An Ecoregional Perspective on Malnutrition

by Manohar Sharma, Lynn Brown, Aamir Qureshi, and Marito Garcia

In agrarian developing countries the natural environment is a key determinant of both poverty and nutritional status. Climate, terrain, and soil characteristics drive the agricultural system, determining in large part cropping patterns, choice of crops, yield rates, and overall productivity levels. The human resources crucial to agricultural productivity are also influenced by the natural environment. For example, conditions that encourage or mitigate the incidence and spread of disease have adverse effects on the health and nutritional status of rural families and in turn on their productivity.

To date, however, most studies on the location, magnitude, and distribution of poverty are for individual countries or other administrative entities that do not necessarily coincide with ecoregional boundaries. Poverty, which manifests itself in high incidences of malnutrition, is a serious problem in some regions, especially Sub-Saharan Africa and South Asia. That living standards vary widely within regions is well known, but do some of these variations have their origins in agroecological differences?

What Are Ecoregions?

The Consultative Group on International Agricultural Research (CGIAR) is placing priority on developing a concept of ecoregional zones based on the premise that agroecological conditions largely determine the production potential and the size of population that an area can support in the developing world. Building on earlier work by the Food and Agriculture Organization of the United Nations, the CGIAR has developed a classification system of nine agroecological zones (AEZs) based on mean daily temperature during the growing season and the number of days when moisture and temperature permit crop growth. (The AEZs are listed in Figure 1.) When these AEZs are superimposed on the four major geographic regions of the developing world--Asia, Latin America and the Caribbean, Sub-Saharan Africa, and West Asia/North Africa--they are referred to as "ecoregions." (Because Asia includes such large populations, it is divided for this analysis into two subregions, Asia and the Pacific and South Asia.) Understanding the ecoregional dimensions of poverty and malnutrition potentially could be a major step forward in alleviating poverty sustainably by the year 2020 because it may help to target scarce resources more effectively.
Figure 1—Malnutrition by ecoregions: prevalence of underweight preschool children by regions and agroecological zones, 1990

Percent Below -2 Standard Weight-for-Age

Sub-Saharan Africa
- Warm semi-arid (T)
- Warm sub-humid (T)
- Cool (T)

West Asia/North Africa
- Warm semi-arid (T)
- Cool (T)
- Cool (S,T) (WR)

Asia and the Pacific
- Warm semi-arid (T)
- Warm sub-humid (T)
- Warm humid (T)
- Warm semi-arid (ST) (SR)
- Warm sub-humid ST (SR)
- Warm/cool ST (SR)
- Cool ST (SR)

South Asia
- Warm semi-arid (T)
- Warm sub-humid (T)
- Warm humid (T)
- Warm semi-arid (ST) (SR)
- Warm sub-humid ST (SR)
- Warm/cool ST (SR)
- Cool ST (SR)

Latin America and the Caribbean
- Warm semi-arid (T)
- Warm sub-humid (T)
- Warm humid (T)
- Cool (T)
- Warm semi-arid (ST) (SR)
- Warm sub-humid ST (SR)
- Warm/cool ST (SR)
- Cool ST (SR)
- Cool ST (WR)

All developing countries
- AEZ1: Warm semi-arid (T)
- AEZ2: Warm sub-humid (T)
- AEZ3: Warm humid (T)
- AEZ4: Cool (T)
- AEZ5: Warm semi-arid (ST) (SR)
- AEZ6: Warm sub-humid ST (SR)
- AEZ7: Warm/cool humid (ST) (SR)
- AEZ8: Cool ST (SR)
- AEZ9: Cool ST (WR)

Notes: T is tropics, ST is subtropics, SR is summer rainfall, and WR is winter rainfall. The U.S. National Center for Health Statistics standards are used here.
The results presented here represent an initial attempt to map the worldwide distribution of poverty, as indicated by the prevalence of underweight children across ecoregions. Although this work is still in an early stage and the eco-regional mapping is incomplete, all of the countries in the developing regions have been assigned to one or more AEZs.

**Ecoregional Dimensions of Malnutrition**

Malnutrition is one of the most reliable indicators of endemic poverty. Using data compiled by the United Nations Administrative Committee on Coordination/Subcommittee on Nutrition (ACC/SCN) and the World Health Organization (WHO), IFPRI is exploring the geographic, agroecological, and ecoregional dimensions of the prevalence of childhood malnutrition among children 0 to 60 months of age.

