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## **A spatial perspective to introducing biofortified staple food crops in Colombia**

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## Abstract

Micronutrient malnutrition affects 2 billion people worldwide and biofortification—the process of breeding and delivering staple food crops with higher micronutrient content— could prove to be a cost-effective strategy for its alleviation. There is, however, a dearth of information on where and in which crop-micronutrient combinations to invest for this strategy to be most effective and yield the highest impact. To fill in this gap, a global biofortification index (BPI) was developed (Asare-Marfo et al., 2013). It is based on three sub-indexes, namely production, consumption, and micronutrient deficiency, all developed with subnational-level representative data. The Global BPI, however, is not granular enough to suggest within country investment opportunities for biofortification. In this paper we develop a methodology for a subnational-level BPI, using Colombia as a case study. In order to guide strategies for geographic targeting and intervention within country, we set statistical conditions for each sub-index and classify geographic targeted areas as areas of: (1) impact and intervention, (2) impact, or (3) intervention. To further identify geographic areas for intervention, a spatial interaction index derived from an economic gravity model is used. This spatial interaction index helps to identify and link food-surplus and food-deficit areas. Our empirical results show that crops biofortified with zinc, namely white maize and rice, should be introduced in the North Coast of Colombia; crops biofortified with vitamin A, namely yellow maize and cassava, should be introduced primarily in the Atlantic and Amazon regions of the country. Introduction of iron-biofortified beans in the Andean region, especially Tolima and Antioquia, could have the greatest impact. Finally, we also estimate area- or population-weighted subnational BPIs, which, depending on the objective, takes into account the intensity of crop production as well as the proportion of people at risk of micronutrient deficiency.

**Keywords:** biofortification, subnational BPI, food balance sheet, spatial interaction index

## 1. Introduction

Despite its upper middle income status and the existence of nutrition programs like fortification (e.g. fortified wheat flour), supplementation, and nutrition education over the last 15 years, Colombia still faces social inequalities and health challenges, including a high prevalence of micronutrient malnutrition<sup>1</sup>. The latest report from the National Survey of Nutritional Situation (ENSIN 2010) shows that approximately 18 percent of Colombian children aged under 5 and 25 percent of women of childbearing age (15 – 49 years) suffer from anemia; 25 percent of children under 5 are living with vitamin A deficiency, as defined by a plasma retinol concentration less than 0.7  $\mu\text{mol/L}$  (WHO, 2009); and, as high as 50 percent of children under 5 suffer from zinc deficiency. Within Latin America, Colombia ranks as a medium priority country for intervention with biofortified staple food crops. According to the global Biofortification<sup>2</sup> Prioritization Index (BPI)<sup>3</sup> it ranks seventh in zinc-cassava, twelfth in zinc-rice, and thirteenth in high-iron beans.

The main aim of this paper is two folds: (1) to bridge the geographic-scale gap for geographic targeting of biofortified crops from national to subnational level based on a subnational biofortification crop-micronutrient index (BPI) and (2) to guide strategies for spatial targeting/intervention with biofortified staple food crops by exploring geographical differences in the demand of crop  $j$ , the areas of production of crop  $j$ , and the areas with high prevalence of micronutrient deficiency. For the latter, geographic areas were classified as: (1) *areas of impact and intervention* or “hot spots”— these are areas with high consumption, high production, and high micronutrient deficiency; (2) *areas of impact* are areas with high consumption and high risk of micronutrient deficiency but with low or no production; (3) *areas of intervention* are zones, under the assumption that impact will take place on neighboring deficit zones, with high production but have low risk of micronutrients deficiency and low or no crop consumption. The third scenario becomes important in fast-urbanizing countries<sup>4</sup> where there exist large flows of staple food crops from rural to large urban markets. This study fills the gap in the global BPI in three dimensions:

1. To do a fine-grained spatial assessment, this paper explores geographical differences in crop production, consumption, and micronutrient deficiency at subnational level.
2. To model flows of staple food crops between food-surplus areas and food-deficit neighbors, the paper introduces a spatial interaction index derived from an economic gravity<sup>5</sup> model for rice.
3. We propose five micronutrient-crop combinations at department level based on the subnational BPI index. These include: vitamin A-cassava, zinc-rice, vitamin A-yellow maize, zinc-white maize, and high iron-beans. In this paper we present a review of the empirical results for zinc-rice.

