Mapping and GIS Analysis of IMCI programming and child health outcomes: Ethiopia, Nigeria and the DRC

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Background and Purpose

The Integrated Management of Childhood Illness [IMCI] was introduced as a global strategy by WHO in 1996 [1-3]. The strategy involves: 1) a community component, 2) recognition and management of common childhood illnesses at the first-level health facility and, 3) improvement of services at referral facilities. Each of the three components of the strategy requires both pre-service and in-service training. The WHO introduced training into many countries (Africa, Asia and Latin America), initially starting in geographic areas of a country with particularly high morbidity and mortality, but subsequently extending to the complete country (in most cases) [4,5]. Unfortunately, several problems arose with the strategy, one of them being the length of training necessary for continuity in districts where there is often high health worker turnover [6]. A more prudent approach might be a strategy that focuses on districts or health centers with the highest under five mortality.

Integrated Community Case Management [iCCM] is a strategy designed to train community health workers in the correct management of childhood pneumonia, diarrhea and malaria in the community, and to provide appropriate supervision and support with an uninterrupted supply of medicines and equipment required to manage these conditions [7]. Since UNICEF and WHO introduced the strategy into Africa in 2008, at least 38 countries have introduced some component of iCCM by 2014. While iCCM was designed primarily to be administered in areas with no access to care, it has been taken to scale in many countries, often with many thousands of community health workers being trained [8,9]. In many countries, the training has extended to all districts, regardless of high or low mortality. In fact in some countries, donor supported training has occurred in most districts, except the ones with the highest mortality [10]. As with IMCI, a more prudent approach would be to target districts or health centers with the highest disease burden.

Selective geographic targeting could be a more effective alternative for implementing health programs and interventions. The targeting of health interventions is not a new concept. As far back as the 1980's, researchers in health education/health promotion advocated "social marketing" strategies for public health interventions [11,12]. These strategies focus primarily on individuals and small groups, rather than targeting whole communities or entire populations, and develop health promotion messages or programs that are specifically targeted to the social and cultural circumstances of those small groups. But a major gap in the social marketing literature is the almost complete disregard for spatial relationships. The social marketing literature all but ignores the fact that most of the factors used to create targeted health programs – different care-seeking behaviors, socioeconomic status, and demographic characteristics – also have a strong geographic expression. Theoretical and empirical evidence from public health, geography, and sociology indicate that people with similar characteristics cluster in space, creating larger

spatial patterns within a population [13]. Geographic targeting, and the use of GPS and GIS technology, can be used for "spatial targeting" of interventions [14,15] which could improve the effectiveness and cost-effectiveness of IMCI/iCCM programming.

Geographic targeting requires a spatial analysis of disease burden, the location of health resources, and the location of major organizations operating in a region. Much of the time, geographically explicit information is available either through censuses, large-scale surveys or data maintained by heath organizations operating in a country. Maps and geographic analysis are a key method that can be used to examine under 5 disease burden, current IMCI/iCCM program implementation and the mismatch between need and service provision.

The purpose of this report is to provide case studies for how mapping of health and resource data can be used to further our understanding of IMCI/iCCM activities in three countries: Ethiopia, Nigeria, and the Democratic Republic of Congo (DRC). We provide:
1. An overview of the data source used to examine the geographic distribution of mortality, health and health behaviors and the partner mapping exercise.
2. A discussion of the results of the mapping exercise and recommendations for how to translate such maps into public health policy in developing countries.

Data

Health and Mortality Outcomes

The Demographic Health Surveys (DHS) are a population-representative household survey maintained by the DHS Program, implemented by ICF International, and funded by USAID (http://www.dhsprogram.com). The DHS have a variety of indicators on child morbidity and mortality, and most now collect GPS data which can be used to examine health indicators for small subnational areas. A 2014 report by USAID provides recommendations for geospatial analysis, suggests indicators appropriate for spatial analysis, and best practices for analyzing and displaying geographically explicit data [16]. This report supports geospatial analysis of DHS data and suggests it is reliable and accurate at the subnational level if analyzed correctly. At the same time, the DHS is a survey and subnational analyses can be subject to small numbers issues (especially for rare events such as infant mortality). In areas where sample sizes are small, rates and proportions should be interpreted with caution, and maps may reflect small numbers by showing areas with particularly high or low rates that do not accurately represent the reality of health outcomes in the area. In addition, some regions of a country may have no data at all. This occurs for a variety of reasons – e.g., populations are nomadic and difficult to sample, conflict creates dangerous operating conditions for interviewers.

DHS attempts to conduct surveys every 5-6 years in priority countries, but in some regions (especially those with significant conflict and political instability) the timing between surveys may be longer. Here we utilize the latest DHS for each country – the 2013 Nigeria DHS, 2013-2014 DRC DHS, and the 2011 Ethiopia DHS. As an example

of how DHS can be used over time, we also extracted the infant mortality rates from the 2006 Ethiopia DHS. From the Standard DHS files, the birth recode and child recode files were used; these files are structured as one row per child with the potential of multiple children per eligible woman interviewed. We use the following specific indicators from the DHS data:

Infant Mortality and *Under 5 Mortality* were developed using the SAS *DHS_U5M* package [17] which utilizes the birth roster from DHS to calculate 5- or 10-year mortality rates. The DHS birth roster asks all eligible women in the household to list all live births, whether the child is currently alive or dead and, if the child died, the date of death. This information is used to produce estimates of the infant mortality and under 5 mortality rate and summary statistics (rate and SD) by DHS cluster and district/subdistrict. Areas with too few observations of child death to create stable rates are excluded from analysis.

Percent of Children Underweight and *Percent of Children Stunted* were developed using the SAS *igrowup* package which applies the WHO Child Growth Standards [18]. The macro utilized DHS data on child age, sex, weight and length/height to produces sex- and age-specific estimates for the prevalence of under/over nutrition and summary statistics (mean and SD) of the z-scores for each indicator by DHS cluster and district/subdistrict. Extreme (i.e. biologically implausible) z-scores for each indicator are flagged and removed from analysis.

Prevalence of Acute Lower Respiratory Infection was developed using a series of questions which ask mothers about symptoms: cough, fever, rapid breathing or difficulty breathing. This measure should be interpreted with caution as it is only a 2-week recall and underestimates the true LRI burden in the area. The DHS is conducted over the course of a year, and regions that were surveyed during peak infection season are more likely to show higher rates of LRI.

Percent of Children Ever Breastfed was developed using as question on the DHS which asks if a woman ever breastfed their child. This question was asked separately for each of the prior three births.

Percent of Children Given Oral Rehydration Therapy was derived from a series of questions which asked women if a child had diarrhea in the last 2 weeks and, if so, whether or not the child was given oral rehydration solution as treatment. As with the LRI variable, this measure should be interpreted with caution as it is only a 2-week recall and underestimates the true diarrheal disease burden in the area and is subject to seasonality.

Percent of Children Fully Immunized measures the proportion of children who have received four WHO recommended vaccines: Measles, Polio, DPT and BCG. Vaccination is primarily recorded by copying the date a child received each immunization from a country-specific immunization card where available. The Standard DHS collects information for BCG, Polio, DPT and Measles. Some countries collect

additional immunizations. In the case that a child does not have an immunization card, the parent is asked directly whether the child had received each vaccine, and if so, how many times. Full vaccination was calculated as children aged 12 to 59 months who received all doses of the vaccines recommended by the EPI (BCG, three doses of OPV, three doses of DPT, Measles).

Partner Mapping Data

Information collected for the IMCI review in each country included geographic data by lowest level possible, and the activities of implementing partners. An example of how this listing can be collected is shown in Appendix A. We were able to obtain at least the locations of implementing partners for Nigeria and Ethiopia. No partner data was obtained from the DRC. We note two challenges to collecting and using these data:

1. For the most part, only a simple listing of partners by region was obtained. Additional information on the types of activities and funding amount for partners was often unavailable, though would be very important for understanding the roles of these organizations. The simple presence of partners in a region (which we map here) does not necessarily mean they are providing comprehensive health system strengthening support.
2. Geographically detailed information on the location of partners is challenging to obtain. For Nigeria, very detailed data was available for the location of all partners in the country. However, for Ethiopia, the data were quite mixed. For some of the partners, zone-level information available while for others we only obtained regional activities. It is unlikely that partners are providing services in an entire region and more detailed data is necessary for understanding the impact of programs.

In addition, available data on the number of health centers (HCs), health posts (HPs) and health education workers (HEWs) operating in each district was utilized for this analysis . The per capita number of HCs, HPs, and HEWs were calculated by dividing by the total population in each region. A limitation of these data is that only some partners reported these data, so there are many areas with no data in the maps. In other areas, the maps may underreport the true number of HCs, HPs, and HEWs.

Additional Data Sources

Conflict data came from the UCDP Georeferenced Event Database [19,20]. This is an event-based dataset of organized violence. The basic unit of analysis for the UCDP GED is the "event", an individual incident (phenomenon) of lethal violence occurring at a given time and place. It is a global dataset that covers the entirety of Asia, Africa and the Middle East (excluding Syria) between 1989-01-01 and 2014-12-31. Here we map the best (most likely) estimate of total fatalities occurring during the time of the DHS survey in each country to give a sense of the magnitude of the conflict in an area.

Food security data was obtained from the Famine Early Warning System Network (FEWS NET) [21]. The FEWS NET dataset estimates the state of food security in a country by using key drivers of food security, including agro-climatic performance, markets and trade, etc. This is a best estimate of likely food security and should not be

taken as a firm prediction. Acute food insecurity is classified into 5 levels: minimal, stressed, crisis, emergency and famine. Here we map the food security data for the year during which the DHS was conducted.

Discussion of Mapping Analysis

Infant Mortality/Under 5 Mortality

In Ethiopia, infant mortality is highest in the SNNP, Gambella and Benishangul-Gumuz regions and the southern Afar/northern Oromia regions of the country. The Developing Regional States (DRS) including Afar, Ethiopia-Somali, Benishangul-Gumuz and Gambella (with the exception of some towns and accessible districts) reportedly have poor health systems (weak in almost all the building blocks): infrastructure, human resource, equipment, supervision, partner's support etc. We did not receive data on the HEWs and HPS in these areas, so it is difficult to examine this hypothesis with the current mapping. Specifically, Save the Children and the International Rescue Committee are the main partners providing services in these regions, but we did not receive any data on the HPs and HEWs from these partners so it is unclear what resources are actually available. This information is critical for governance of the health system. Geographically explicit information is necessary so that governments can direct partners to the regions of most need. Placing such information in the hands of governing bodies ensures that they can take a leadership role in the process of health systems strengthening and service provision.

