

# Implementing CIP's Vision: Impact targeting

**Kelly Theisen**, Consultant  
**Graham Thiele**, International Potato Center (CIP)

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# Working Paper

## Implementing CIP's Vision: Impact targeting



The Social Sciences Working Paper Series is intended to advance social science knowledge about production and utilization of potato, sweetpotato, and root and tuber crops in developing countries to encourage debate and exchange of ideas. The views expressed in the papers are those of the author(s) and do not necessarily reflect the official position of the International Potato Center.

Comments are invited.

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Impact targeting

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International Potato Center  
P.O.Box 1558, Lima 12, Peru  
cip@cgiar.org • www.cipotato.org

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**Production Coordinator**

Cecilia Lafosse

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Elena Taipe and contributions from Graphic Arts

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# Abstract

This study reports an updated targeting exercise to identify priority populations of the world for CIP's commodity research, combining indicators of livelihood and the importance of the two crops of principal concern to CIP, potato and sweetpotato. Indicators of livelihood are determined by a composite of several factors – including income, nutritional status, and mortality rates of children and of mothers during pregnancy or childbirth – as reported by the United Nations' Millennium Development Goals. The importance of each crop is estimated by production per capita. The exercise is applied to populations of nations and sub-national areas, to the extent that relevant data are available, as displayed by accompanying maps and tables.

# Implementing CIP's Vision: Impact targeting

## **BACKGROUND**

In 2003-04 the International Potato Center (Centro Internacional de la Papa, CIP) conducted a Vision Exercise which proposed a major realignment of the Center's research program to address the Millennium Development Goals (MDGs) for reducing poverty (CIP, 2004). Part of this exercise included a global targeting analysis using indicators of livelihoods in areas where potato or sweetpotato is an important crop.

The objectives of the targeting exercise were:

- To identify the regions of the world where increasing potato and sweetpotato productivity is most likely to enhance the livelihoods of the most disadvantaged people, and
- To examine the multiple dimensions of livelihood in order to establish priorities by a wider set of poverty indicators, including not only income-based measures, but also indicators such as malnutrition, child mortality and maternal mortality.

Similar targeting exercises linking commodities with poverty maps at different scales of geographic resolution have been conducted by other CGIAR centers (Byerlee, 2000, Bigman and Loevinson 2003, and Bellon, 2005).

The analysis reported in this paper extends the 2004 exercise by combining the MDG livelihood measures used in 2004 into a more robust composite indicator for each country, and by utilizing more spatially refined data of potato and sweetpotato production, classified according to production per capita. Although the use of the composite indicator helps guide overall alignment of CIP's research program, specific indicators can be more appropriate for targeting particular technologies or interventions, e.g. distribution of Vitamin A deficiency to guide the release of newly developed orange-fleshed sweetpotato varieties rich in beta-carotene.

## COMPOSITE INDICATORS OF LIVELIHOOD

Indicators used by the initial impact targeting analysis have been retained, but updated. They include:

- **Income:** the percentage of the population with incomes below US\$1 per day, adjusted to purchasing power parity (PPP), a widely cited and internationally comparable indicator useful for global analysis
- **Malnutrition:** the percentage of a population classified as chronically malnourished, based on estimates of the amount of food available in each country and a measure of inequality in distribution derived from household income and expenditure surveys
- **Child Mortality:** the number of children who die before reaching five years of age, per 1,000 live births annually
- **Maternal Mortality:** the number of women who die during pregnancy or childbirth per 100,000 live births.

All data are provided by the United Nations Millennium Development Goals Indicators. (See “Data Sources” for more information about specific data tables.) For consistency of presentation, all data have been converted to percentages in this updated analysis.

In order to provide a comprehensive measure of livelihood which can be displayed on one global map, each of the original four indicators has been classified into six categories, “0” to “5.” Composite country scores also range from “0” (highest indicator of livelihood, of lowest priority to CIP) to “5” (lowest indicator, and highest priority to CIP). Scores for livelihood indicators are determined for each percentage class of the relevant population (Table 1).

Classification of each of the four indicators is determined primarily by natural breaks, where differences are greatest between adjacent observations. Since the entire population of any country is assigned the same value for an indicator, it is not feasible to classify countries by quantiles, so that each class would contain a roughly equivalent number of people. Much of the world’s population of highest priority to CIP is contained in only two countries, China and India.



**Table 1.** Classification of livelihood indicators.

Income Below US\$1 (Percent of Population):		Malnutrition (Percent of Population):	
• Above 40:	5	• Above 40	5
• 20 – 40:	4	• 26 – 40:	4
• 10 – 19:	3	• 15 – 25:	3
• 3 – 9:	2	• 6 – 14:	2
• 2:	1	• 3 – 5:	1
• Below 2:	0	• Below 3:	0

Child Mortality (Percent of Live Births):		Maternal Mortality (Percent of Live Births):	
• Above 14.9:	5	• Above 0.880:	5
• 8.1 – 14.9:	4	• 0.301 – 0.880:	4
• 4.6 – 8.0:	3	• 0.141 – 0.300:	3
• 2.0 – 4.5:	2	• 0.051 – 0.140:	2
• 1.5 – 1.9:	1	• 0.030 – 0.050:	1
• Below 1.5:	0	• Below 0.030:	0

The income (percent of population) data value of “2,” which is scored as a livelihood indicator of “1,” is consistent with MDG reporting. That specific value is assigned by the MDG classification to several countries where income poverty is relatively low (e.g. Chile and Estonia). Wealthier countries not included in the MDG poverty report are classified as “Below 2” (e.g. Japan and the United Kingdom) and are scored as “0.”

A composite score for a country is generally based on the sum of the scores of the four indicators, with a highest possible sum of 20 where all four indicators are reported. However, if one indicator is strongly divergent from the average, the higher score(s) is given greater weight. This provision is intended to account for the possibility that an indicator is either inaccurately reported or is not locally relevant. If, for example, the four livelihood indicators for a country are reported as “0,” “1,” “4,” and “5,” the higher scores (indicating lower livelihood) would be more heavily weighted.