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<sup>1</sup> Its causes are multifactorial and include poor quality diets, characterized by a high intake of staple foods and low consumption of micronutrient-rich foods.

<sup>2</sup> It is a new biological (agricultural mechanism) innovation. It is the process of breeding staple food crops with higher micronutrient content with additional traits i.e. yields. A cost-effective innovation to reach malnourished populations in rural and urban vulnerable population.

<sup>3</sup> BPI is a micronutrient-crop-country specific index that ranks countries as a function of three variables: consumption, production, and micronutrient deficiency (Asare-Marfo et al. 2013). The global BPI was developed by HarvestPlus, a global convener program on biofortification.

<sup>4</sup> Today, a great majority of the world’s rural population lives in Asia (69 percent), followed by Africa (19 percent). LAC hosts only four percent of the world’s rural population that might have insufficient access to nutritious food. Among the developing regions, LAC has an exceptionally high level of urbanization (79 percent). This figure is significantly higher than those for Africa and Asia, as well as Europe (United Nations, 2011).

<sup>5</sup> There exists a fair amount of empirical literature that examines bilateral flows of commodities; common methods used include multiregional partial/general equilibrium models (Arguello R, 2009) and economic gravity models.

The remainder of the paper is organized in four sections: section II sets a general overview of the spatial distribution of production, consumption and domestic trade of staple food crops; section III provides methodological background and data used; section IV reviews the estimation results and discussion; and section V concludes.

## **2. Spatial distribution of population, production, consumption, domestic trade of staple food crops and micronutrient deficiency in Colombia**

**Population distribution**<sup>6</sup> is an essential determinant in planning and policymaking in order to better understand economic activity, food crop production, regional trade, consumption patterns, and welfare needs. We start with the spatial distribution of economic activity. As an upper middle-income economy, Colombia's gross domestic product (75 percent) is concentrated in four major hubs<sup>7</sup>: Bogota, Cali, Medellin, and Barranquilla located in the Andean highlands and valleys and the Caribbean lowlands, respectively. These cities represent major markets for HarvestPlus' biofortified staple food crops and areas of impact due to (1) the high prevalence of micronutrient deficiency in both children under 5 and women of childbearing age and (2) the level of staple food crop consumption. These major urban centers are connected with each other through primary roads (Andean highlands) and interconnected to rural areas<sup>8</sup>—where the majority of the population is engaged in crop production—through secondary/feeder roads (Fig. 1 (b)). Figure 1(b) provides the geographic extent of city centers with more than 100,000 people as marketsheds<sup>9</sup>. Darker and smaller polygons represent marketsheds of the largest agglomeration, such as the cities of Cali, Bogota, Medellin, and Barranquilla that feature high population density and reasonable travel times by road. Lighter colors represent marketsheds of smaller population centers with lower economic activity (population density) and longer travel times by road.