Given the standard of living and health services, it is difficult to explain the low IMR in the pastoralist areas of Ethiopia (especially the Eastern and SE parts). We suggest this may be due to limitations in the DHS data. Data collection procedures (the DHS does not cover nomadic populations well) and small numbers can drive larger regional patterns with the method we used (as discussed above). This highlights the importance of cautious interpretation of data and country-level review of mapping.

The 2005 infant mortality data suggests that SNNP, Gambella, Amhara and Afar have had historically high IM rates. But overall, between 2005 and 2011, infant mortality decreased across the country. The quality of the data in the 2005 DHS data is not as good, with fewer rural areas sampled and large portions of the country without data. This is a challenge with older DHS surveys, and can make historical longitudinal comparisons challenging in some countries. However, longitudinal analysis is imperative for program tracking, impact analysis and long term planning efforts. The DHS data collection effort is very important and should be supported into the future. In the case of infant mortality, we don't know if the apparent reduction is due to partnership activities, money, etc. because we do not have historical data on health resources or partner activities. Longitudinal data for resources and partner activities as well as health outcomes is imperative for governments to decide whether partners are having an impact on outcomes.

The question that arises from this GIS analysis is whether or not we can explain regional infant mortality rates, and if so how and with what data? Certainly, country-level knowledge about populations and resources are important, but there are a complex of factors – some not related to IMCI programs at all, such as conflict, food insecurity, and rural livelihood strategies – that contribute to infant and child death. A key strength of mapping is that data for many of these factors exist and can be integrated with country-specific health and resource data. The UCDP Conflict Database we use here is a good example of a potential data source for examining complex dynamics affecting child health.

Under 5 mortality is similarly high in SNNP, Gambella, Benishangul-Gumuz and Afar. However the ratio of infant mortality to under 5 mortality in Benishangul-Gumuz is different than other regions (under 5 mortality is higher) suggesting that something is happening between infancy and ages 1-5 which is driving the higher rate of under 5 mortality in this area. The conflict database shows that this region borders a conflict zone in southern Sudan and information from UNHCR show several refugee camps in this area related to this conflict.

Underweight/Stunting

Measures of underweight and stunting are a reflection of what has happened in the past. In comparing the underweight/stunting maps with the mortality maps, we see very different spatial patterns across all three countries; it does not appear that underweight is commensurate with infant mortality. However, it is clear from the FEWS NET data that food security is correlated with infant mortality, particularly in Ethiopia. Food security is vitally important for child health. IMCI efforts focus on managing undernutrition and malnutrition, but programs may not be able to affect these outcomes because of larger food security problems in a region. Management should perhaps be left to nutrition departments; IMCI should coordinate with FAO and other food/nutrition organizations to have a maximal impact on stunting and undernutrition.

Other outcomes

Data from the DHS survey on rates of ARI and use of ORS do not show any clear overlap with infant mortality or under 5 mortality. This could be an artifact of the data collection process (see discussion of the data above). For these variables it would be helpful to have a more longitudinal data set (e.g., a full year of data) perhaps from government sources.

The regional variation in immunization rates show how country-level indicators of vaccine coverage are driven by large urban areas. For example, the maps of Ethiopia show that county rates of immunization (between 75-85%) are driven by Addis Abba and Dire Dawa. Since these are the larger population centers, immunization efforts may reach more children, driving country reported rates. Immunizations rates are also higher in the Tigray region of the country where the health system is stronger in terms of

infrastructure, human resource, equipment, supervision, partners' support, which would clearly facilitate immunization efforts.

In Nigeria, we show a map of the location of Muslim population. It is clear from the DHS data that, for the most part, the areas with a large Muslim population are also the areas with the lowest vaccination rates. Similar to Ethiopia, the areas larger populations, mostly in the south and around the city of Kaduna, have higher immunization rates, suggesting that county-level reported rates may be driven by these areas. The southern region also happens to have the smallest Muslim population. This example shows how simple census data, which captures cultural and ethnic differences in countries may help to provide explanations for area-level patterns of immunization and other health behaviors.

Health Resources

Although the resource maps are incomplete (and only received from Ethiopia), there is still an imbalance between infant mortality and HEWs. In addition, there are inequalities in the distribution of HPs and HEWs across the country. There are some regions with 0.7 HEWs per 1,000 persons and other regions with fewer than 0.1 HEWs per 1,000 persons. It is possible that some regions have high turnover of health workers (including HEWs) related to high migration. Migration data for Ethiopia may help confirm these population dynamics.

Geographically detailed data on health resources can help guide relationship between developmental partners and governments so that resources are spent to actually achieve child health outcomes in the right areas. These data proved difficult to obtain for all the countries we examined, though other sources may be available. We had originally suggested using Service Provision Assessment (SPA) surveys from the DHS. The SPA is a health facility assessment that provides information on health service delivery. The surveys specifically examine availability of children's health services and IMCI. For example, in 2014 the Ethiopia Service Provision Assessment Plus Survey (2014 ESPA+) was conducted with technical support from ICF International under the MEASURE DHS Project, and World Bank [22]. These data, however, are not publically available on the DHS Program website, so we could not integrate them into this project. The SARA has not been conducted for the other 2 countries. The Service Availability and Readiness Assessment (SARA) tool by the WHO is a very similar tool which has been implemented in the Democratic Republic of Congo. These data were only available in French, and could not be translated for this project. However, these may be viable sources of resource data for future mapping efforts.

The location of partners also shows that some areas have many partners, while some have none. This is particularly apparent in Nigeria where partners are operating in sometimes very small, very specific geographic areas. The Cross Rivers and Niger states have 5 different partners with programming while Adamawa and some small

areas in Zafara state have no partners at all. Such information may be useful for governments wishing to direct resources to areas of need.

Broader implications of the analysis for the strategic review of IMNCI

Implications for the Ministry of Health for countries

The DHS data is available for most developing countries and is usually used to help guide high-level programmatic implementation for a country or region. We have used a very small proportion of the data that is available in the DHS including the often overlooked geographic information that is collected along with the surveys. Careful mapping of data, and overlaying of information with partner and resource availability data, makes a very simple graphic representation of what is happening in the country. Much more data is available in the DHS data sets for each country, and depending on how the data is mapped, it can be utilized in real time for planning health interventions. Given the increasingly complex implementation of Healthcare Services, ranging from the community to the hospital, targeting interventions specifically to some areas and targeting resources as well as coordinating with various developmental implementation partners could result in more effective use of resources.

We have only been able to use a small portion of the data, related to IMCI and iCCM implementation, though the government will have access to much more granular data, that we were not privy to. As can be seen in the comparisons between the data from the three countries illustrated here, the more specific the data, the more detailed the analysis can be made.

The graphic representation of data, of course, is a very potent visual aid in advocacy, but also in planning.

Implications for the IMNCI strategic review

Though not comprehensive, the data presented here from three countries clearly illustrates the areas where infant and under five mortality are high. Coupled with local country level data, the interpretation of data could be very powerful in developing targeted strategies for rapidly reducing infant in under five mortality. It can also be seen that while there are many partners working in countries, it is possible that with governmental support, resources could be directed to areas with higher mortality, to overcome many limitations that contribute to this mortality. This analysis does not suggest what the problems or what the solutions are, but a detailed analysis, with government and partner input, could help focus these interventions

Limitations of interpretation and potential

It is quite clear that the data presented here is representative, and yet not comprehensive The DHS data we used was sampled from the whole country, and as can be seen in some areas where data is not available or is sparse (e.g., Ethiopia),

conclusions cannot be made. For some seasonal diseases, ARI and diarrhea for instance, the cross-sectional surveys reflect only disease that occurred in the last two weeks and cannot be extrapolated beyond that's was presented here, with the caveats and limitations expressed above.

If additional data were available, for instance the geospatial mapping of health extension workers or health posts, a more detailed analysis could have been done. Such data might be available, and could assist in more detailed mapping and analysis. Population-based data, and projections from a census, at the district level or sub district levels, would be useful in determining the overall burden of disease.

If individual partner expenses on different programs were available by year, or major program [IMCI, EPI, nutrition etc.] as well as government expenditure at the same levels, this would allow for a very rapid visual presentation of data that could be used in planning and advocacy.

Most importantly interpretation of the data is subject to a deep understanding of all of the factors that influence morbidity and mortality. This is probably best done by people involved in government in the country, since they would have the best knowledge of local circumstances. For instance, we noted the imbalance between infant and under five mortality with the rates of acute and chronic malnutrition. In Ethiopia, this appears to track much closer with food insecurity than with infant and under five mortality. But this may not be true for all countries, especially those without acute food insecurity issues.

We suggest that analyses such as these can be expanded at great length with currently available data, if coordinated with governmental input. This data could be very rapidly used to assist in health resource planning and programmatic implementation. It can be very useful for developmental partners as well as UN organizations and other funding agencies working in developing countries.

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Appendix A: Partner Listing

IMNCI Strategic Review - COUNTRY NAME

Please list all partners working in country on IMCI / IMNCI / iCCM:

	Partner name	Districts or regions supported (please specify if the whole district or region is supported or only parts)	Programming provided	Years of support	Amount of funding
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Appendix B

Maps of Ethiopia, Nigeria and the
Democratic Republic of Congo

ETHIOPIA

Administrative Regions and Zones of Ethiopia

W. Tigray

C. Tigray

E. Tigray

Mekele

Afar Zone2

N. Gonder

Wag Hemra

S. Tigray

Afar Zone4

Afar Zone 1

Metekel

S. Gonder

Bahir Dar

N. Wello

Oromiya (R3)

Agew Awi

W. Gojam

E. Gojam

S. Wello

Afar Zone5

Asosa

Kamashi

E. Wellega

N. Shewa (R3)

Afar Zone3

Shinile

Dire Dawa

Tongo

N. Shewa (R4)

Addis Ababa

Harari

Jigjiga

W. Wellega

W. Shewa

E. Shewa

W. Harerge

E. Harerge

Gambella Zone 3

Gambella Zone 1

Illubabor

Yem

Gurage

Arsi

Degehabur

Gambella Zone 2

Jimma

Hadiya KAT

Fik

Warder

Keficho Shekicho

Bench Maji

N. Omo

Sidama

Bale

Korahe

Gambella Zone 4

Dirashe

Gedio

Gode

South Omo

Amaro

Burji

Afder

Konso

Borena

Liben

Inset map

Tigray

Beneshangul Gumuz

Amhara

Afar

Dire Dawa

Addis Abab

Harari

Gambella

SNNPR

Oromiya

Somali

Persons per km²

	0
	1 - 5
	6 - 25
	26 - 250
	251 - 1,000
	1,001 +

Source: Global Urban-Rural Mapping Program, CIESIN, Columbia University

Ethiopia
Infant Mortality Rate
(per 1,000)