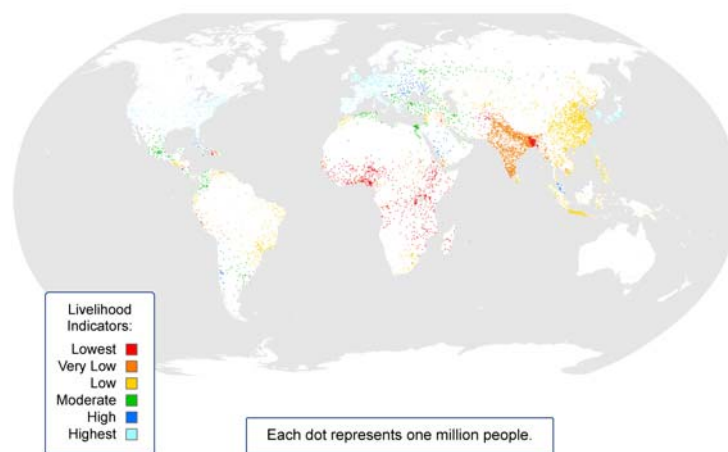
Nigeria, for example, is reported at a very high 70.8 percent of the population living at a daily income of less than US\$1, but a much lower nine percent chronically malnourished. This wide disparity of data is especially doubtful considering that Nigeria’s population is estimated to be 44 percent urban (PRB), and thus likely to be cash-dependant for subsistence needs. A classification based only on nutritional status would therefore incorrectly label Nigeria as a lower priority country. In this case, the income score is effectively given greater weight.

A single indicator can be essentially correct, but nevertheless provide an incomplete account of poverty. Although the US\$1 per day indicator is widely used for global comparative analysis, it is not always equally relevant across regions. Several countries report low levels of poverty based on the US\$1 indicator, but significantly higher scores on other indicators. Armenia, for example, reports two percent of the population living below the US\$1 level (for a score of “1,”), while 29 percent is reported as chronically malnourished (for a score of “4”).

The four indicators are not available for every country. Where the data set is incomplete, reporting three or fewer of the four indicators, the final composite country score is based on those which are reported. In these cases, the higher scores are weighted still more heavily, to account for the possibility that the factors indicating lowest livelihood conditions are those least likely to be reported.

Composite livelihood scores, by country, are determined as indicated in Table 2. Data of all countries with a population over 500,000 people and a composite rating above “0” are included in Table 3 and displayed by Map 1: Population by Livelihood Indicators.

**Map 1.**  
Population by  
livelihood indicators.



**Table 2.** Determination of composite livelihood scores.

SUM of Scores	OR SUM with Highest Score	Composite Score
---------------	---------------------------	-----------------

Where all four indicators are reported:

17 – 20	13 – 16	5	5
13 – 16	9 – 12	4 or 5	4
9 – 12	5 – 8	3 or 4 or 5	3
5 – 8	2 – 4	2 or 3	2
2 – 4			1
0 – 1			0

Where three indicators are reported:

13 – 15	10 – 12	5	5
10 – 12	7 – 9	4 or 5	4
7 – 9	4 – 6	3 or 4 or 5	3
4 – 6	1 – 3	2 or 3	2
1 – 3			1
0			0

Where two indicators are reported:

9 – 10	6 – 8	5	5
6 – 8	5	4 or 5	4
5	3 – 4	3	3
3 – 4	2	2	2
1 – 2			1
0			0

(No country is reported by only one indicator.)

**Table 3.** Countries by composite livelihood scores.  
Includes all rated above "0" with a population above 500,000

Country	Income Below US\$1		Malnutrition		Under-Five Mortality		Maternal Mortality		Sums of Ratings by Number of Values Reported			Composite Score
	Value	Rating	Value	Rating	Value	Rating	Value	Rating	(2)	(3)	(4)	
Afghanistan					25.7	5	1.900	5	10			5
Albania	2	1	6	2	1.8	1	0.055	2			6	2
Algeria	2	1	5	1	3.9	2	0.140	2			6	2
Angola			38	4	2.6	5	1.700	5		14		5
Argentina	7	2	2.5	0	1.8	1	0.082	2			5	2
Armenia	2	1	29	4	2.9	2	0.055	2			9	4
Azerbaijan	4	2	10	2	8.9	4	0.094	2			10	4
Bangladesh	41	5	30	4	7.3	3	0.380	4			16	5
Belarus	2	1	3	1	1.2	0	0.035	1			3	1
Benin	31	4	14	2	15	5	0.850	4			15	5
Bhutan					7.5	3	0.420	4	7			4
Bolivia	23	4	23	3	6.5	3	0.420	4			14	4
Bosnia- Herz.			9	2	1.5	1	0.031	1		4		2
Botswana			30	4	12	4	0.100	2		10		4
Brazil	7	2	8	2	3.3	2	0.260	3			9	3
Brunei			3	1	0.9	0	0.037	1		2		1
Bulgaria	2	1	9	2	1.5	1	0.032	1			5	2
Burkina Faso	27	4	17	3	19.1	5	1.000	5			17	5
Burundi	54	5	67	5	19	5	1.000	5			20	5
Cambodia	34	4	33	4	14.3	4	0.450	4			16	4
Cameroon	17	3	25	3	14.9	4	0.730	4			14	4
Cape Verde					3.5	2	0.150	3	5			3
Central African Rep.			45	5	19.3	5	1.100	5		15		5
Chad			33	4	20.8	5	1.100	5		14		5
Chile	2	1	4	1	1	0	0.031	1			3	1
China	10	3	12	2	2.7	2	0.056	2			9	3
Colombia	7	2	14	2	2.1	2	0.130	2			8	2
Comoros			62	5	7.1	3	0.480	4		12		5
Congo, DRC			72	5	21	5	0.990	5		15		5
Congo, Rep.			34	4	10.8	4	0.510	4		12		4
Costa Rica	3	2	4	1	1.2	0	0.043	1			4	2
Cote d'Ivoire	15	3	14	2	19.5	5	0.690	4			14	5
Croatia	2	1	7	2	0.7	0	0.008	0			3	2
Cuba			2.5	0	0.7	0	0.033	1		1		1
Cyprus			2	0	0.5	0	0.047	1		1		1
Djibouti			26	4	13.3	4	0.730	4		12		4
Dominican Rep.	3	2	27	4	3.1	2	0.150	3			11	4
Ecuador	18	3	5	1	2.5	2	0.130	2			8	3
Egypt	3	2	3	1	3.3	2	0.084	2			7	2
El Salvador	19	3	11	2	2.7	2	0.150	3			10	3
Equat. Guinea					20.5	5	0.880	4	9			5
Eritrea			73	5	7.8	3	0.630	4		12		5
Estonia	2	1	3	1	0.7	0	0.063	2			4	2
Ethiopia	23	4	46	5	16.4	5	0.850	4			18	5
Fiji			4	1	1.8	1	0.075	2		4		2
Gabon			5	1	9.1	4	0.420	4		9		4

