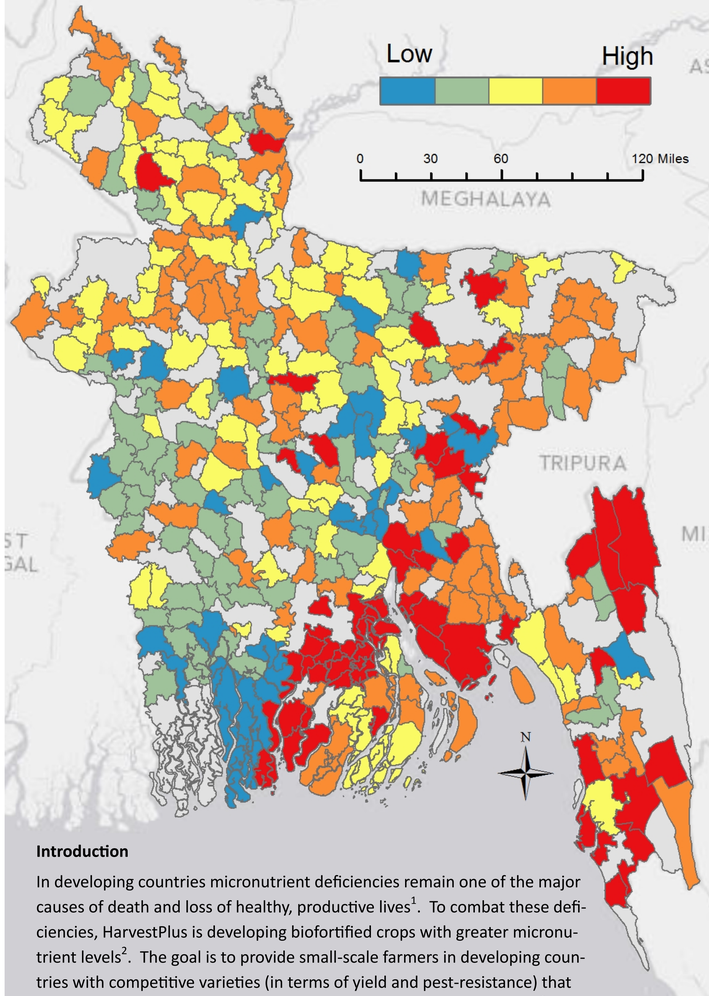
Prioritizing Areas for Implementation of Biofortified Rice in Bangladesh

Nutr 231: Fundamentals of GIS
Poster Produced: May 2, 2014
Cartographer: Keith Lividini

Projected Coordinate System:
WGS_1984_UTM_Zone_46N

Geographic Coordinate System:
CGS_WGS_1984



Introduction

In developing countries micronutrient deficiencies remain one of the major causes of death and loss of healthy, productive lives[1]. To combat these deficiencies, HarvestPlus is developing biofortified crops with greater micronutrient levels[2]. The goal is to provide small-scale farmers in developing countries with competitive varieties (in terms of yield and pest-resistance) that have higher micronutrient levels capable of increasing daily adequacy[3].

HarvestPlus has developed a biofortified, high-zinc rice (HZR) for Bangladesh, a country which has high deficiencies of zinc and iron[4]. The purpose of this analysis is to prioritize areas for implementation of HZR in Bangladesh.

Methodology

The prioritization of areas for implementation of HZR was based on two primary factors: 1) production and consumption conditions conducive to implementing HZR, and 2) poor overall health status related to zinc deficiency.

1. Determining the conditions conducive to implementing HZR was based on production and consumption patterns and the probability of adopting a high yield variety of rice in the two primary planting seasons (Aman and Boro). These layers are contained in the **red outlined box along the bottom.**

A. Total annual rice production as well as the proportion retained for home consumption was calculated at the household level[5].

B. Households were ranked based on factors that determined the likelihood of adopting a high yield variety of rice in Aman and Boro seasons[6].