Infant Mortality Rate
High : 141.2

Low : 41.6

No DHS Data
Water Areas
Zone Boundary
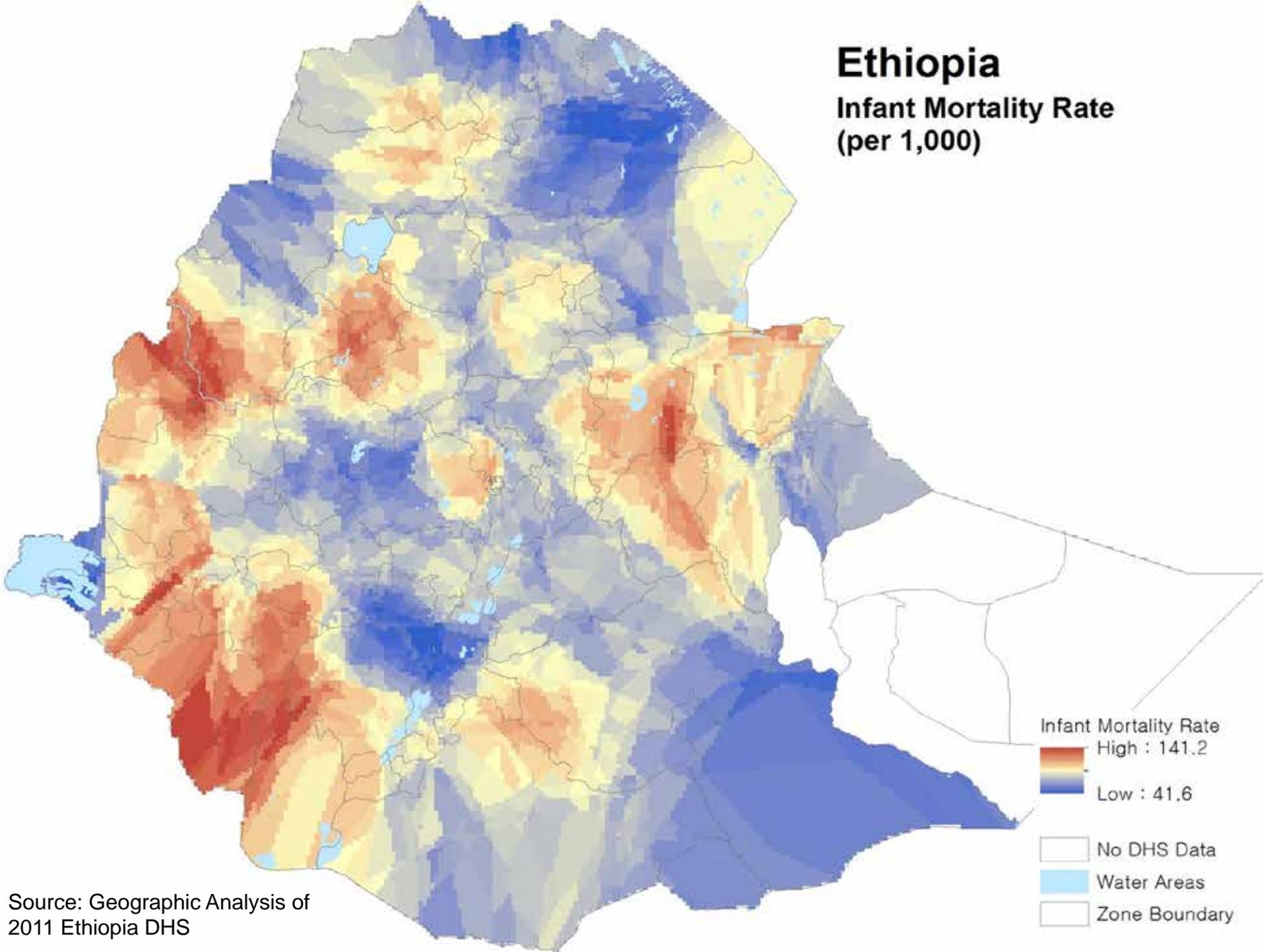
Source: Geographic Analysis of
2011 Ethiopia DHS

Ethiopia
Infant Mortality Rate
(per 1,000)
2005

Infant Mortality Rate

High : 170.3

Low : 31.4

No DHS Data
Water Areas
Zone Boundary
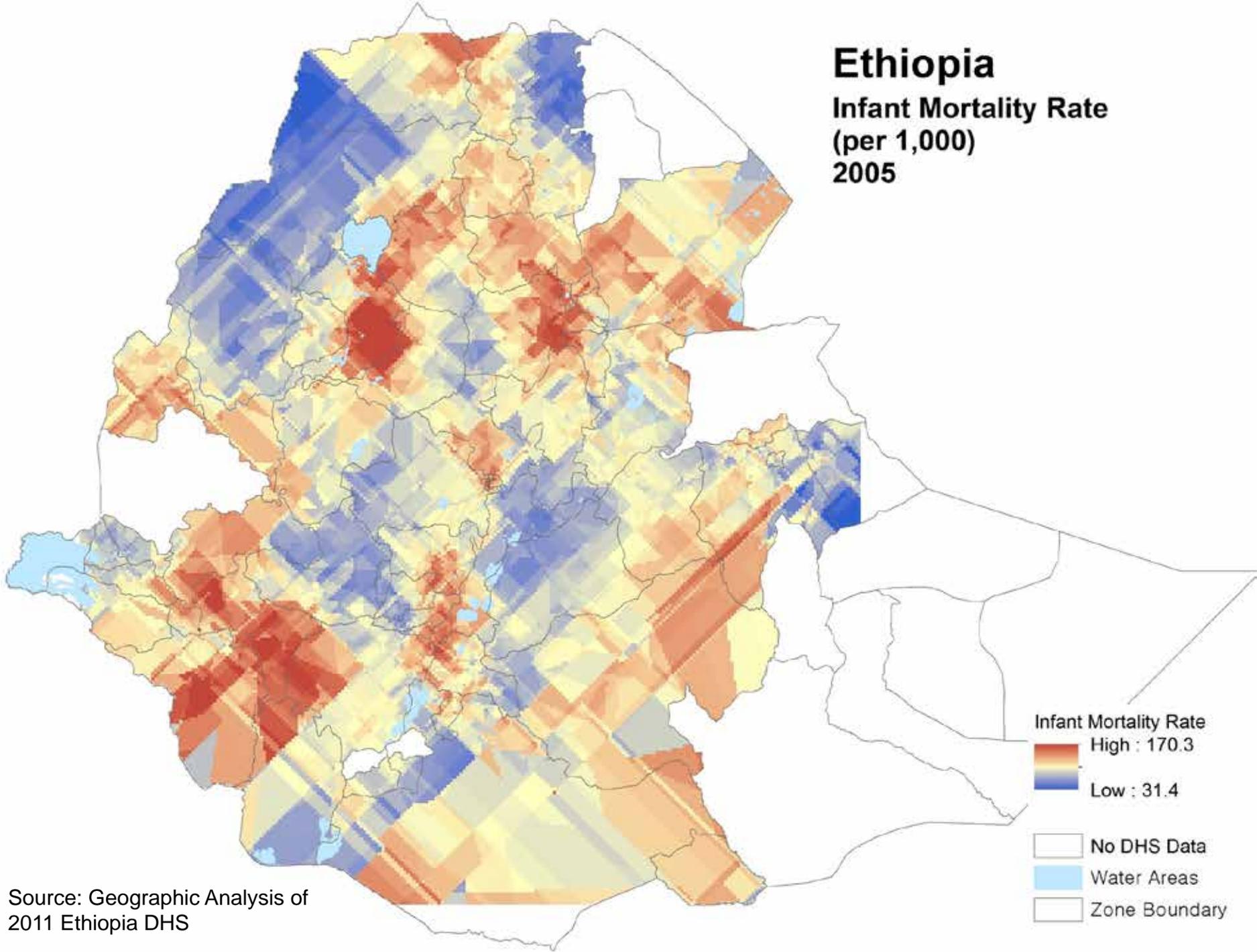
Source: Geographic Analysis of
2011 Ethiopia DHS

Ethiopia
Under 5 Mortality Rate
(per 1,000)
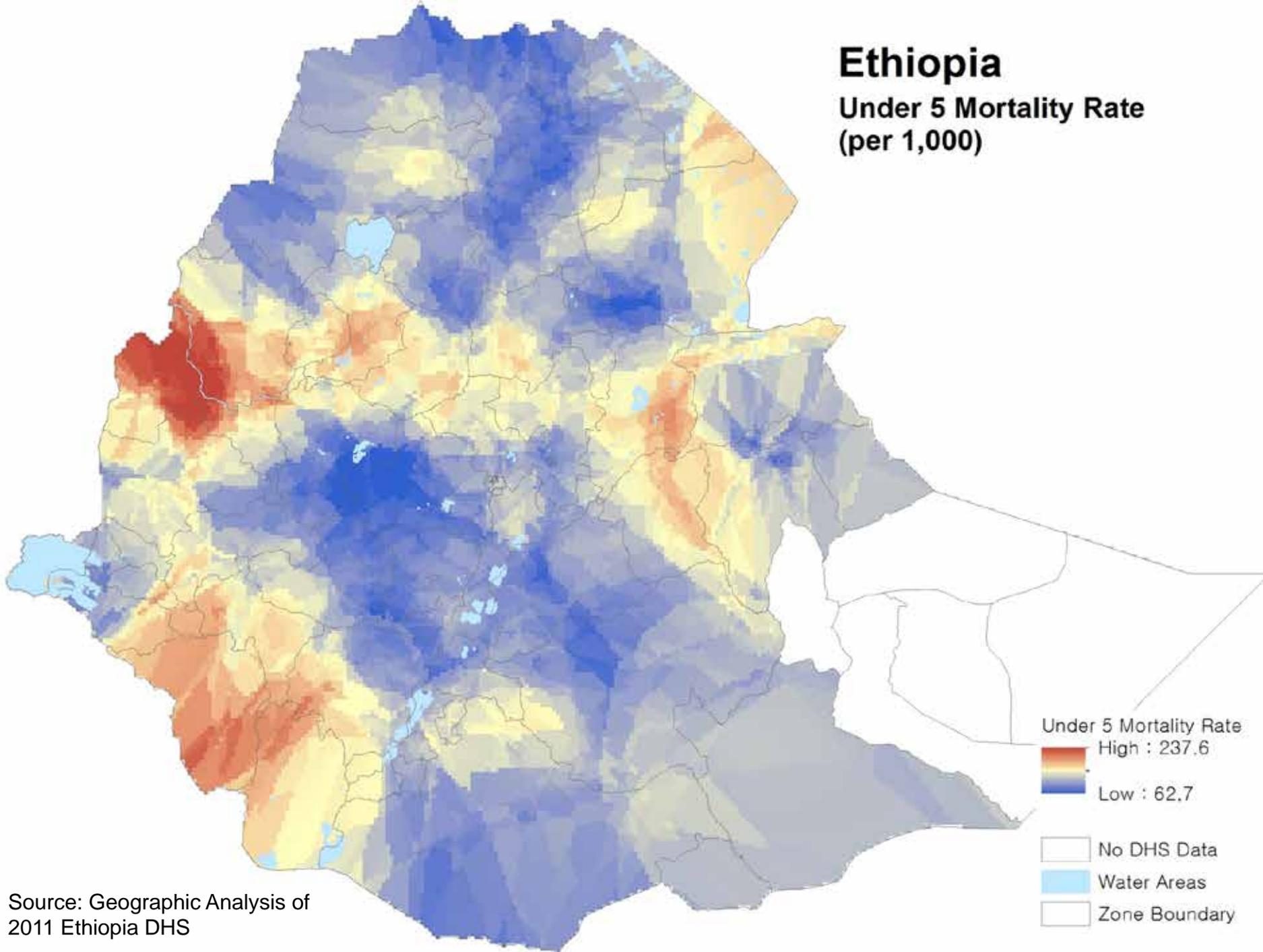
Under 5 Mortality Rate
High : 237.6