Overall, 34 percent of the population in developing countries is malnourished. The incidence of malnutrition varies by geographical regions from a low of 10 percent in Latin America and the Caribbean to a high of 60 percent in South Asia. At the AEZ level, the variation is not as wide, ranging from 17 percent in the cool subtropics with winter rainfall (AEZ9) to 49 percent in the warm semi-arid tropics (AEZ1), a zone encompassing very large areas of Asia (149 million hectares) and Sub-Saharan Africa (1,246 million hectares). The extent of malnutrition in an AEZ varies greatly from one geographic region to another, however. For example, 63 percent of the children in the warm humid subtropics with summer rainfall in South Asia are malnourished, compared with just over 1 percent for the same AEZ in Latin America and the Caribbean. This indicates that the effects of the natural environment on welfare are significantly modified by socioeconomic factors such as the level of technology adopted, the social organization of resource management, and demography. In Latin America and the Caribbean region, per capita incomes are higher than in any other geographic region, and the incidence of malnutrition is consistently lower across all AEZs.

Whereas the warm humid tropic zone (AEZ3) has the highest productivity in agricultural output per hectare overall, the incidence of malnutrition is also relatively high at 37 percent. Ecoregionally, AEZ3 in South Asia has the highest rate of malnutrition at 65 percent (Figure 1). This estimate of malnutrition corresponds closely to an estimate that 70 percent of this ecoregion's population lives below the poverty line. The most fertile tracts of land attract the highest population densities so that the rich natural resource base is spread thinly across the population. Even in Latin America and the Caribbean, despite relatively higher incomes, malnutrition in the warm humid tropical zone is relatively high at 10 percent, compared with just 2 percent in the cool subtropics.

In addition to population densities, an important modifying factor in the warm humid tropical zone is the interaction between the natural environment and health and nutrition where diseases such as malaria and human trypanosomiasis are endemic. The combination of thinly spread resources and a relatively high prevalence of disease leads to a high rate of malnutrition, despite the well-endowed natural resource base.
Data across AEZs show that the cool tropics (AEZ4) have relatively less malnutrition than the warm tropics, even though they are close to the bottom of the agricultural productivity ladder. At the ecoregional level, however, research indicates that in every geographic region that has a cool tropics zone—Sub-Saharan Africa, Latin America and the Caribbean, and West Asia/North Africa—the incidence of malnutrition in the zone is among the highest for any AEZ in that geographic region. In West Asia/North Africa, for example, where the cool tropics include Yemen, the share of malnourished children is 53 percent. In Latin America and the Caribbean, where the cool tropics include countries like Bolivia, Colombia, and Ecuador, the prevalence of malnutrition is 14 percent—higher than any other AEZ in that region. Among all the AEZs, per capita availability of arable land is lowest in the cool tropics. The reason for this apparent contradiction between low prevalence rates of malnutrition in the cool tropics when only AEZs are examined and high relative rates in those geographic regions that have cool tropic zones is clear in Figure 1, which shows that the high rates of malnutrition and the large populations in South Asia are overwhelming. They tip the balance toward the AEZs in that region—the warm semi-arid tropics and subtropics—and away from the cool tropics, which do not occur at all in South Asia.

The observation that the prevalence rates of malnutrition tend to be lower in the cool subtropics (AEZs 7, 8, and 9) is borne out at the ecoregional level for every ecoregion. Even in South Asia where, at 54 percent, the incidence of malnutrition is high in the cool subtropics zone (AEZ8), it is still lower than that of any other AEZ in the region. In Asia and the Pacific, malnutrition probably occurs in AEZs 7 and 8 because some parts of this region are mountainous, which severely constrains intensive cultivation.

There is very little variation in the prevalence rates of malnutrition across AEZs in the Sub-Saharan Africa and South Asia regions, the two regions that are home to the largest shares of the world's poor, indicating again that socioeconomic factors, especially those related to population, may be even more important than environment-related factors in determining malnutrition outcomes.

**Ecoregional Analysis Improves Targeting**

The linkages between agricultural productivity and nutrition found at the agroecological zone level are largely borne out at the ecoregional level. The warm semi-arid tropics (AEZ1), the warm subhumid tropics (AEZ2), and the cool tropics (AEZ4) have experienced the smallest increases in land and labor productivities and the highest prevalence rates of malnutrition, and they are dominated by Asia and Sub-Saharan Africa where agricultural productivity is relatively low.

There are clearly discernible links between the natural environment, agricultural productivity, health, and nutritional status. Use of an ecoregional dimension to explore the incidence of malnutrition exploits these linkages. Analysis at the ecoregional level suggests that targeting of scarce resources to address the problems of poverty and malnutrition could potentially be improved by 2020 by taking into consideration these linkages between ecoregional characteristics and poverty.
Manohar Sharma and Lynn Brown are research analysts and Aamir Qureshi is a research assistant at IFPRI. Marito Garcia is an economist at the World Bank.

"A 2020 Vision for Food, Agriculture, and the Environment" is an initiative of the International Food Policy Research Institute (IFPRI) to develop a shared vision and consensus for action on how to meet future world food needs while reducing poverty and protecting the environment. Through the 2020 Vision initiative, IFPRI is bringing together divergent schools of thought on these issues, generating research, and identifying recommendations. The 2020 Briefs present information on various aspects of the issues.