C. Total daily rice consumption was calculated for individuals[7].

These variables were averaged across subdistricts and scored ranging from low to high. Low score was given to low production, low proportion retained, low likelihood of adoption, and low consumption. High score was given to high production, high proportion retained, high likelihood of adoption, and high consumption. The scores for these layers were combined to produce the 'Favorable Production and Consumption Conditions' map.

2. Determining areas with poor overall health status related to zinc deficiency was done by combining health statistics related to zinc deficiency. These layers are contained in the **blue outlined box along the right.**

A. The prevalences of acute respiratory infections (ARI) (used as a proxy for pneumonia), diarrhea and stunting were calculated[4] and mapped at the level of the survey cluster.

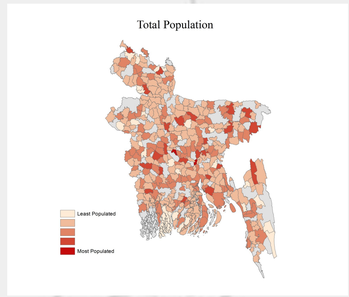
B. Under 5 mortality rates by subdistrict[8] were mapped by subdistrict.

C. The prevalence of inadequate zinc intake was calculated for individuals and mapped by subdistrict[7].

The prevalences of acute respiratory ARI, diarrhea and stunting were averaged across division before scoring. All indicators were then scored, assigning low score for lower prevalences and mortality rates and high scores for higher prevalences and mortality rates. These layers were combined to produce the 'Health Status' map. The 'Health Status map and 'Favorable Production and Consumption Conditions' maps were then combined into the 'Production and Health Intersection' map to determine the intersection of poor health and favorable implementing conditions. The 'Total Population' map was created[5] to prioritize areas with greater population. Total population at the subdistrict level was scored (high score for greater population) and combined with the 'Production and Health Intersection' map to determine the priority areas for implementing biofortification.

Conclusion

Subdistricts within the divisions of Barisal and Chittagong in the southeast should be examined more closely for prioritizing implementation. While these areas are not the largest producers of rice, they demonstrate the poorest health conditions related to zinc deficiency, consume rice primarily from own production, and have a high likelihood of adopting high yield rice varieties. While greater production of rice occurs within subdistricts in the northwest divisions of Rajshahi and Rangpur, a large proportion of rice production is sold. More information is needed to determine how much of that production is sold to Barisal and Chittagong vs. subdistricts within neighboring divisions Khulna and Dhaka where health outcomes related to zinc deficiency are not as poor. If the proportion is low, then subdistricts in Barisal and Chittagong should be prioritized first for implementation, followed by those within Rajshahi and Rangpur divisions in the northwest and Sylhet in the northeast.



A few limitations should be noted. First, only subdistricts for which information on each variable was available were used in this analysis. This resulted in data for 331 of 463 subdistricts. Second, rice is consumed throughout all of Bangladesh. Households primarily either produce it themselves or buy it. Households that produce a lot also sell a lot. Therefore, different approaches can be taken for determining favorable production/consumption conditions and may yield different results. Third, while information on U5 mortality and inadequate intake was available at the subdistrict level, information on stunting, ARI, and diarrhea was available at the cluster and division level. Because it was not possible to match the clusters to the subdistricts, these data were averaged across divisions, thereby diluting the health results. Finally, while the health data were weighted according to survey design, production and consumption information was presented as unweighted averages.