Low : 62.7

No DHS Data
Water Areas
Zone Boundary

Source: Geographic Analysis of
2011 Ethiopia DHS

Ethiopia
Percent of Children Underweight

% Underweight
High : 55.6

Low : 2.8

No DHS Data
Water Areas
Zone Boundary

Source: Geographic Analysis of 2011 Ethiopia DHS

Ethiopia
Percent of Children Stunted

% Children Stunted
High : 66.0
Low : 10.7

No DHS Data
Water Areas
Zone Boundary
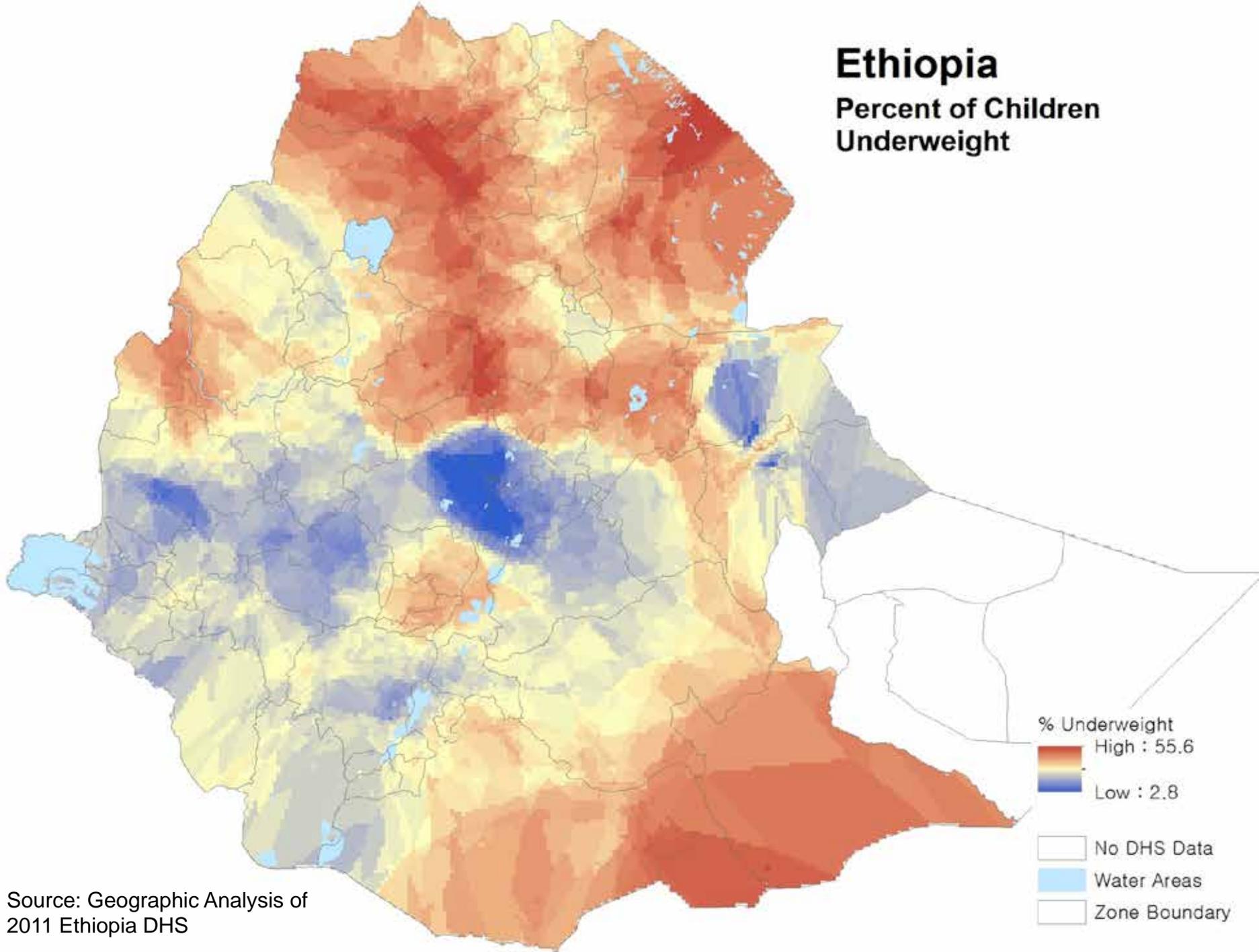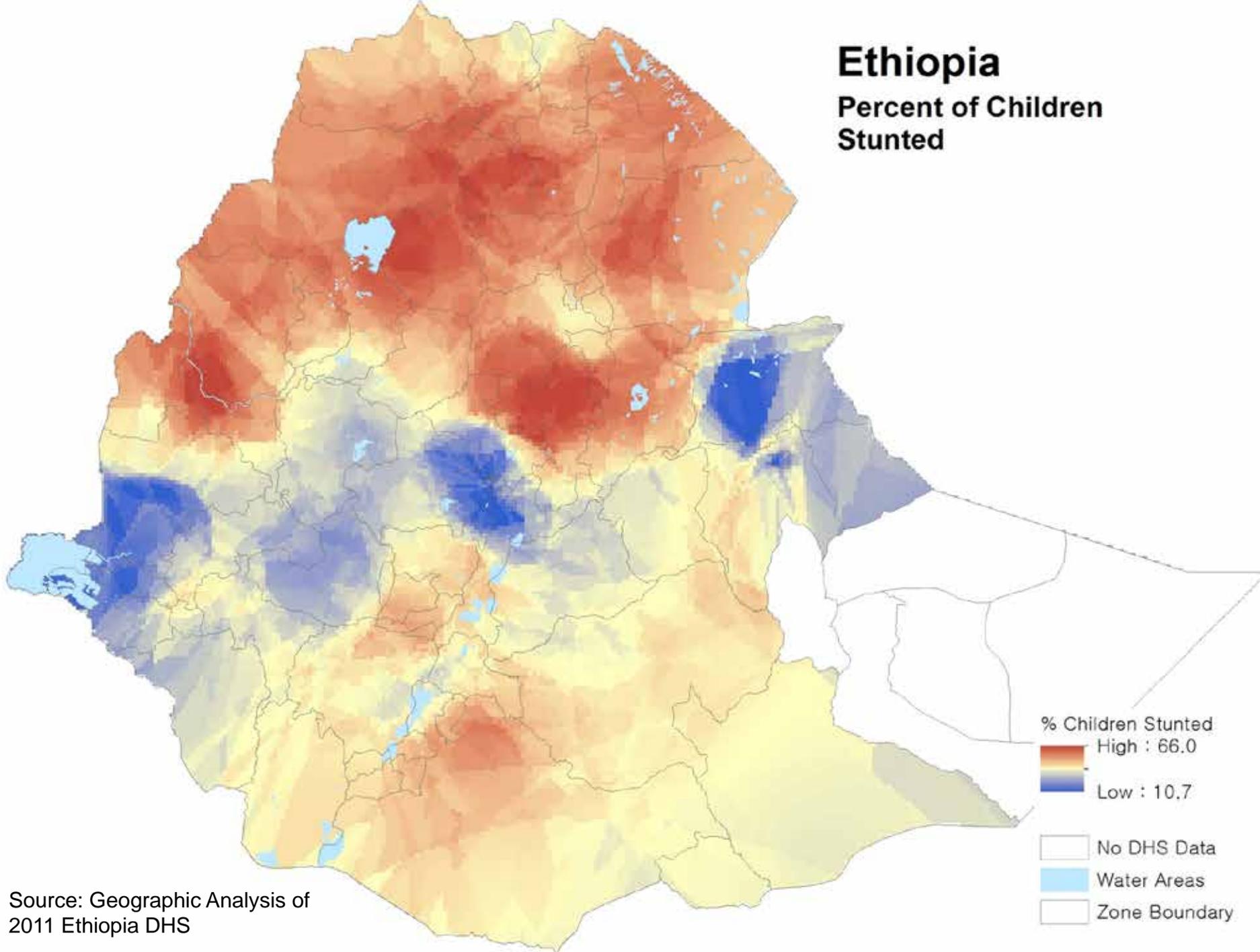
Source: Geographic Analysis of 2011 Ethiopia DHS