(continued)

**Table 3.** Countries by composite livelihood scores (continued).

Includes all rated above "0" with a population above 500,000

Country	Income Below US\$1		Malnutrition		Under-Five Mortality		Maternal Mortality		Sums of Ratings by Number of Values Reported			Composite Score
	Value	Rating	Value	Rating	Value	Rating	Value	Rating	(2)	(3)	(4)	
Gambia	59	5	27	4	13.7	4	0.540	4			17	5
Georgia	6	2	13	2	4.5	2	0.032	1			7	2
Ghana	49	5	12	2	11.2	4	0.540	4			15	5
Guatemala	13	3	23	3	4.3	2	0.240	3			11	3
Guinea			24	3	15	5	0.740	4			12	5
Guinea-Bissau			37	4	20	5	1.100	5			14	5
Guyana	2	1	9	2	6.3	3	0.170	3			9	3
Haiti	54	5	47	5	12	4	0.680	4			18	5
Honduras	15	3	22	3	4	2	0.110	2			10	3
India	34	4	20	3	7.4	3	0.540	4			14	4
Indonesia	8	2	6	2	3.6	2	0.230	3			9	3
Iran	2	1	4	1	3.6	2	0.076	2			6	2
Iraq			31	4	12.5	4	0.250	3			11	4
Jamaica	2	1	10	2	2	2	0.087	2			7	2
Jordan	2	1	7	2	2.6	2	0.041	1			6	2
Kazakhstan	2	1	8	2	7.3	3	0.210	3			9	3
Kenya	23	4	31	4	12	4	1.000	5			17	5
Korea, DPR			35	4	5.5	3	0.650	4			11	4
Kyrgyzstan	2	1	4	1	6.7	3	0.110	2			7	3
Laos	27	4	21	3	7.9	3	0.650	4			14	4
Latvia	2	1	3	1	1.1	0	0.042	1			3	1
Lebanon			3	1	3	2	0.150	3			6	3
Lesotho			12	2	13.2	4	0.550	4			10	4
Liberia			49	5	23.5	5	0.760	4			14	5
Libya			2.5	0	1.9	1	0.097	2			3	2
Macedonia	2	1	7	2			0.023	0			3	2
Madagascar	61	5	34	4	11.9	4	0.550	4			17	5
Malawi	21	4	24	3	12.5	4	1.800	5			16	5
Malaysia	2	1	3	1	1.2	0	0.041	1			3	1
Mali	36	4	28	4	21.8	5	1.200	5			18	5
Mauritania	26	4	10	2	12.5	4	1.000	5			15	5
Mauritius			6	2	1.5	1	0.024	0			3	2
Mexico	3	2	5	1	2.7	2	0.083	2			7	2
Moldova			11	2			0.036	1			3	2
Mongolia	11	3	28	4	4.9	3	0.110	2			12	4
Morocco	2	1	6	2	4	2	0.220	3			8	3
Mozambique	38	4	45	5	14.5	4	1.000	5			18	5
Myanmar			5	1	10.5	4	0.360	4			9	4
Namibia			23	3	6.2	3	0.300	3			9	3
Nepal	23	4	17	3	7.4	3	0.740	4			14	4
Nicaragua	45	5	27	4	3.7	2	0.230	3			14	5
Niger	60	5	32	4	25.6	5	1.600	5			19	5
Nigeria	71	5	9	2	19.4	5	0.800	4			16	5
Oman					1.2	0	0.087	2			2	2
Pakistan	17	3	23	3	9.9	4	0.500	4			14	4
Palestine (Occupied)			16	3	2.3	2	0.100	2			7	3
Panama	7	2	25	3	2.4	2	0.160	3			10	3

(continued)

**Table 3.** Countries by composite livelihood scores (continued).  
Includes all rated above "0" with a population above 500,000