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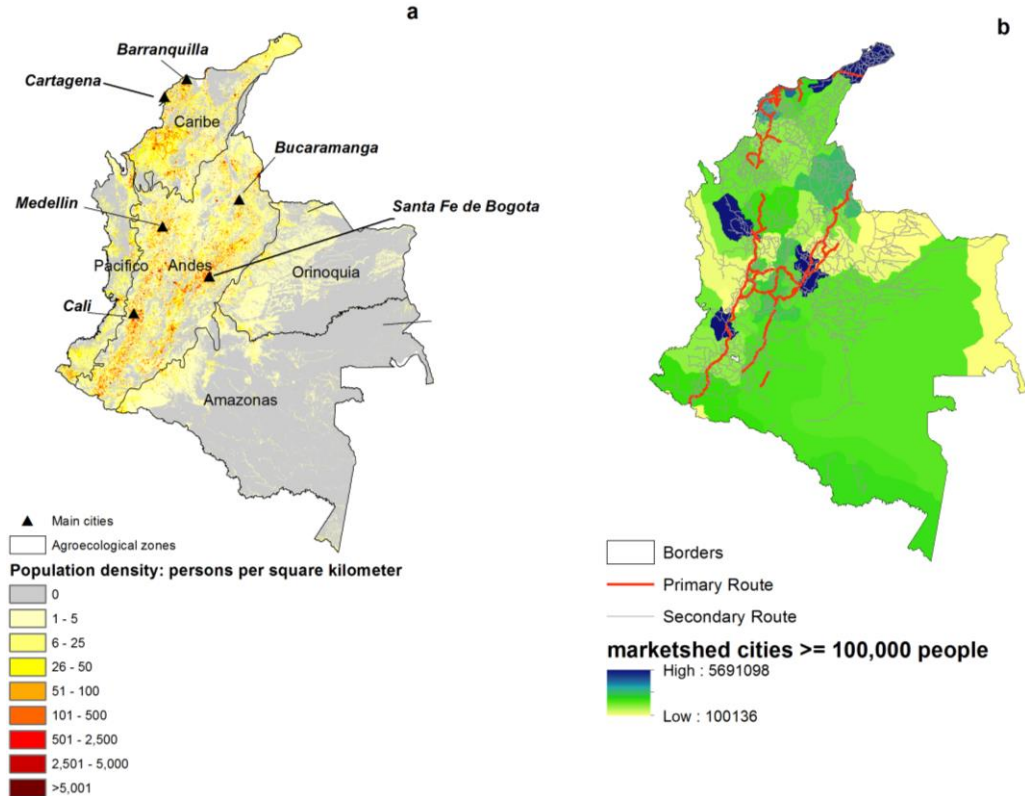
<sup>6</sup> Population statistics: 2011 population projections, based on 2005 population census, at municipality level were used for our analysis (DANE, 2011).

<sup>7</sup> Colombia is a highly urbanized country where 75 percent of the population lives in cities (DANE –ENA 2011, UN 2012, Samad et al. 2012).

<sup>8</sup> The Pacifico region seems to be the least connected; most of inter and intra agricultural trade occurs through its river network. Farmers in these regions face high transportation costs, depending heavily on middlemen (PYMES, 2000). Recent studies (Samad et al. 2012) have revealed that economic distances exacerbate physical distances in Colombia where the transportation cost of goods within regions and connection between cities tend to be higher than international fares.

<sup>9</sup> The marketshed geographic boundaries definition includes the following variables: road type and condition, slope, land cover, rivers, borders, elevation and water bodies.

Figure 1. (a) Agroecological zones and population density, (b) marketshed and road network.



Source: Landscan 2009.

**Food crop production** varies across Colombia due to different agroecological zones<sup>10</sup> and market demand. Figure 3 shows the share of crop production by elevation and proximity by road to cities greater or equal than 100,000 inhabitants. To explain food production across different agroecological zones, we used elevation as a proxy of rainfall and temperature regimes, which are both key variables in the definition of agroecological zones. Rice production<sup>11</sup> is concentrated in areas between the first (<100 meters above sea level) and fourth deciles (average 700 meters) (almost 90 percent of the total rice production); after the third decile, the intensity of production decreases. Areas of rice production from the fifth decile (average 1,000 meters) onward decreases smoothly until it reaches zero production in the eighth decile (2,131 meters) probably due to either less suitable areas or land competition with cash crops like coffee, beans, urban settlements or other valuable highland crops.

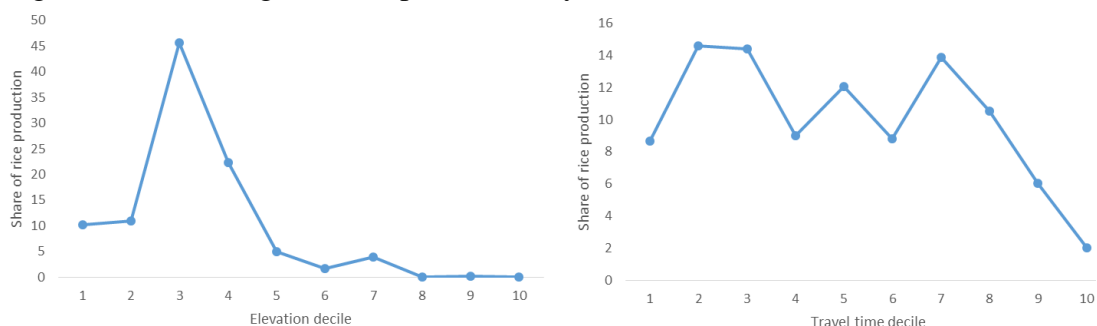
We now look into the linkage between the market demand of staple food crops (rice) and the geographic proximity to supply areas. To do so, we examine the relationship between road connectivity (measured as travel time), rice production, and population distribution as shown in figure 2. Forty percent of rice production comes from areas located in the first three deciles, on average areas located less than 3 hours away to well-connected markets in dense towns/cities