Ethiopia
ARI Rate per 1,000

ARI Rate per 1,000
High : 247.9
Low : 59.5

No DHS Data
Water Areas
Zone Boundary
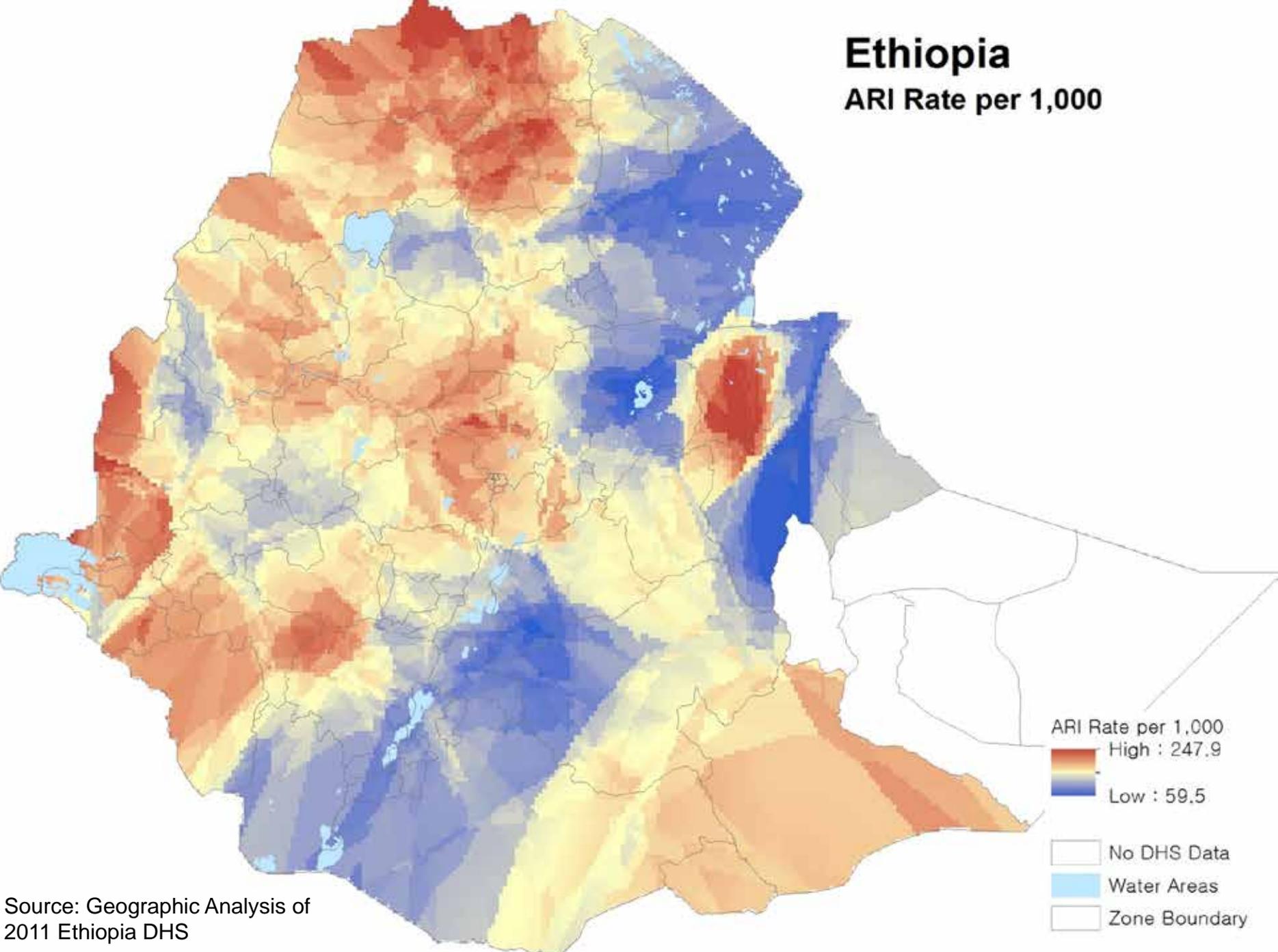
Source: Geographic Analysis of
2011 Ethiopia DHS

Ethiopia
Percent of Babies Ever Breastfed
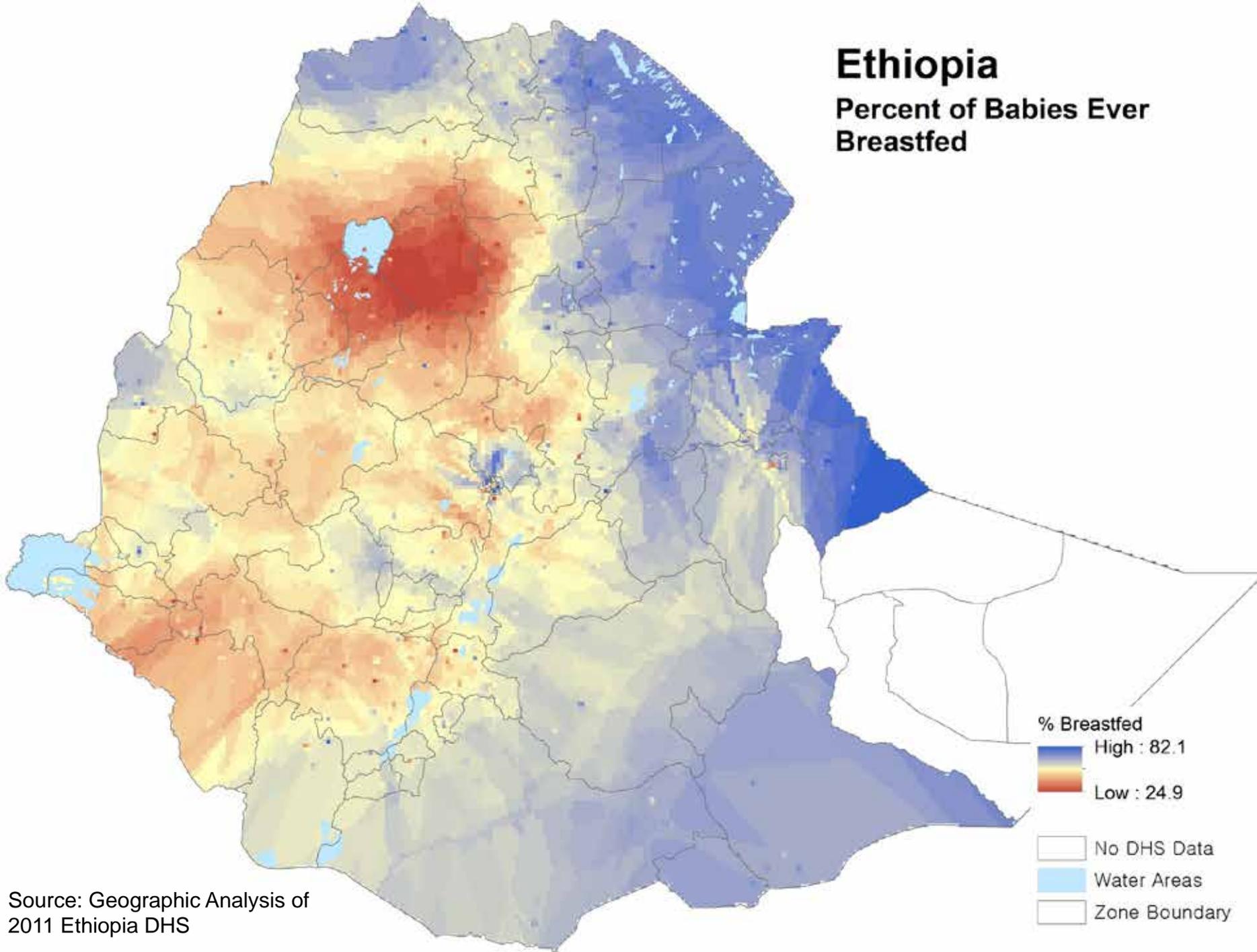
% Breastfed
High : 82.1
Low : 24.9

No DHS Data
Water Areas
Zone Boundary

Source: Geographic Analysis of
2011 Ethiopia DHS

Ethiopia
Percent of Children Fully Immunized

% Fully Immunized
High : 71.3
Low : 7.6

No DHS Data
Water Areas
Zone Boundary
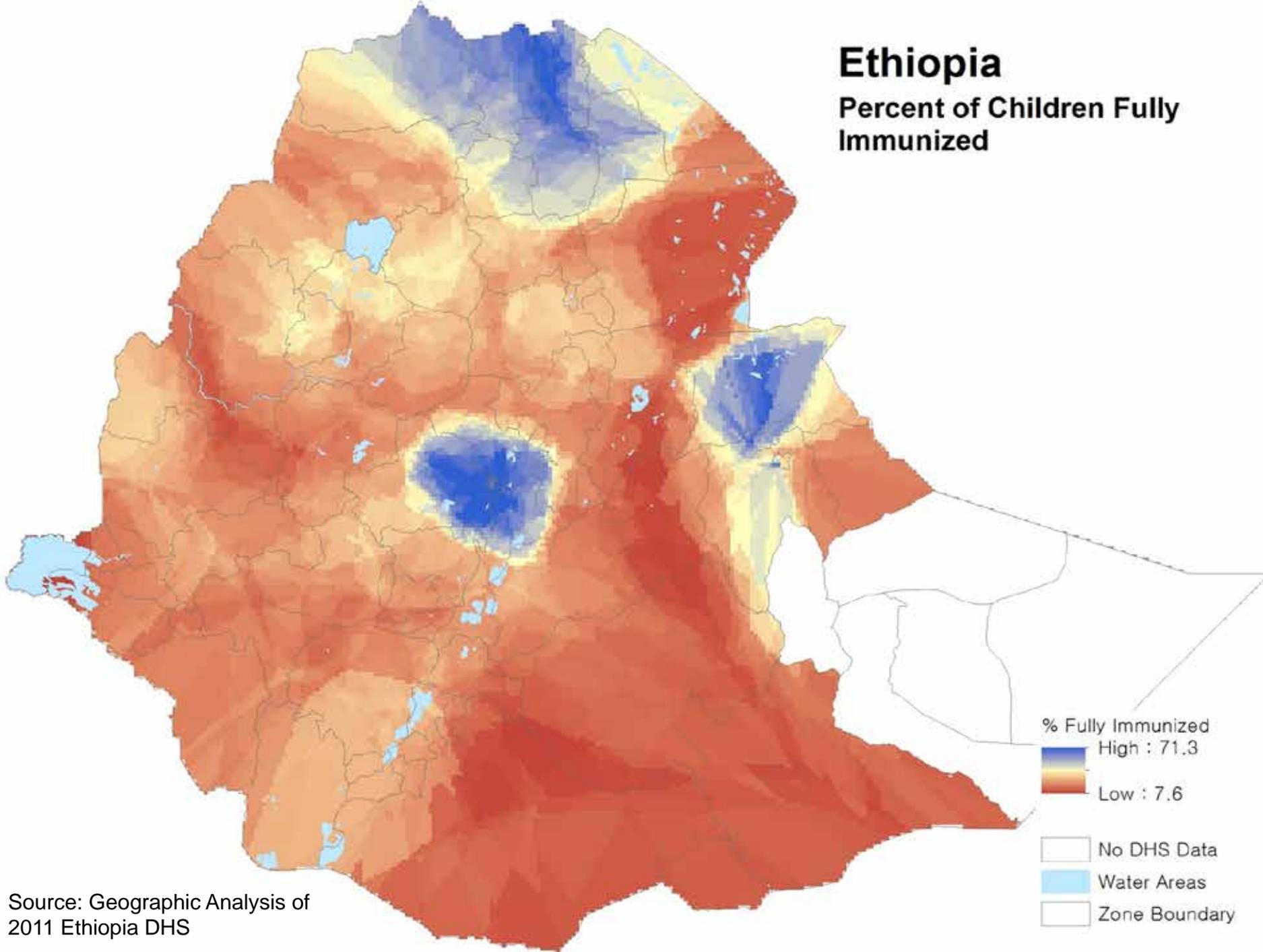
Source: Geographic Analysis of
2011 Ethiopia DHS