Country	Income Below US\$1		Malnutrition		Under-Five Mortality		Maternal Mortality		Sums of Ratings by Number of Values Reported			Composite Score
	Value	Rating	Value	Rating	Value	Rating	Value	Rating	(2)	(3)	(4)	
Papua New Guinea			13	2	7.4	3	0.300	3		8		3
Paraguay	13	3	15	3	2.3	2	0.170	3			11	3
Peru	11	3	12	2	2.7	2	0.410	4			11	4
Philippines	15	3	19	3	3.3	2	0.200	3			11	3
Romania	2	1	2.5	0	1.9	1	0.049	1			3	1
Russian Federation	2	1	3	1	1.8	1	0.067	2			5	2
Rwanda	60	5	36	4	20.3	5	1.400	5			19	5
Saudi Arabia			4	1			0.023	0	1			1
Senegal	17	3	23	3	13.6	4	0.690	4			14	4
Serbia-Montenegro			10	2	1.5	1	0.011	0		3		2
Sierra Leone			50	5	28.2	5	2.000	5		15		5
Slovakia	2	1	6	2	0.8	0	0.003	0			3	2
Slovenia	2	1	3	1	0.4	0	0.017	0			2	1
Somalia					22.5	5	1.100	5	10			5
South Africa	11	3			6.8	3	0.230	3		9		3
Sri Lanka	6	2	22	3	1.4	0	0.092	2			7	3
Sudan			27	4	9	4	0.590	4		12		4
Suriname			10	2	3.9	2	0.110	2		6		2
Swaziland			19	3	16	5	0.370	4		12		5
Syria			4	1	1.5	1	0.160	3		5		3
Tajikistan	7	2	61	5	1.1	0	0.100	2			9	4
Tanzania	58	5	44	5	12.2	4	1.500	5			19	5
Thailand	2	1	21	3	2.1	2	0.044	1			7	3
Timor-Leste			8	2	6.1	3	0.660	4		9		4
Togo			25	3	13.9	4	0.570	4		11		4
Trinidad-Tobago			11	2	1.9	1	0.160	3		6		3
Tunisia	2	1	2.5	0	2.4	2	0.120	2			5	2
Turkey	3	2	3	1	2.9	2	0.070	2			7	2
Turkmenistan			8	2	10.4	4	0.031	1		7		4
Uganda	58	5	19	3	13.6	4	0.880	4			16	5
Ukraine	2	1	3	1	1.7	1	0.035	1			4	1
United Arab Emirates			2.5	0	0.9	0	0.054	2		2		2
Uruguay	2	1	3	1	1.5	1	0.027	0			3	1
Uzbekistan	2	1	26	4	6.8	3	0.024	0			8	3
Venezuela	19	3	18	3	2.1	2	0.096	2			10	3
Viet Nam			17	3	1.9	1	0.130	2		6		3
Yemen	16	3	37	4	10.2	4	0.570	4			15	4
Zambia	76	5	47	5	18.2	5	0.750	4			19	5
Zimbabwe			45	5	13.2	4	1.100	5		14		5

## PER CAPITA CROP INDICATORS

Indicators of the importance of potato and sweetpotato were derived in the 2004 targeting study by an analysis of both crop production and land use at the national level, except for China, India, and Russia, where sub-national data were utilized. Since the initial study, CIP has further investigated potato and sweetpotato crops within high-priority nations using more detailed sub-national data wherever possible. Several nations of highest priority to CIP are included as chapters in the World Potato Atlas (WPA) and the World Sweetpotato Atlas (WSA), where more detailed information is available. (See Data Sources.)

Utilizing more complete and current crop and population data, the updated targeting study is more directly based on the importance of each crop relative to the local population. In some areas of the world, potato and sweetpotato crops are essential to the livelihoods of a moderately high concentration of people, while in other areas they are less essential, but still very important for subsistence and income generation to a great many. Here the local importance of each crop is displayed relative to population, not to land, classified according to production in kilograms per capita for a given area.

Production per capita is presented as a globally relevant indicator of the local importance of each crop, but it is a highly generalized indicator. Both crops serve various local roles. Potato crops provide an essential staple in fresh form to millions of people throughout the world. However, the rapid growth of potato production in Asia over the past several decades has been driven to a large extent by market forces, as much of the crop is consumed as a vegetable or in processed forms by people in urban areas. Sweetpotato presents an even more complex picture, as the crop is of enormous importance as a direct source of nutrition in some areas of the world, especially the more humid areas of Africa, but is being developed for other purposes elsewhere. In China, which produces roughly eighty percent of the world's crop (FAOSTAT), sweetpotato is becoming less important as a direct source of food, but is vitally important as animal feed (especially for pigs) and is being developed as a raw material for several industrial products, such as starch and alcohol (WSA, China).

Some countries can be adequately represented by a single value of production per capita, but where there is considerable variability within a country, finer estimates based on additional sources are used wherever possible. In most cases, these estimates are reported by agencies of the respective government and are consistent with FAO data. In a few countries, the analysis is based on more detailed crop surveys which are not consistent with FAO. (Examples include

Cameroon and Ethiopia for potato, Mozambique for sweetpotato, and Malawi for both crops. See “Cropping Data Notes by Selected Countries” for more details.)

More specific reasons for representing a country by a single per capita value, or several, are indicated below.

1. One value is displayed for the entire country, for one of four reasons, with examples:

1A. *The crop is produced for countrywide consumption.*

Potato might be cultivated in a few areas of intensive production, as in the United States, but it is widely marketed and consumed within the country (and in some cases exported internationally). One value of average per capita potato production for the entire country is therefore appropriate. Other countries within this category for potato include Canada, Japan, Australia, and all countries of Western and Central Europe.

1B. *The distributions of people and crops generally coincide.*

The crop might be produced either for local consumption or for commercial markets, but crops and people are generally concentrated in the same areas, so that the local importance of the crop is likely to be fairly consistent across populations within the country. Examples include potato in most countries of Central Asia and North Africa, and sweetpotato in Papua New Guinea.

1C. *Within-country data are not complete or reliable.*

This category includes countries where sufficient and reliable data are not available to estimate variable per-capita production. Russia is an obvious example for potato, where production data are available only for the entire country. Several countries in Africa are likewise assigned to this category for either or both crops.

1D. *The country is very small in area and/or population.*

Given the limitations of cartographic display for a global map, one value is reported for small countries, e.g. potato in Bhutan and sweetpotato in Haiti.

2. Values are displayed at variable rates within the country for one of two reasons:

2A. *The crop is produced for a mix of distant markets and local consumption.*

In these countries, demand for the crop by urban populations is often a factor of growing importance, but the local importance of the crop (as reflected in marketing and/or consumption) is highest in areas of high production, often far from population centers. Estimates have been made based on the literature for each country, especially those included as atlas chapters. Annual per capita use of potato by people living in major cities of Asia is generally estimated to be around 20 kilograms. For people living in



major cities of Latin America, per capita potato consumption is typically 50 to 60 kilograms. Countries in this category include, for potato: China, India, Turkey, Morocco, South Africa, Kenya, and all countries with a significant potato crop in South and Central America. For sweetpotato, Viet Nam and China are both examples of this category, although to the extent that sweetpotato is utilized less as a direct source of food and more for other uses as noted above, the importance of the crop would become less localized and more consistent across each country.