<sup>10</sup> Colombia can be divided into four agro-ecological zones: the Andean highlands, the Caribbean lowlands coastal region, the Pacific lowlands region, and eastern (Orinoquia y Amazonas) Colombia. In this paper we use elevation as a proxy for agro-ecological zones to show the spatial distribution of production.

<sup>11</sup> There are two rice production systems: mechanized and manual. Mechanized accounts for 90 percent of the national area and 99 percent of the national volume of production. The main crop is planted from January to June and accounts for two thirds of annual acreage and output. The secondary or second semester crop is planted from July to December.

(cropland-labor ratio increases from 75 m<sup>2</sup> in the first decile to 550 m<sup>2</sup> (maximum) in the fourth decile).

Figure 2. Share of agricultural production by elevation and travel time



Source: Authors' calculations.

**Food consumption –rice.** Overall at national level, urban per capita consumption for rice was higher than rural consumption (43 kg/year vs 38 kg/year). Looking closer at consumption across regions, the Pacifica region (60 kg/year) followed by Atlántida (56 kg/year) had the highest urban per capita consumption. Atlantica (50 kg/year) and Pacifica (39 kg/year) also had the highest consumption in rural areas. Given the spatial heterogeneity of consumption, production, and food availability, we provide an illustrative example of potential commodity flow.

**Micronutrient deficiency indicators.** The target population is approximately 10 percent of the total population, which include rural women of childbearing age (15 – 49 years) and rural children aged 0 – 4 years. **Zinc:** sub-regions with the highest prevalence of zinc deficiency include Litoral Pacific and Amazonia and Orinoquia with 64.5 percent and 60.4 percent, respectively. In Atlantica, the sub-regions of Guajira, Cesar, and Magdalena have a prevalence of 57 percent.

### 3. Conceptual framework and linear transformation

To assess suitable areas for biofortified staple food crop interventions, we adopt the global BPI conceptual framework, with slight modification, which accounts for three factors: the supply of crop  $j$ , the demand of crop  $j$ , and synthetic measures of population health such as micronutrient deficiency indicators in HarvestPlus' target population. The three components are represented as sub-indexes. They are then combined to form a composite subnational BPI crop-micronutrient index.

The final BPI is calculated as:

$$\text{Biofortification Priority Index (BPI)} = \sqrt{\text{Micronutrient Deficiency Index} * \sqrt{(\text{Production Index} * \text{Consumption Index})}} \quad (1)$$

Similar to the global BPI and human development index (HDI) (UNDP, 2013), we use geometric mean. The main reason is that the presences of all of the three indices are necessary for biofortification interventions to have a measurable impact. In other words, these sub-indexes should complement, rather than substitute for, one another. Below we provide details for each model or sub-index.

On the supply side, the relative importance of the crop  $j$  depends on the per capita area harvested (cropland-labor ratio) and the share of agricultural land allocated to crop  $j$ . The basic model for the production of crop  $j$  is:

$$\text{Production index}^{12} = [1/2 * \text{per capita area harvested}^r] + [1/2 * \text{share of agricultural land allocated to the crop}^r] \quad (2)$$

Per capita area harvested measures the factor intensity or the average number of square meters per habitant. It roughly informs us about the endowment of both factors, i.e. capital and cropland. A high cropland-labor ratio implies abundance of cropland and scarcity of labor; a low ratio means the opposite. The share of agricultural land allocated to the crop measures the relative importance of a particular crop in the agricultural sector. With a large cropland area devoted to a particular crop, economies of scale can be realized for the investment that will be made in breeding, seed multiplication, delivery, marketing, and information diffusion. Production statistics came from two data sources: the annual evaluation of agriculture and livestock of municipalities 2011<sup>13</sup> produced by the Ministry of Agriculture, and the food balance sheet produced by FAO.