Sources and Citations

1. Lim SS, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: A systematic analysis for the Global Burden of Disease Study 2010. The Lancet 2012;380:2224-2260.
2. Saltzman, A., E. Birol, H.E. Bouis, E. Boy, F.F. De Moura. Y. Islam, and W. Pfeiffer. 2013. "Biofortification: Progress toward a more nourishing future". *Global Food Security* 2(1): 9-17.
3. Bouis, H.E., C. Hotz, B. McClafferty, J.V. Meenakshi, and W.H. Pfeiffer. 2011. "Biofortification: A new tool to reduce micronutrient malnutrition". *Food and Nutrition Bulletin* 32 (Supplement 1): 31S-40S.
4. National Institute of Population Research and Training (NIPORT), Mitra and Associates, and ICF International. 2013. *Bangladesh Demographic and Health Survey 2011.* Dhaka, Bangladesh and Calverton, Maryland, USA: NIPORT, Mitra and Associates, and ICF International.
5. The Bangladesh Household Income and Expenditure Survey 2005. Accessed from http://www.bbs.gov.bd/Home.aspx.
6. Fiedler JL and Lividini K. 2014. Assessing Bangladesh's Zinc Program Portfolio Options, 2013-2042. Report prepared for the Bill and Melinda Gates Foundation.
7. Bermudez OI, Lividini K, Smitz MF, Fiedler JL (012) Estimating micronutrient intakes from HIES: An Example using the Bangladesh 2005 Household Income and Expenditure Survey. Food Nutr Bull, Supplement 2: 208-213.
8. UNICEF. Under 5 Mortality Rate By Upazila, 2009. Access from http://www.unicef.org/bangladesh/knowledgecentre_6317.htm

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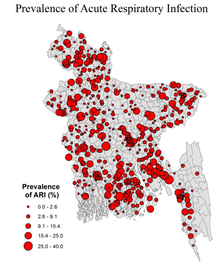
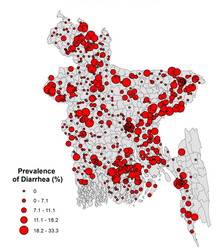
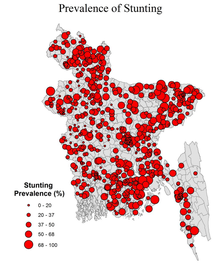
Prevalence of Acute Respiratory Infection



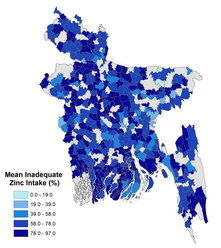
Prevalence of Diarrhea



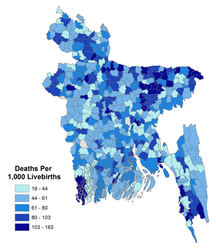
Prevalence of Stunting



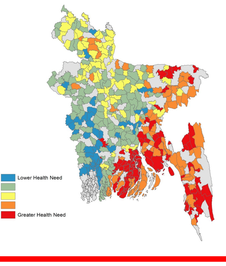
Inadequate Zinc Intake



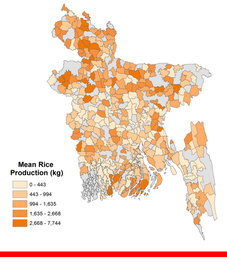
Under 5 Mortality Rate



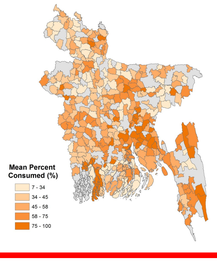
Health Status



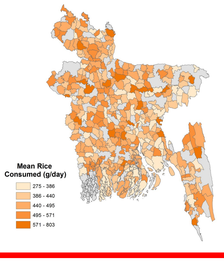
Average Annual Rice Production



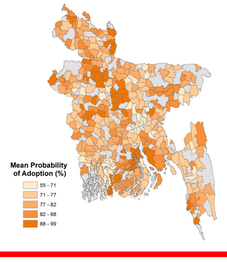
Percent of Annual Rice Production Consumed



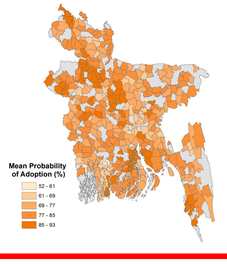
Average Daily Consumption



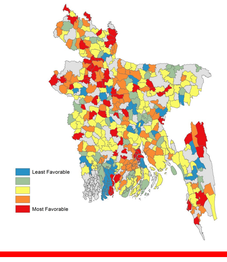
Probability of Adopting in Boro Season



Probability of Adopting in Aman Season



Favorable Production and Consumption Conditions



Production and Health Intersection