Ethiopia
Location of Implementing Partners

Implementing Partner

- Int'l Rescue Comittee
- MOH
- Save the Children
- L10K
- JSI
- IFHP
- SCI
- Water Areas
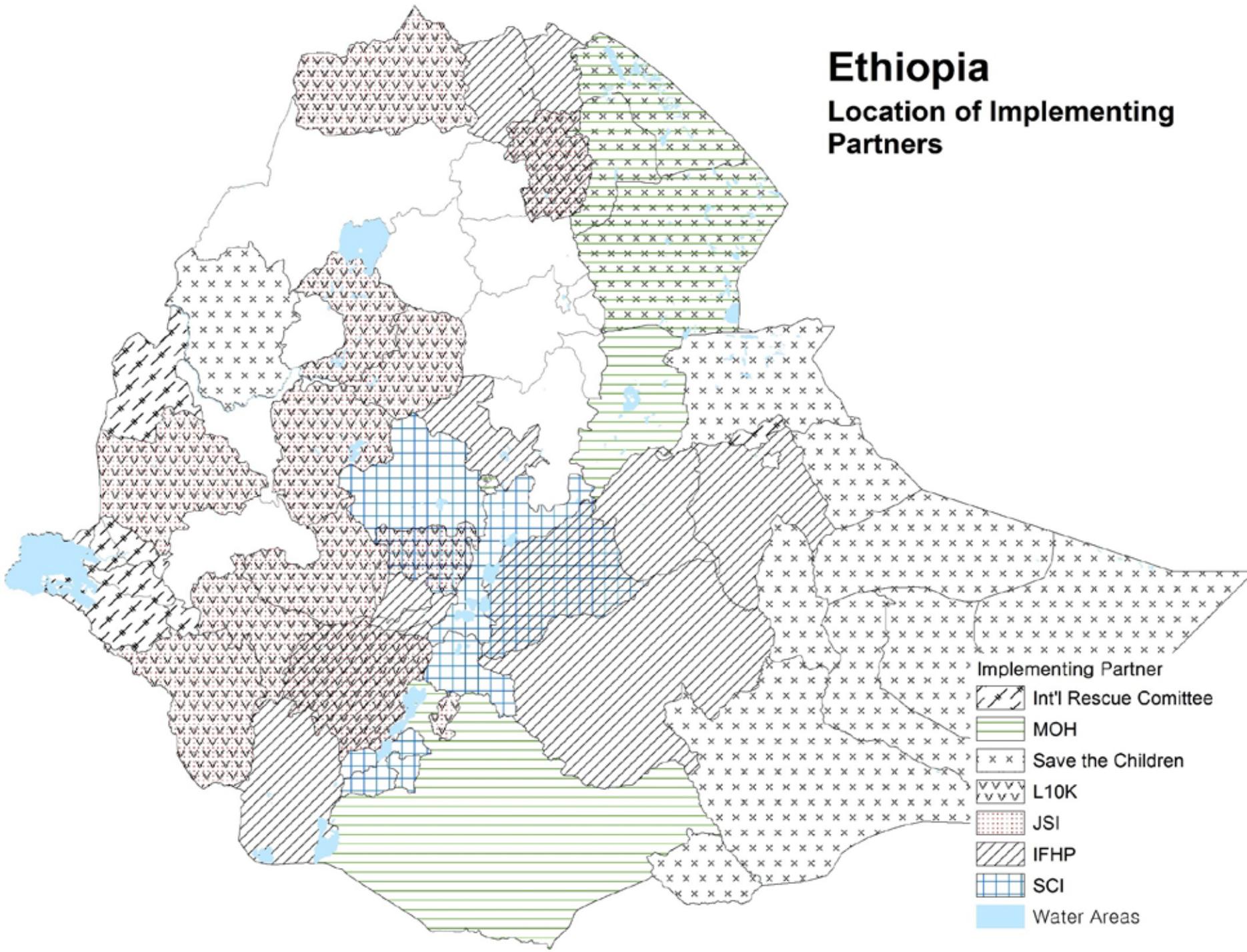
Ethiopia
Funding Sources

Funding Source

- UNICEF
- USAID
- CIFF
- Water Areas

Ethiopia
Health Centers per Capita

HCs per capita
No Data
0.03
0.04
0.05
0.06
Water Areas
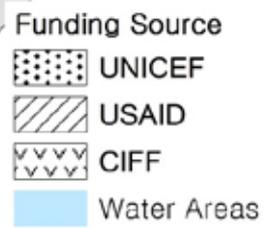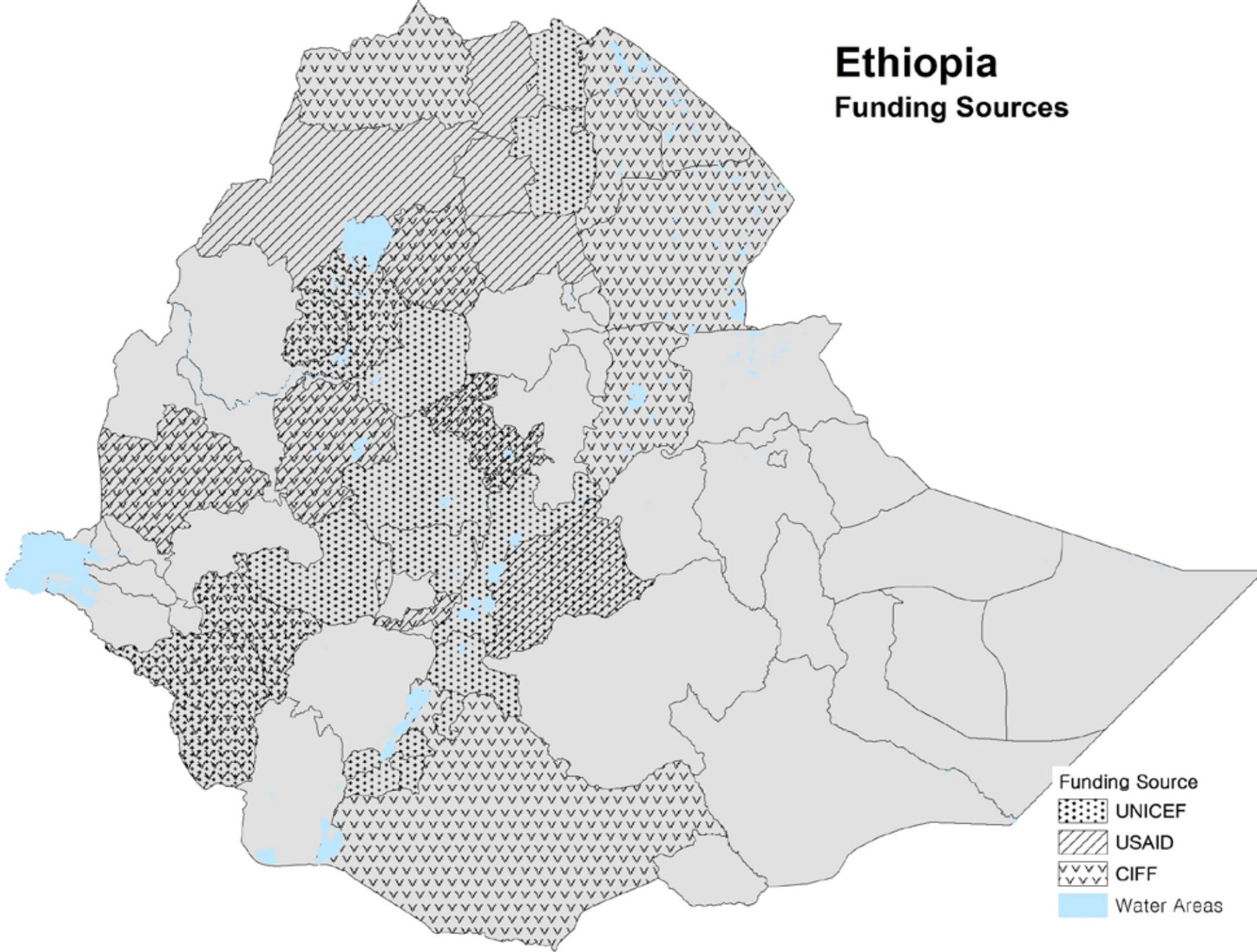
Ethiopia
Health Posts per Capita