On the demand side, the consumption sub-index measures the intensity of consumption of the specific crop in both rural and urban geographies. The higher the per capita consumption of a crop, the easier it is to improve target populations' micronutrient intake through biofortification of that crop. Consider the consumption for two geographies, rural and urban;  $C_g$ ,  $g=1, 2$ , respectively. The consumption index at department  $i$  then follows as:

$$\text{Consumption Index} = \sum_{g=1}^G C_g * \frac{P_g}{P_{total}} \quad (3)$$

Demand for crop  $j$  in geography  $g$  depends on (1) the size of the local market, per capita consumption, income distribution, and the potential domestic trade or commodity flow from surplus to deficit areas. Therefore, of interest was to model flows of crops in Colombia as specified in the last part of this section. Consumption statistics came from two sources: the ENSIN 2010 survey that provides per capita food consumption statistics at subnational level and the FAO's food balance sheet 2009 that provides a national summary of the patterns of Colombia's food supply and utilization for 2009.

The synthetic cohort measures of micronutrient deficiency aim to assess the extent of micronutrient deficiency at subnational level. Three separate indices are computed for each micronutrient. To assess the nutritional state in Colombia,<sup>14</sup> statistics on micronutrient deficiency and prevalence of food group consumption were obtained from ENSIN 2010. The survey is nationally, regionally (6 regions) and departmentally (32 departments) representative. It is also representative of urban and rural areas. Thus, the zinc micronutrient deficiency index includes: percentage of population at risk of inadequate intake of zinc (children 1-4 years < 65 mg/dL), and, prevalence of stunting among children 6-59 months of age. The overall formula is below:

$$\text{Micronutrient Index (Zinc)} = 1/2 * \text{Prevalence of Zinc deficiency}^r + 1/2 * \text{Stunting prevalence}^r \quad (4)$$

<sup>12</sup> The equation with the superscript  $r$  indicates that the variable is rescaled using equation 6.

<sup>13</sup> <http://www.agronet.gov.co/agronetweb1/Estad%C3%ADsticas.aspx> (accessed on 01/22/2014).

<sup>14</sup> <http://www.icbf.gov.co/portal/page/portal/PortalICBF/NormatividadC/ENSIN1> (accessed on 09/03/2013).



Complementary to the subnational BPI, we classify target areas as: (1) areas of impact and intervention or “hot spots” – these are areas with high consumption, high production, and high micronutrient deficiency; (2) areas of impact, with high consumption<sup>15</sup> and high risk of micronutrient deficiency, but with low or no production; and (3) areas of intervention—these are zones, under the assumption that impact will take place on neighbors’ deficit zones, with high production but have low risk of micronutrients deficiency and low or no crop consumption.

We estimate aggregate measures of potential commodity flow between areas of intervention (crop production in location  $i$ ) and areas of potential impact (areas with high micronutrient deficiency levels and markets surrounding location  $i$ )<sup>16</sup>. The basic assumption is that commodity flows are a function of (1) the demand for crops in the locations of destination, (2) the supply of crops in the locations of origin, and (3) the friction of distance (transportation cost) between origin and destination (s)<sup>17</sup>.

Thus, we generalize as the single equation below:

$$\text{Spatial Interaction Index } ai = \sum_{j=1}^n \sum_{k=1}^m \frac{Q_{sai} * Q_{dajk}}{D_{ij}^b} + \frac{(Q_{sai} - Q_{dajk}) * Q_{daj(k+1)}}{D_{ij}^b} + \frac{(Q_{sair} - Q_{daj(k+1)}) * Q_{da(j+1)(k)}}{D_{ij+1}^b} + \dots + (5)$$