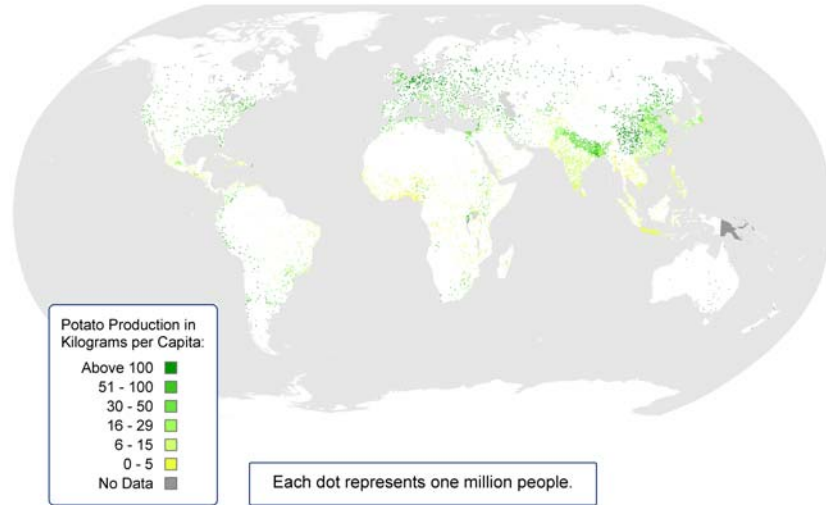
2B. Production is mostly for local consumption and/or local markets.

Where a crop is significant, but rarely travels far after harvest, per capita production is estimated from the best available within-country data of production and population. Potato or sweetpotato might be a very important crop in one region of a country and unknown elsewhere, accounting for per capita production values as low as zero in some cases. Countries in this category include nearly all of Sub-Saharan Africa, e.g. Ethiopia and Cameroon for potato, and Angola and Mozambique for sweetpotato.

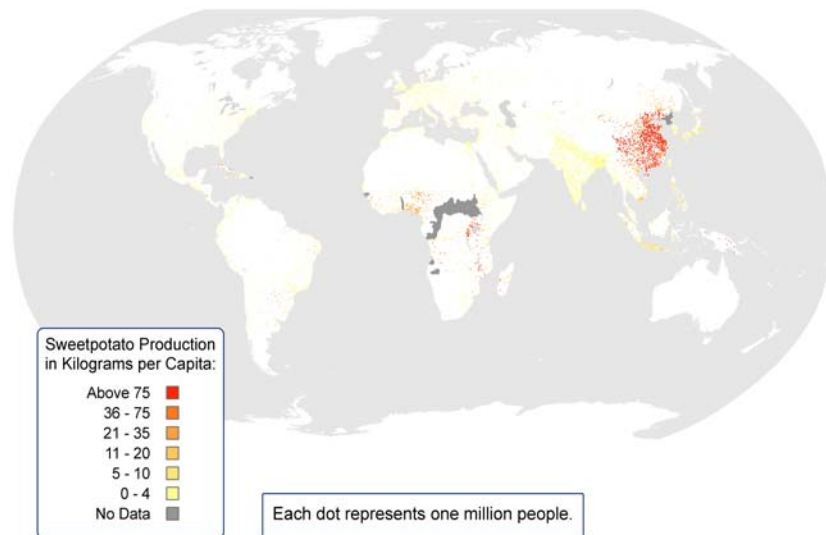
To estimate values of production per capita, population data provided by the Environmental Systems Research Institute (ESRI, the creator of ArcGIS/ ArcMap software) have in many cases been revised, usually upwards, based on a consensus of other sources, including the Population Reference Bureau (PRB), United Nations data reported by the Food and Agriculture Organization (FAOSTAT), and Population Statistics (Populstat). (See "Data Sources" for links.)

A summary of these data is provided for potato in Table 4 and for sweetpotato in Table 5. The data are displayed relative to global population density for potato in Map 2 and for sweetpotato in Map 3.

**Map 2.**  
Population by per capita  
potato production.



**Map 3.**  
Population by per capita  
sweetpotato production.



**Table 4.** Potato production per capita (in kilograms).

Country	Category	Average	Range
Afghanistan	2A		4 - 12
Albania	1D	52	
Algeria	1B	61	
Angola *	2B		0 - 87
Argentina	2A		30 - 127
Armenia *	1D	184	
Australia	1A	61	
Austria	1A	84	
Azerbaijan	1D	118	
Bangladesh *	2A		18 - 38
Belarus	1B	904	
Belgium-Luxembourg	1A	277	
Bolivia *	2A		20 - 125
Bosnia-Herzegovina	1D	116	
Brazil	2A		3 - 35
Bulgaria	1B	56	
Burundi *	No Data		
Cameroon *	2B		0 - 77
Canada	1A	154	
Chad	2B		0 - 7
Chile	2A		45 - 105
China *	2A		11 - 170
Colombia *	2A		10 - 134
Costa Rica	1D	15	
Croatia	1D	85	
Cuba	1A	27	
Cyprus	1D	154	
Czech Republic	1A	88	
Denmark	1A	281	
Dominican Republic	2A		0 - 9

Includes all potato-producing countries with a population above 500,000  
 Data for most countries provided by FAO, values averaged 2004 – 2006  
 Other data sources are utilized for countries marked with an asterisk (\*).

(continued)

**Table 4.** Potato production per capita (in kilograms) (continued).

Country	Category	Average	Range
Ecuador *	2A		10 - 116
Egypt	1B	34	
Eritrea	2B		0 - 16
Estonia	1D	136	
Ethiopia *	2B		0 - 62
Finland	1A	122	
France	1A	110	
Georgia	1D	73	
Germany	1A	140	
Greece	1A	86	
Guatemala	2A		8 - 65
Hungary	1A	65	
India *	2A		15 - 105
Indonesia	2A		3 - 9
Iran	2A		41 - 115
Iraq	2A		15 - 70
Ireland	1A	102	
Israel	1A	80	
Italy	1A	30	
Japan	1A	22	
Jordan	1B	30	
Kazakhstan	1B	156	
Kenya *	2A		5 - 40
Korea, South	1A	14	
Korea, North	1C	88	
Kyrgyzstan	1B	240	
Laos	2B		0 - 25
Latvia	1D	265	
Lebanon	1D	133	
Lesotho	1D	17	
Libya	1B	33	

Includes all potato-producing countries with a population above 500,000  
 Data for most countries provided by FAO, values averaged 2004 – 2006  
 Other data sources are utilized for countries marked with an asterisk (\*).