HPs per capita

No Data
0.01 to 0.17
0.18 to 0.20
0.21 to 0.27
0.28 to 0.35
Water Areas
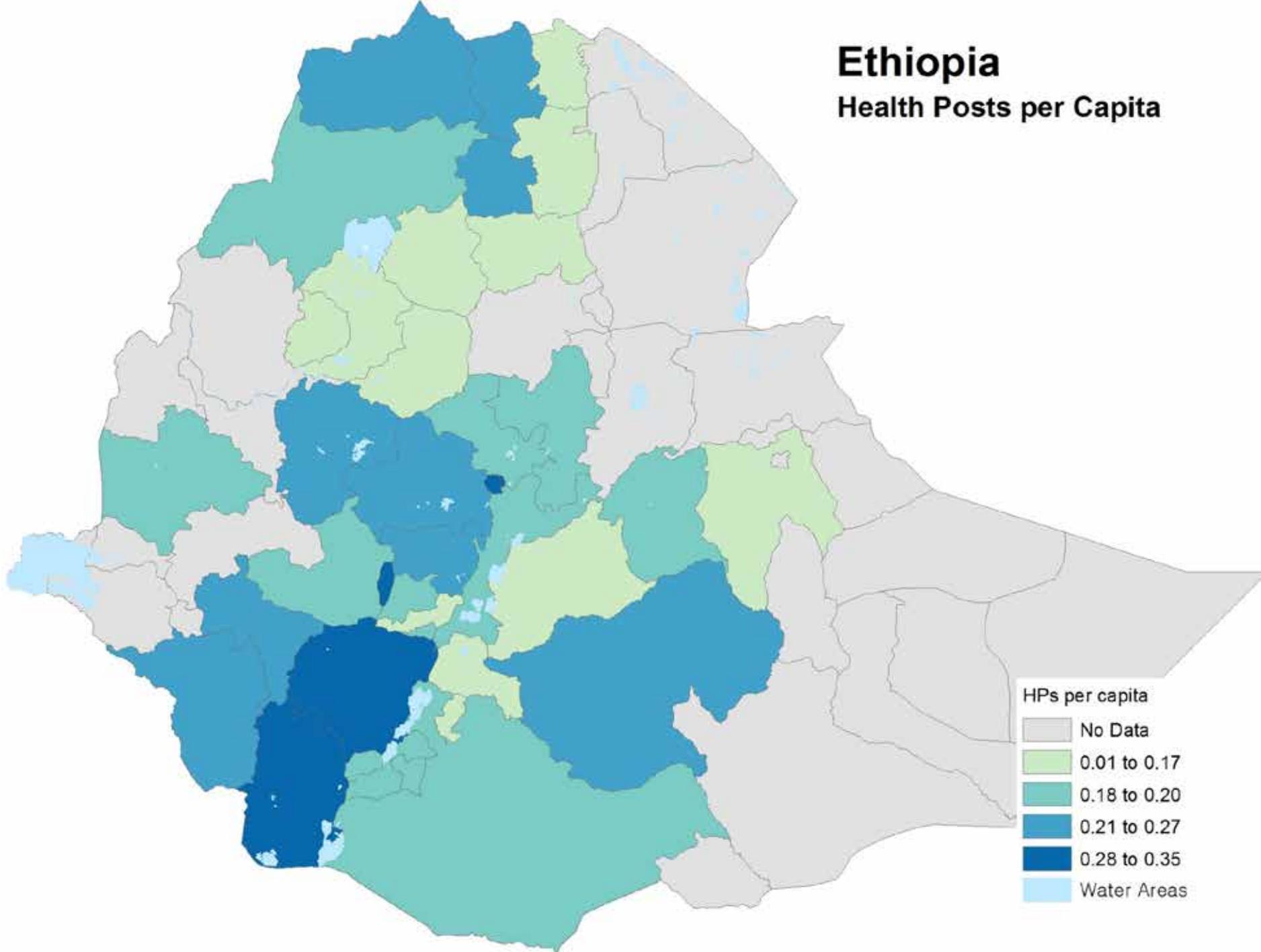
Ethiopia
Health Extension Workers per Capita
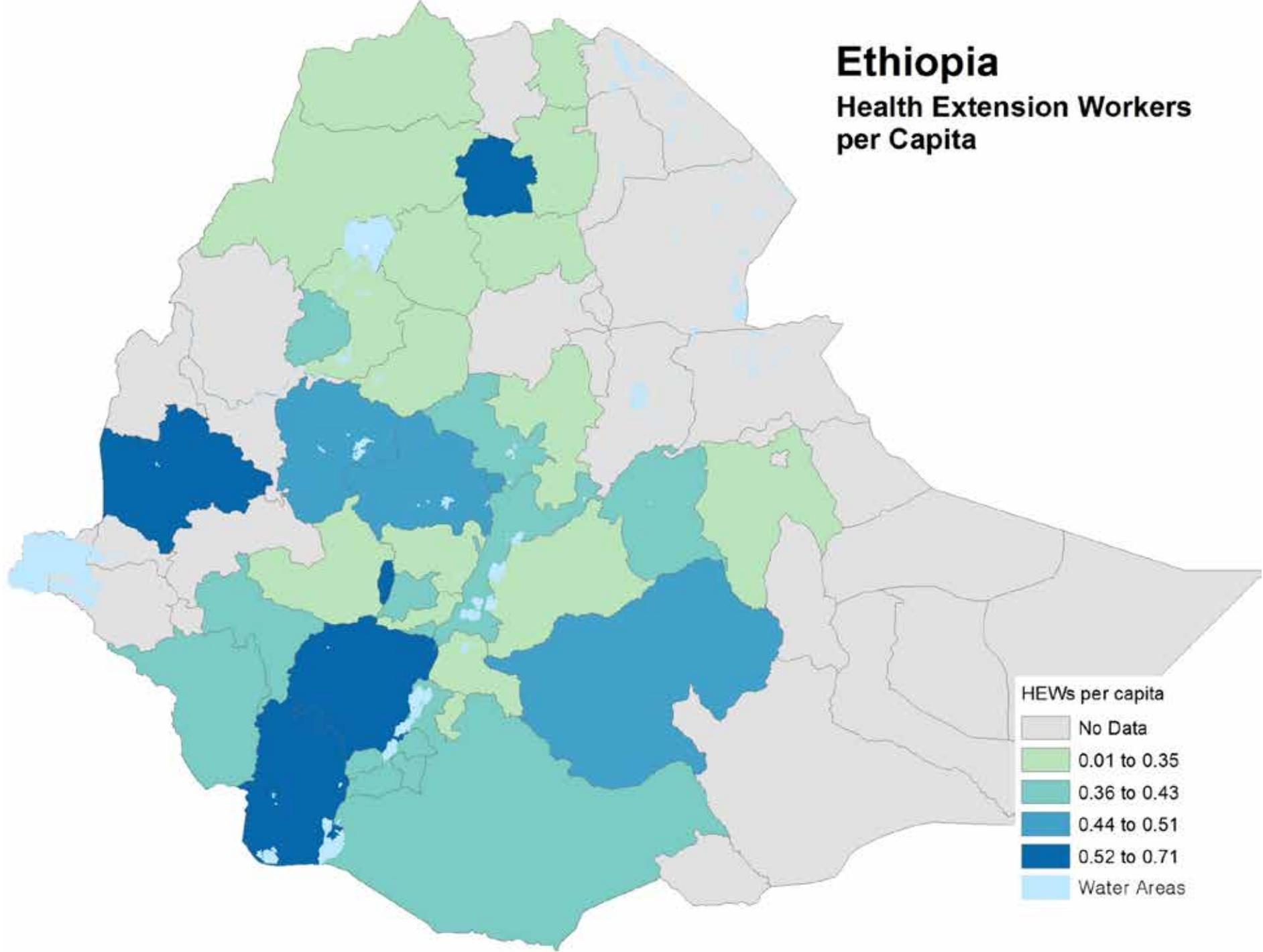
HEWs per capita

- No Data
- 0.01 to 0.35
- 0.36 to 0.43
- 0.44 to 0.51
- 0.52 to 0.71
- Water Areas

Ethiopia
Percent of Children
Underweight
and
Estimates of Food Insecurity

(Famine Early Warning System Network – FEWS NET)

Food Insecure Areas
Stressed
Crisis
% Underweight
High : 55.6
Low : 2.8

No DHS Data
Water Areas
Zone Boundary

Ethiopia

Infant Mortality Rate (per 1,000) and Estimated Number of Deaths from Conflict

(UCDP Georeferenced Event Dataset v.4.0)

Est. Number of Deaths
- 0 - 9
- 10 - 49
- 50 - 99
- 100 - 199
- 200 - 433

Infant Mortality Rate
High : 141.2
Low : 41.6

No DHS Data
Water Areas
Zone Boundary

NIGERIA

NIGERIA

N

CHAD

NIGER

BENIN

BF

BORNO

Lake Chad

N'Djamena

Sokoto

SOKOTO

Katsina

KATSINA

Birnin Kebbi

Gusau

KANO

JIGAWA

YOBE

ZAMFARA

Kano

Dutse

Damaturu

Maiduguri

KEBBI

Zaria

KADUNA

BAUCHI

GOMBE

Kaduna

Bauchi

Gombe

NIGER

ADAMAWA

Minna

Jos

CHAD
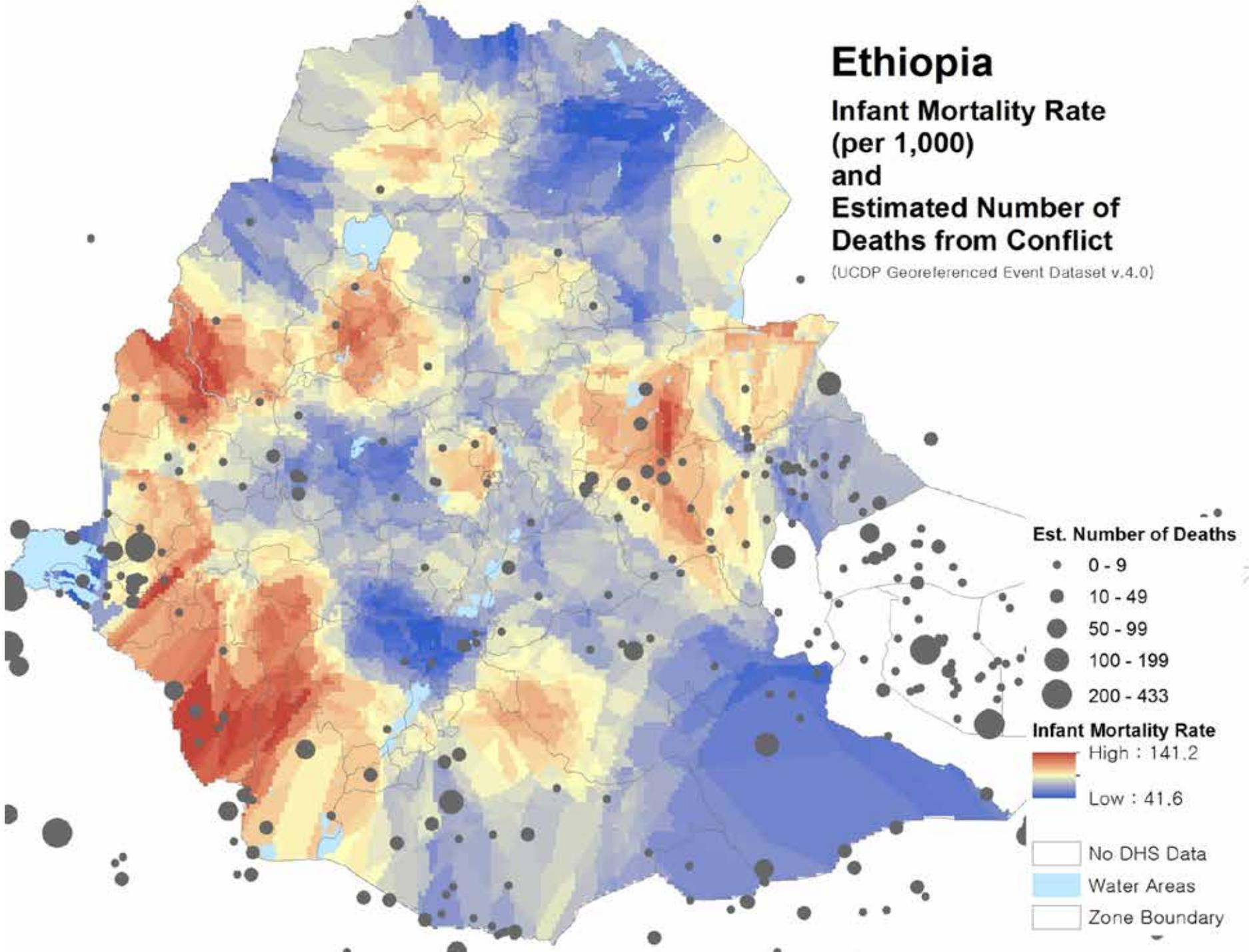
Abuja

PLATEAU

Yola

ABUJA CAPITAL TERRITORY

NASSARAWA

KWARA

Ilorin

Lafia

Jalingo

OYO

Lokaja

TARABA

EKITI

Makurdi

Oshogbo

Ado-Ekiti

KOGI

BENUE

Ibadan

OSUN

Akure

Abeokuta

ENUGU

OGUN

ONDO

EDO

Enugu

Ikeja

Benin City

EBONY

CROSS RIVERS

Lagos

LAGOS

ANAMBRA

Asaba

Abakaliki

Porto-Novo

Awka

Bight of Benin

IMO

DELTA

Owerri

Umuahia

CAMEROON

Gulf of Guinea

RIVERS

ABIA

Uyo

Calabar

C.A.R.