where the subscript  $i$  pertains to an excess surplus of crop  $a$  in a producing department. The excess supply  $Q_{sai}$  at department  $i$  is the difference after fulfilling its own crop demand (food, seed, and feed). This excess supply  $Q_{sai}$  is shipped to potential deficit areas, i.e. municipality  $k$  within neighbor department  $j$ , with excess crop demand  $Q_{dajk}$ . The excess demand  $Q_{dajk}$  at municipality  $k$  is the difference after consuming its own crop supply.  $Q_{sari}$  is the residual value, obtained after the first loop, of subtracting  $Q_{dajk}$  from  $Q_{sai}$ .  $D$  is the Euclidean distance  $D$  between  $i$  and  $j$  adjusted by exponent  $b$ . The Euclidean distance is adjusted by exponent  $b$  to reflect the influence of distance as a function of other factors such as road infrastructure, transportation mode, and terrain conditions<sup>18</sup>. Thus, the department-crop specific interaction index combines its excess surplus crop production  $Q_{sai}$  multiplied by the volume of deficit  $Q_{dajk}$  at municipality  $k$  within neighbor deficit department  $j$  divided by the Euclidean distance  $D$ .

Variables used for the construction of the three sub-indexes all feature different units of measurements. All variables are rescaled to a range between 0 and 1 by applying the following formula:

$$\text{Rescaled value } (r) = \frac{\text{actual value} - \text{minimum value}}{\text{maximum value} - \text{minimum value}} \quad (6)$$

<sup>15</sup> High refers to values greater than the median. Areas of impact are those values which are equal or greater than the median.

<sup>16</sup> On economic spatial interaction–flows of goods–theory, it is hypothesized that it is the cost factor that leads to shorter distances being favored over larger distances. We employed travel time as a proxy of transportation costs to model the process of distant decay and used social gravity models to build our final model.

<sup>17</sup> We assume that the market forces of supply and demand between two geographic areas would influence the amount of interaction between them. We postulate that the flow of goods from a surplus to a deficit area is related to the degree of attraction between them adjusted by an exponent to indicate whether the impact of distance (measured as travel time) is proportional or not.

<sup>18</sup> Large exponents indicate that the friction of distance becomes increasingly important in the degree of the expected level of interaction. The exponent takes numerical value from 0.5 to 2 in correspondence to the travel time needed to reach cities with more than 100,000 inhabitants as an indicator of market accessibility. To operationalize this equation, we created a first order spatial connectivity neighbor matrix (among the most common spatial weights are contiguity, distance, and kernel weight among others (see Anselin, 2002; Getis, 2009). This matrix provides a list of neighbors for each department that are then classified as either surplus or deficit. Then a food balance sheet is calculated for each district similar to the FAO’s food balance approach.

