include the increased risk of drought, particularly in mid-latitude continental interiors, and the increased risk of flooding.[8] Crop production models based on the Intergovernmental Panel on Climate Change Special Report on Emission Scenarios data show cereal crop production increasing in high-income countries and decreasing in LMICs.[6,10] The discrepancy between crop production is explained by the current climate. With the exception of Central Asia and Eastern Europe, LMICs are located at lower latitudes and therefore already have warm climates. In these areas, increasing temperatures will move more quickly into a range that is not suitable for crop production. In addition, the economies of LMICs are more reliant on agriculture and thus at a greater risk of destabilization secondary to crop failure.[7]

CHANGING AGRICULTURAL YIELDS AND NUTRITIONAL STATUS

Through this decrease in cereal crop yields, climate change threatens to exacerbate undernutrition. The Food and Agricultural Organization estimates that, in 2007, 923 million people were undernourished worldwide, a major public health concern.[11] Global rates of undernourishment are expected to decrease from that estimate due to socio-economic development; however, models comparing hunger in futures with and without climate change show higher numbers of undernourished people in a future with climate change.[8,12] These models are thought to underestimate the impact of climate change on nutrition status, as they do not account for decreased micronutrient availability or the deleterious synergism between poverty and undernutrition.[13] This synergism threatens to undermine other social determinants of health. Undernutrition decreases human productivity and increases the risk of disease, further decreasing agricultural outputs and triggering a detrimental feedback loop. Changes in productivity also impact employment and time available for child care, while decreased access to food will trigger migration.[14] Sufficient nutrition depends on food security. Food security itself depends on four factors: food availability, ability to access food, stability of this access, and food utility. For example, a drought would decrease availability, lack of funds would decrease ability to access food, climate variation would decrease stability, and food contamination would decrease utility. Climate change could impact all four of these factors. For instance, decreased agricultural productivity in LMICs may lead to an increasing dependence on expensive imports and therefore a decreased ability for those with low incomes to afford adequate nutrition.[12]

At the opposite end of the spectrum, agriculture in cooler climates is expected to be improved by climate change.[7] This is not, however, as positive as it first sounds. A recent Lancet series on health and energy concluded that agricultural oversupply is a major cause of the obesity epidemic in the Western world.[15] Thus, increasing agricultural yields threaten to exacerbate the obesity epidemic that is linked to heart disease, stroke, diabetes and a number of other health concerns.[16] The overproduction of calorie-dense foods drives down prices, meaning that the poor are disproportionately affected, worsening health inequalities in high-income countries.[17] Public health interventions must therefore also

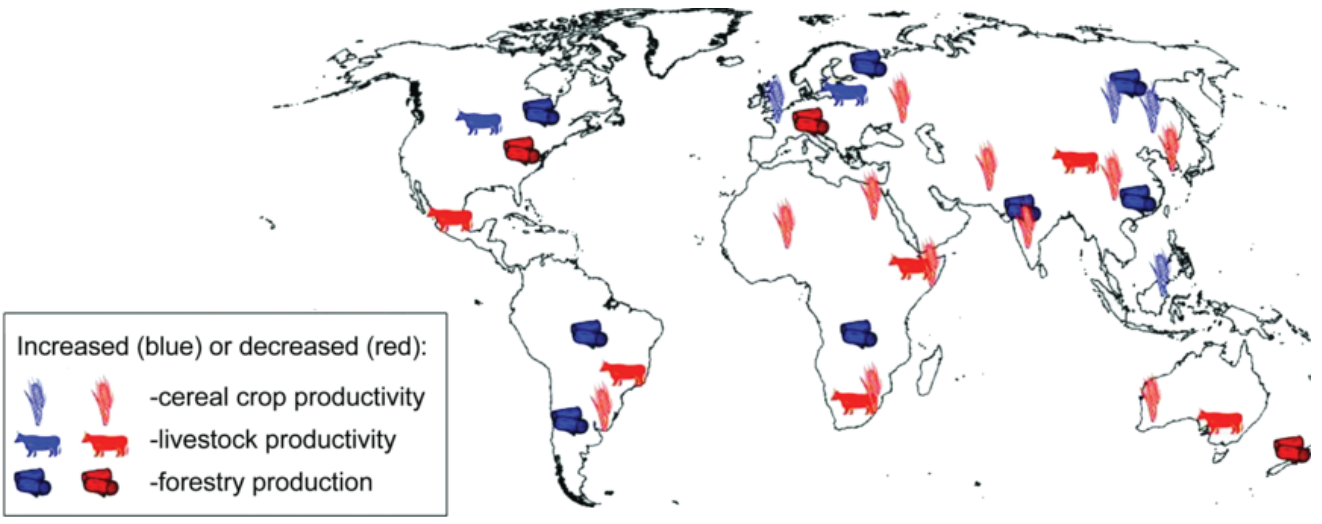

Figure 1. Major impacts of climate change on crop and livestock yields and forestry production by 2050 based on literature and expert judgement. Reproduced as per Intergovernmental Panel on Climate Change (IPCC) copyright from Reference 8, p. 302.

address agricultural oversupply.[15] Furthermore, increased agricultural activity threatens to worsen climate change: agricultural activity and land use produces about one-fifth of the total global green-house gas emissions,[17] most of which is attributable to livestock.[15]

CONCLUSION

In summary, climate change threatens to worsen malnutrition, through both under- and overnutrition. Unfortunately, identifying which public health concerns will be most impacted by climate change is stymied by a lack of evidence. There are numerous methodological barriers to assessing the impacts of climate change on health: reliance on projections and modelling, lack of a control group, and the massive geographical and temporal scale. Accumulating evidence based on the early health impacts of climate change is therefore essential.[18] The major role for public health is the provision and interpretation of health-related data in order to develop evidence-based environmental policy and emergency preparedness plans that adequately address health concerns.[3]

The World Health Organization states that malnutrition is "the single most important risk factor to global health,"[13] suggesting that this issue may be an appropriate place for public health to become involved in addressing the negative health impacts of climate change. Although most of the negative health outcomes attributable to climate change are speculative, implementing preventative programs generally confers less risk and is less costly than trying to address problems after they have developed.[3] Because climate change is expected to exacerbate current public health concerns rather than introduce new ones, public health strategies that focus on these health concerns will result in improvement no matter the degree of climate change.[19]

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Author Biography

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