(continued)

**Table 4.** Potato production per capita (in kilograms) (continued).

Country	Category	Average	Range
Lithuania	1D	192	
Macedonia	1D	93	
Madagascar	2B		0 - 24
Malawi *	1B	23	
México	2A		5 - 42
Moldova	1D	84	
Mongolia	1B	35	
Morocco	2A		11 - 69
Mozambique	2B		0 - 16
Myanmar *	2B		0 - 70
Nepal *	1B	65	
Netherlands	1A	424	
New Zealand	1A	118	
Nigeria *	2B		0 - 38
Norway	1A	78	
Pakistan *	2A		5 - 16
Papua New Guinea *	No Data		
Peru *	2A		28 - 277
Philippines	2A		0 - 6
Poland	1B	284	
Portugal	1A	62	
Romania	1B	166	
Russian Federation	1C	264	
Rwanda *	2B		18 - 368
Saudi Arabia	1A	8	
Serbia-Montenegro	1B	98	
Slovakia	1B	60	
Slovenia	1B	66	
South Africa	2A		21 - 115
Spain	1A	58	
Sudan	1C	6	

Includes all potato-producing countries with a population above 500,000  
 Data for most countries provided by FAO, values averaged 2004 – 2006  
 Other data sources are utilized for countries marked with an asterisk (\*).

(continued)

**Table 4.** Potato production per capita (in kilograms) (continued).

Country	Category	Average	Range
Sweden	1A	98	
Switzerland	1A	64	
Syria	1B	30	
Tajikistan	1B	78	
Tanzania	2B		0 - 54
Thailand	2A		0 - 5
Tunisia	1B	34	
Turkey	2A		14 - 105
Turkmenistan	1B	29	
Uganda *	2A		11 - 39
Ukraine	1B	430	
United Kingdom	1A	96	
Uruguay	1D	45	
USA	1A	66	
Uzbekistan	1B	36	
Venezuela	2A		5 - 44
Viet Nam*	2A		2 - 9
Yemen	2A		5 - 35

**Table 5.** Sweetpotato production per capita (in kilograms).

Country	Category	Average	Range
Angola *	2B		5 - 136
Argentina	2A		2 - 9
Bangladesh	2A		1 - 5
Benin	1C	6	
Bolivia	2A		2 - 4
Brazil	2A		1 - 11
Burkina Faso	2B		0 - 6
Burundi	1B	99	
Cambodia	1C	3	
Cameroon	2B		4 - 56
Cape Verde	1D	9	

Includes all sweetpotato-producing countries with a population above 500,000. Data for most countries provided by FAO, values averaged 2004 - 2006. Other data sources are utilized for countries marked with an asterisk (\*).

(continued)

**Table 5.** Sweetpotato production per capita (in kilograms) (continued).

Country	Category	Average	Range
Central African Republic	No Data		
Chad	2B		0 - 10
China *	2A		0 - 95
Comoros	1D	7	
Congo, Republic of	No Data		
Congo, DRC	2B		0 - 12
Cote d'Ivoire	1C	4	
Cuba	1A	42	
Dominican Republic	1C	4	
Ecuador	2A		1 - 4
Egypt	1B	4	
Equatorial Guinea	1D	69	
Ethiopia	2B		0 - 37
Fiji	1D	7	
Gabon	1C	3	
Gambia	No Data		
Ghana	1C	4	
Guinea	1C	23	
Guinea Bissau	No Data		
Guyana	1C	3	
Haiti	1C	20	
India	2A		1 - 9
Indonesia	2A		2 - 135
Jamaica	1C	9	
Japan	1A	8	
Kenya	2A		0 - 54
Korea, North	No Data		
Korea, South	1A	6	
Laos	1B	31	
Liberia	1C	6	
Madagascar *	2B		9 - 105
Malawi *	1B	210	
Malaysia	1C	1	
Mali	1C		0 - 6
Mauritania	1C		0 - 1
Mexico	2A		4 - 7

Includes all sweetpotato-producing countries with a population above 500,000.  
 Data for most countries provided by FAO, values averaged 2004 - 2006.  
 Other data sources are utilized for countries marked with an asterisk (\*).

(continued)

**Table 5.** Sweetpotato production per capita (in kilograms) (continued).

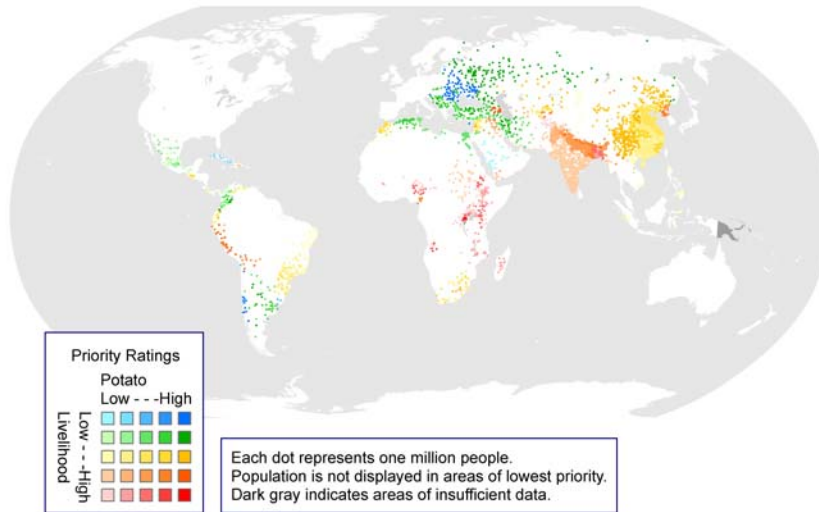
Country	Category	Average	Range
Morocco	2A		0 - 1
Mozambique *	2B		8 - 116
Myanmar	1C	1	
New Zealand	1A	5	
Niger	2B		0 - 7
Nigeria	1C	24	
Papua New Guinea	1B	86	
Paraguay	1B	23	
Peru	2A		3 - 9
Philippines	1B	7	
Portugal	1A	2	
Rwanda *	2B		34 - 150
Senegal	2B		0 - 19
Sierra Leone	2B		5 - 8
South Africa	2A		0 - 5
Sri Lanka	1C	2	
Sudan	No Data		
Swaziland	1C	2	
Tanzania	2B		2 - 57
Togo	No Data		
Uganda *	2A		52 - 104
USA	1A	2	
Uruguay	1D	20	
Viet Nam *	1B	19	
Zambia	1C	5	