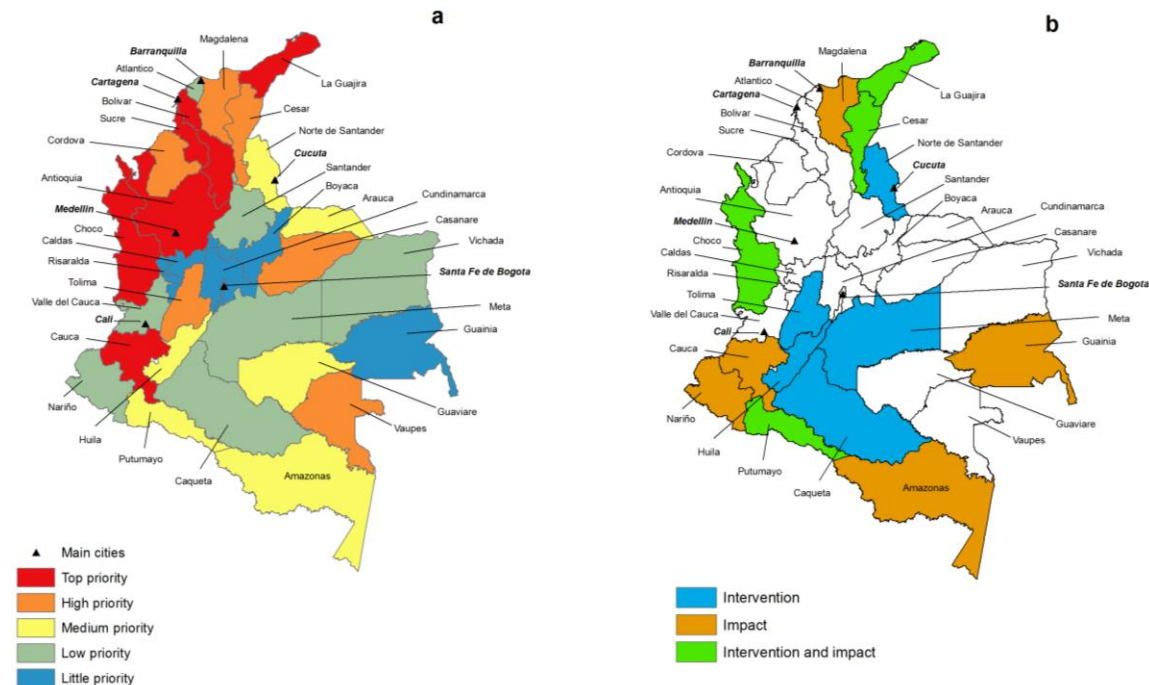
#### 4. Results and discussion

This section provides a review of the empirical results of the estimation method to calculate the subnational BPI. We describe the different scenarios for interventions, rankings, and spatial interaction index.

#### Geographic targeting for biofortification: BPIs, rankings, and options for intervention and/or impact

*Zinc-rice:* We now examine the results of targeted sites for biofortification with zinc-rice (table 5). Geographic regions cataloged as areas of intervention and impact include four departments (Choco, La Guajira, Cesar, and Putumayo) out of the top 16 with the potential to reach approximately 10 percent of HarvestPlus’ target population. Five departments stand out as areas of impact; however, just 3 departments were in the top 16, including Cauca, Amazonas, and Magdalena, where another 10 percent of the target population lives. Five departments are categorized as areas of intervention (supply areas<sup>19</sup>). These range from major rice-surplus producing areas, such as Tolima and Huila in the top 16, to large destination urban markets with a high prevalence of zinc deficiency among children, such as Bogota (50 percent) and Cali (Fig. 3 (b)).

Figure 3. Geographic sites for biofortification with zinc–rice: (a) rice BPI (b) recommended areas for intervention.



Source: Authors’ calculations.

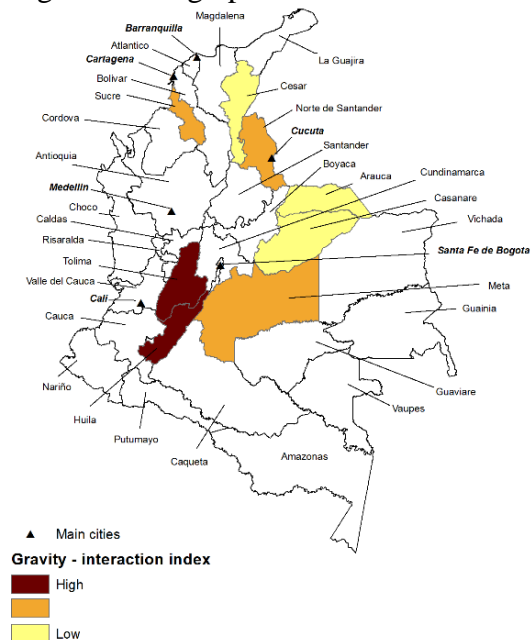
**Spatial interaction index:** the main aim of this index is to identify areas of intervention (or food-surplus producing departments) with geographic accessibility and market integration

<sup>19</sup> Tolima has the highest share of rice-harvested area (30 percent) among all departments.

advantages to ship crop surpluses to importing crop-deficit neighboring markets. The final results suggest a list of crop-surplus producing areas with potential impact on crop-deficit neighboring markets.

*Rice:* The production sub-index ranks as top five departments Casanare, Meta, Tolima, Sucre, and Choco, all rice-surplus producing areas except Choco. The spatial interaction index reshuffled these rankings, giving priority to rice-surplus producing departments bordered by rice-deficit departments (areas of impact with minimum production) with accessibility to importing markets. The inter-regional gravity model finds the least-cost method (from farm to market)<sup>20</sup> to ship rice surpluses from rice-surplus producing areas to rice-deficit areas, with the final score adds up the interaction of surplus-producing areas with multiple deficit-demand areas discounted by the Euclidean distance and road quality. The top five rice surplus departments, according to the spatial interaction index, include Tolima, Huila, Sucre, Meta, and Norte de Santander, in descending order. The pattern of trade and the quantity shipped from one department to another may be altered by shifts in the demand (number of consumers)<sup>21</sup> and supply curves (number of producers/technology). The departments of Tolima and Huila, where almost 60 percent of the irrigated rice-harvested area is concentrated could be considered as high priority for intervention due to their high interaction with neighboring rice-deficit departments such as Antioquia, Santa Fe de Bogota, and Valle del Cauca where approximately 20 percent of the target population lives. Within these rice food-deficit departments, the target population is concentrated in urban areas with a high prevalence of zinc deficiency, such as Medellin, Santa Fe de Bogota, and Cali. This also provides insights on potential areas of delivery to ease the multiplicative effect, diffusion, dissemination, and adoption of biofortified seed.

Figure 4. Geographic areas for intervention with zinc- rice



Source: Authors' calculations.

<sup>20</sup> The total transfer cost increases with distance, and consequently the cost per unit of product moved increases.

<sup>21</sup> Given the observed rural-urban migration we would expect higher demand from urban markets.

## 5. Conclusions and policy implications (way forward)

This paper provides estimation methods to create spatial indicators to help guide differentiated policies for intervention with biofortified crops on geo-targeted vulnerable population groups. The study has caveats and limitations. First, the subnational BPI does not factor in the Disability-Adjusted Life Year (DALY) in the calculation of the micronutrient sub-indexes like the global BPI. Access to data, especially on incidence and prevalence indicators, constrained our capacity to estimate geographic disaggregates of DALY on disease burden, which would facilitate the design of a stratified strategy for intervention. Computation of DALYs normally demands a large amount of demographic data and would require further data scooping and modeling. Second, further information on crop suitability could further advance the geo-targeting of suitable areas for intervention as a function of biophysical, environmental and market structure variables. Third, recent empirical evidence on the impact of trade liberalization suggest the need to further investigate and assess the impact and changes on Colombia's spatial structure on agricultural production. Understanding the geography of food production and consumption, vulnerable populations, and potential commodity flows is key for the development of a successful intervention program.

The developed country- and crop-specific Biofortification Prioritization Index (BPI) aimed to rank countries both globally and within regions. However, it was necessary to complement this index with a subnational version to account for in-country variation in production, consumption, and micronutrient deficiency, especially in countries such as Colombia with high inequity, different agroecological zones, and highly urbanized populations. To help fill this gap, we have created a subnational BPI and other spatial food access indicators. We built the subnational-crop-micronutrient BPI model for Colombia using subnationally representative agricultural and health surveys, and the population census. Among the other spatial indicators are the spatial interaction index and the food availability index. The interaction index aims to systematically identify areas of intervention (crop-surplus areas) with potential impact over crop-deficit neighboring departments (crop-deficit areas with good accessibility to large crop-deficit importing areas). It also sheds lights on potential areas of delivery to ease the multiplicative effect, diffusion, dissemination, and adoption of biofortified seed. We then catalogued geographic areas as (1) areas of intervention and impact, (2) areas of intervention, and (3) areas of impact. The first group is considered a hotspot or priority area for future HarvestPlus support because it is where the crop is economically important, the most vulnerable population lives, and the demand for the food staple crop exists. In addition, it was necessary to account for urban versus rural market structures as Colombia has a high level of urbanization (75 percent). This might yield further information on potential flows of commodities from areas of interventions to areas of impact.

These empirical results show that biofortified zinc rice should be introduced in the North Coast of Colombia. Finally, in general the subnational BPI aims to strategically guide targeted intervention, but future studies cost-effectiveness of the interventions should be undertaken.

In summary, the use of the BPI in combination with these other spatial indicators and scenarios for intervention can provide further information to decision makers and analysts to draft differentiated regional policies on the design of intervention programs. This information could also be helpful to other organizations, including national agriculture research institutes and NGOs to focus their interventions in targeted regions rather than atomizing intervention across wide areas.

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