Includes all sweetpotato-producing countries with a population above 500,000.  
 Data for most countries provided by FAO, values averaged 2004 - 2006.  
 Other data sources are utilized for countries marked with an asterisk (\*).

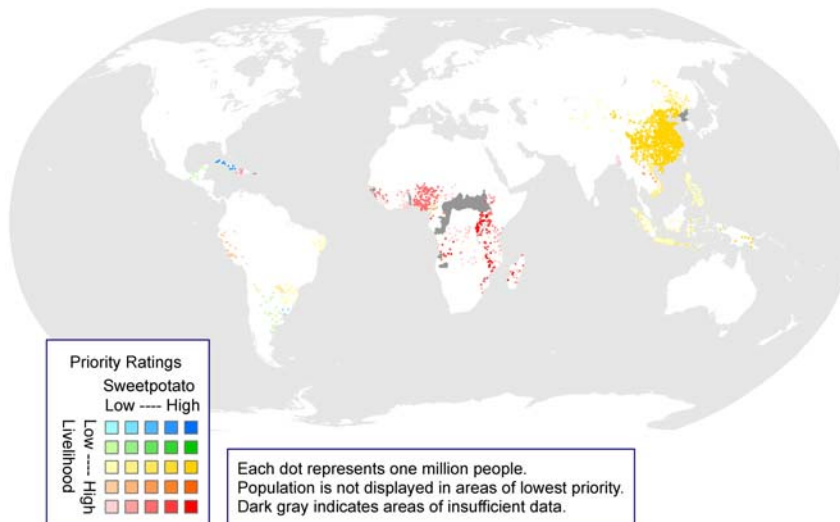
## AREAS OF HIGH PRIORITY

Areas of highest priority to CIP, determined by a combination of livelihood indicators and the importance of each crop, are displayed in Map 4 and Map 5. Areas characterized by lowest priority ("0" values) for either factor are not displayed. Areas rated "1" through "5" in both factors have been classified into one of 25 possible combinations, the most important overall being those where livelihood indicators are most severe, and the crop is locally very important. On both maps, areas displayed in vivid red or orange are those of overall highest priority.





**Map 4.**  
 Population by  
 priority for potato.



**Map 5.**  
 Population by priority  
 for sweetpotato.

The countries identified by the initial CIP Vision study generally remain those of highest priority in this updated study, but analysis at a finer geographic scale can reveal large populations of high priority that would be obscured by data reported only at the country level. For example, potato is generally a minor crop in Cameroon, in most areas not cultivated at all. However, in the western highlands, home to over six million people, per capita production ranges from around fifty to over seventy kilograms (WPA, Cameroon). Likewise, sweetpotato is generally a minor crop in Ethiopia, where national per capita production is estimated at five kilograms (FAO). The only extensive area suited to sweetpotato is the southwest, characterized by lower altitude and higher precipitation. For a population of roughly eleven to twelve million people in this part of the country, sweetpotato is cultivated at an estimated annual rate of over 30 kilograms per capita. Considering the degree of poverty which characterizes this region, a finer geographic scale reveals a population of high priority.

For potato, areas of high priority include, with a few examples:

- Higher altitude areas of several countries of Sub-Saharan Africa (Ethiopia, Cameroon, Kenya, Rwanda, Uganda, Tanzania, Malawi, Angola, Mozambique, and Madagascar).
- Andean South America (Bolivia, Peru, Ecuador, and Colombia).
- The Indo-Gangetic basin of southern Asia (Bangladesh, India, Nepal, and Pakistan).
- China, with high production found in several interior provinces.
- Central and western Asia (Tajikistan, Kyrgyzstan).
- The Caucasus region (Armenia, Azerbaijan).

For sweetpotato, areas include:

- Humid areas of several countries of southern, central and western coastal Africa (Madagascar, Angola, Mozambique, Rwanda, Uganda, Ethiopia, and Nigeria).
- Lower altitude areas of central and southern China, where most of the world's crop is grown.

Several areas of Central Africa rank very high for both crops (though not usually in the same immediate zone) and are among those which also score highest in priority for livelihood indicators. They include: Rwanda, Uganda, the Kivu District of Democratic Republic of the Congo, and areas of Tanzania, Kenya, Ethiopia, Mozambique, Angola, and Madagascar.

In addition to better identifying populations of high priority at a finer scale, sub-national mapping can also reveal areas where data quality is doubtful, typically where sharp transitions conform to administrative boundaries absent other geographic factors. In China, for example, the coastal province of Fujian is reported to be a high producer of potato, but very little production is reported from adjacent provinces. It is possible that Fujian is over-reported, or that other areas are under-reported, or that some combination of both factors occurs.

### **FURTHER APPLICATIONS**

Since this analysis is global and therefore highly generalized, it can provide only a first step toward identifying populations of high priority to CIP in respect to either potato or sweetpotato. However, by utilizing more refined and reliable data as they become available, CIP is better able to identify populations where either or both crops are locally important. This effort can be extended and refined via the use of Geographic Information Systems, utilizing data provided by more complete surveys and by more technically advanced methods, such as remote sensing where feasible.

Refining this global approach to identify populations of high priority, CIP's research attempts to address specific aspects of poverty for people in geographically well-defined areas of greatest need. One clear example is CIP's role as a partner in the Vitamin A for Africa (VITAA) project, directing research to develop sweetpotato varieties which are rich in beta-carotene, used by the body to synthesize Vitamin A, and with high dry matter content and other agronomic characteristics sought by farmers in many of the poorest regions of Africa.

This study is limited to reported production data of potato and sweetpotato, however tentative such data often are. What has yet to be considered is the unmet potential for either crop to provide an important role in food security and economic development in areas which are physically suitable for either crop, but where effective research services and other infrastructure are not available. For example, potato could be a very significant crop in the higher altitude areas of the Kivu District of the Democratic Republic of Congo, but if farmers have not had access for several years to either new varieties or sources of seed free of viral infection, that potential is not likely to be realized. An assessment of the production possibilities for potato and sweetpotato, not only their actual production, could provide further guidance to CIP of where its research efforts could have the strongest effect.

More refined and regularly updated analysis, displayed by global and more localized maps, provides a significantly improved framework to guide CIP's research and development program to those areas of the world where we may expect the greatest impact on the livelihoods of poor people.

## DATA SOURCES

### Indicators of Livelihood

Indicators are provided by the United Nations Millennium Development Goals Indicators (<http://mdgs.un.org/unsd/mdg/Data.aspx>), accessed October 30, 2007. (These data are occasionally revised.)

Databases utilized for this analysis include:

- Goal 1: Population below US\$1 (PPP) per day, percentage (data reported various years, none prior to 1997).
- Goal 1: Population undernourished, percentage (data reported 2002).
- Goal 4: Children under five mortality rate, per 1,000 live births (data reported 2005).
- Goal 5: Maternal mortality ratio per 100,000 live births (data reported 2000).

### Cropping Data

The primary source of cropping data for potato and sweetpotato at the national level is FAO, with several exceptions and revisions for countries marked with an asterisk in Tables 4 and 5. FAO data are frequently collected and reported by the governments of each respective country, hence are of widely varied quality in terms of accuracy and completeness. In some cases, national level data reported by FAO have been utilized, with the addition of other sources for sub-national distribution.

More complete information of cropping data is available for countries included in the World Potato Atlas (<http://research.cip.cgiar.org/confluence/display/wpa/Home>) and the World Sweetpotato Atlas (<http://research.cip.cgiar.org/confluence/display/wsa/Home>)

Countries included in the World Potato Atlas are, by continent:

- Africa: Cameroon, Ethiopia, Kenya
- Eurasia: Armenia, Bangladesh, China, India, Myanmar, Nepal, Pakistan, Tajikistan
- South America: Bolivia, Colombia, Ecuador, Peru

Countries included in the World Sweetpotato Atlas are, by continent:

- Africa: Angola, Madagascar, Mozambique, Nigeria, Rwanda, Uganda
- Asia: China, Papua New Guinea, Viet Nam

Other notes are listed for potato production by country below. With the exception of Malawi, all countries marked with an asterisk in Table 5 are included as chapters in the World Sweetpotato Atlas.

***Cropping Data Notes by Selected Countries***

**Angola:** FAO data have indicated rapid increases in area cultivated, from 11,500 hectares in 2001 to a tenfold increase of 115,000 hectares in 2006. National distribution has been estimated according to a July 2003 report of potato and sweetpotato production issued by the FAO and the World Food Programme. (See the WSA Angola chapter.)

**Burundi:** Potato area has been reported by FAO at a consistent 10,000 hectares over the past several years, very likely well below potential and actual production, especially considering production under similar physical conditions in adjacent Rwanda. The country is, for the time being, classified as “no data.”

**Malawi:** Data for both crops are displayed as reported via the Famine Early Warning System (FEWS) for 2004, not as reported via FAO. FAO reports much higher production of potato and nothing of sweetpotato (grown much more extensively than potato), apparently reflecting a confusion of the two crops.

**Nigeria:** Data reported by FAO indicate a gradual but consistent national upward trend over the past five years, known from other sources to be concentrated in areas of higher altitude, centered on the Plateau and Kano States. Cropping data in general are very tentative for Nigeria. (Please refer to the WSA Nigeria chapter.)

**Papua New Guinea:** Potato production is not reported by FAO, but some potato cultivation is reported in other literature cited in the WSA Papua New Guinea chapter. For the time being, the country is reported as “no data.”

**Rwanda:** Sub-national distribution of potato production reported by FAO was estimated via literature cited in the WSA Rwanda chapter.

**Uganda:** Sub-national distribution is estimated by Government of Uganda reporting for 2003, updated with national production estimates reported by FAO.

### **Population Data**

Population data provided by ESRI, the company that produces ARC Geographic Information Systems software used in this analysis, have been updated by composite figures provided by three other sources:

- Population Reference Bureau/ Datafinder (<http://www.prb.org/DataFind/datafinder7.htm>).
- United Nations, FAO Data Archives/ Population (<http://faostat.fao.org/site/430/default.aspx>).
- Populstat (<http://www.populstat.info/>), especially for sub-national population estimates.

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The International Potato Center (CIP) seeks to reduce poverty and achieve food security on a sustained basis in developing countries through scientific research and related activities on potato, sweetpotato, and other root and tuber crops, and on the improved management of natural resources in the Andes and other mountain areas.

#### THE CIP VISION

The International Potato Center (CIP) will contribute to reducing poverty and hunger; improving human health; developing resilient, sustainable rural and urban livelihood systems; and improving access to the benefits of new and appropriate knowledge and technologies. CIP, a World Center, will address these challenges by convening and conducting research and supporting partnerships on root and tuber crops and on natural resources management in mountain systems and other less-favored areas where CIP can contribute to the achievement of healthy and sustainable human development.

[www.cipotato.org](http://www.cipotato.org)



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#### **International Potato Center**

Apartado 1558 Lima 12, Perú • Tel 51 1 349 6017 • Fax 51 1 349 5326 • email [cip@cgiar.org](mailto:cip@cgiar.org)