Yenagoa

Port Harcourt

AKWA IBOM

BAYELSA

Niger Delta

Bight of Biafra

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NIGERIA

NIGERIA

⊗	National capital
⊙	State capital
–·–·–	International boundary
———	State boundary

Scale:
0 50 100 150 200 km
0 50 100 mi

NIGER

CHAD

5°E
10°E
15°E

• Lema
• Isa
Sokoto
• Kukawa
• Kaura namoda
• Monguno
Bimin Kebbi
• Dange
• Katsina
• Bundi
• Maradun
Nguru • Gashua
Gamboru
• Gummi
Gusau
• Musawa
• Bichi
Kano
• Hadejia
Maiduguri
N'DJAMENA

BURKINA
FASO
• Mutumji
• Funtua
Dutse
Damaturu
• Azare
• Goniri
• Daura
• Buni
• Bama

• Zuru
Zaria
• Ikara
• Ningi
• Damboa

BENIN
Niger
• Sabon Birni
• Miya
• Biu

Lake
Kainji
• Kontagora
Kaduna
Bauchi
Gombe
• Mubi

10°N
• Kabogi
• Idon
• Idon

• Kaiama
Minna
• Kafanchan
Jos
N I G E R I A
• Numan
Yola

• Gwasero
• Bida
Suleja
• Bashar
Jalingo

• Kishi
ABUJA
• Keffi
• Shendam
CHAD

• Igboho
Ilorin
• Nasarawa
Lafia

• Shaki
• Offa
• Wukari

• Iseyin
Ikiroy
Lokoja
• Mararaba
• Serti
C.A.R.

• Oyo
• Iwo Osogbo
Ado
Okene
• Ankpa
Makurdi

• Igooora Ibadan
• Ife Ilawa
• Ise Ikare
• Gboko

• Ikire
Akure
• Owo
• Auchi
• Idah

Abeokuta
• Ondo
• Ekpoma
• Aku
• Otukpo

PORTO
NOVO
• Ifo
Ijebu ode
• Okpoko
• Urom
Enugu
• Effium

Cotonou
Lagos
• Okitipupa
Agbor
Awka
Abakaliki
• Ikom

Bight of Benin
Benin City
Asaba
• Ahkpo
• Ugep

Sapele
• Ihiala
Amaigbo
• Warri
• Uchabi
Owerri
Umuahia
Katekpene

5°N
Gulf
of
Guinea
Yenagoa
Aba
Uyo
Calabar
Port Harcourt
CAMEROON

STATES
1. Abia
2. Anambra
3. Enugu

NIGERIA
POPULATION
Country capital
State capital
Other city
State border

Persons per square km
0
1
25
100
250
1000

0   100 km
0   100 mi

N

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NIGER

CHAD

SOKOTO

KATSINA

JIGAWA

YOBE

BORNO

ZAMFARA

KANO

KEBBI

BAUCHI

GOMBE

BENIN

NIGER

KADUNA

ADAMAWA

KWARA

FEDERAL
CAPITAL

PLATEAU

NASAWARA

NIGERIA

OYO

EKITI

KOGI

BENUE

TARABA

OSUN

ONDO

OGUN

EDO

ENUGU

LAGOS

EBONYI

ANAMBRA

DELTA

IMO

ABIA

CROSS
RIVERS

CAMEROON

BAYELSA

RIVERS

AKWA
IBOM

250 km

Muslim Population
2012, % of respondents

- 80-100
- 60-79
- 40-59
- 20-39
- 1-19
- 0

∫ States with *sharia*

Source: The Economist, 2015

Nigeria
Infant Mortality Rate
(per 1,000)

Water Areas

State Boundary

Infant Mortality Rate

High : 161.9

Low : 25.2

Source: Geographic Analysis of
2013 Ethiopia DHS

Nigeria

Under 5 Mortality Rate (per 1,000)

Under 5 Mortality Rate

High : 292.5

Low : 29.8

Water Areas

State Boundary

Source: Geographic Analysis of 2013 Ethiopia DHS

Nigeria
Percent of Children Underweight

Underweight
High : 86.5

Low : 0

Water Areas

State Boundary

Source: Geographic Analysis of
2013 Ethiopia DHS

Nigeria

Percent of Children Stunted

% Children Stunted

High : 80.6

Low : 2.8

Water Areas

State Boundary

Source: Geographic Analysis of
2013 Ethiopia DHS

Nigeria
ARI Rate (per 1,000)

ARI Rate per 1,000
High : 150.2
Low : 17.0

Water Areas
State Boundary

Source: Geographic Analysis of
2013 Ethiopia DHS

Nigeria

**Percent of Children
Ever Breastfed**

% Breastfed

High : 83.8

Low : 55.1

Water Areas

State Boundary

Source: Geographic Analysis of
2013 Ethiopia DHS

Nigeria

Percent of Children Fully Immunized

% Fully Immunized
- High : 66.4
- Low : 5.3

Water Areas

State Boundary

Source: Geographic Analysis of 2013 Ethiopia DHS

Nigeria
Percent of Children
Fully Immunized

% Fully Immunized
High : 66.4
Low : 5.3

Water Areas
State Boundary

NIGER

SOKOTO

KATSINA

JIGAWA

YOBE

BORNO

CHAD

KEBBI

ZAMFARA

KANO

KADUNA

BAUCHI

GOMBE

BENIN

KWARA

NIGER

FEDERAL CAPITAL

PLATEAU

ADAMAWA

OYO

NASAWARA

N I G E R I A

TARABA

OSUN

EKITI

KOGI

BENUE

OGUN
LAGOS

ONDO

EDO

ENUGU

EBONYI

ANAMBRA

DELTA

IMO ABIA CROSS
RIVERS

CAMEROON

BAYELSA

RIVERS

AKWA
IBOM

250 km

Muslim Population
2012, % of respondents

80-100
60-79
40-59
20-39
1-19
0
States with *sharia*

Nigeria

Total Number of Partners by State

Implementing Partner

- NPHCDA
- CHAI
- BBMCA
- SFH
- WINNN
- SURE_P
- MI
- SHOPS
- Pact
- PATHS2

Nigeria

Total Number of Partners by State

Number of Partners

1
2
3
4
5

Water Areas

State Boundary

Nigeria

Percent of Children Underweight and Estimates of Food Insecurity

(Famine Early Warning System Network – FEWS NET)

Food Insecure Areas

Stressed

Crisis

% Children Underweight

High : 86.5

Low : 0

Water Areas

State Boundary

Nigeria

Infant Mortality Rate (per 1,000) and Estimated Number of Deaths from Conflict

(UCDP Georeferenced Event Dataset v.4.0)

Est. Number of Deaths
- 0 - 9
- 10 - 49
- 50 - 99
- 100 - 199
- 200 - 540

Infant Mortality Rate
High : 161.9
Low : 25.2

Water Areas
State Boundary

Democratic Republic of Congo

DECENTRALIZED PROVINCES OF THE DEMOCRATIC REPUBLIC OF THE CONGO

USAID
FROM THE AMERICAN PEOPLE

Legend

- ★ Country Capital
- ⊙ New Province Capital
- • Ville (City)
- ☐ New Province Boundary
- Water Body

Former Provinces

- Bandundu
- Bas-Congo
- Equateur
- Kasai Occidental
- Kasai Oriental
- Katanga
- Kinshasa
- Maniema
- Nord-Kivu
- Province Orientale
- Sud-Kivu

NORD-UBANGI
SUD-UBANGI
MONGALA
KINSHASA
KONGO CENTRAL
KWANGO
KASAI CENTRAL
KASAI ORIENTAL
LUALABA

HAUT-UELE
BAS-UELE
ITURI
NORD-KIVU
MANIEMA
SUD-KIVU
LOMAMI
HAUT-LOMAMI
HAUT-KATANGA

EQUATEUR
TSHUAPA
MAI-NDOMBE
KWILU
KASAI
SANKURU
TSHOPO
TANGANYIKA

Zongo
Gbadolite
Mobayi-Mbongo
Gemena
Bondo
Dingila
Dungu
Aba
Jingbokolo
Ariwara
Aru
Mahagi
Aketi
Buta
Isiro
Wastsa
Lisala
Bumba
Wamba
Mongwalu
Bunia
Basankusu
Basoko
Yangambi
Oicha
Beni
Isangi
Kisangani
Butembo
Boende
Luholu
Mbandaka
Lubutu
Rutshuru
Inongo
Punia
Goma
Bolobo
Nioki
Kalima
Shabunda
Bukavu
Bandundu
Mangai
Dibaya Lubwe
Kindu
Kamituga
Uvira
Masi Manimba
Bulungu
Idiofa
Ilebo
Lodja
Lumumbaville
Namoya
Baraka
Kasangulu
Kikwit
Lusambo
Inkisi
Kenge
Gungu
Luebo
Bena-Dibele
Kasongo
Lukula
Mbanza Ngungu
Tshumbe
Lubao
Kongolo
Kalemie
Boma
Bangu
Kananga
Mbuji Mayi
Kabinda
Muanda
Matadi
Kasongo Lunda
Tshikapa
Miabi
Tshilenge
Kaoze (Moba)
Kahemba
Tshimbulu
Lukalaba
Ngandajika
Manono
Mwene Ditu
Mbuyi-a-Tshow (Luputa)
Manono
Kamina
Kasaji
Kolwezi
Likasi
Lubumbashi
Kipushi

Map Reference: CDRC_DG002_122
Release Date: April 4, 2015

This map was designed for USAID orientation purposes only.
The boundaries, names and designations used do not imply official
endorsement or acceptance by the U.S. Government.

500 Km
300 Miles

Democratic Republic of Congo

Infant Mortality Rate (per 1,000)

Water Areas

Rate (per 1,000)
High : 110.1

Low : 33.0

0   100   200   400
Kilometers
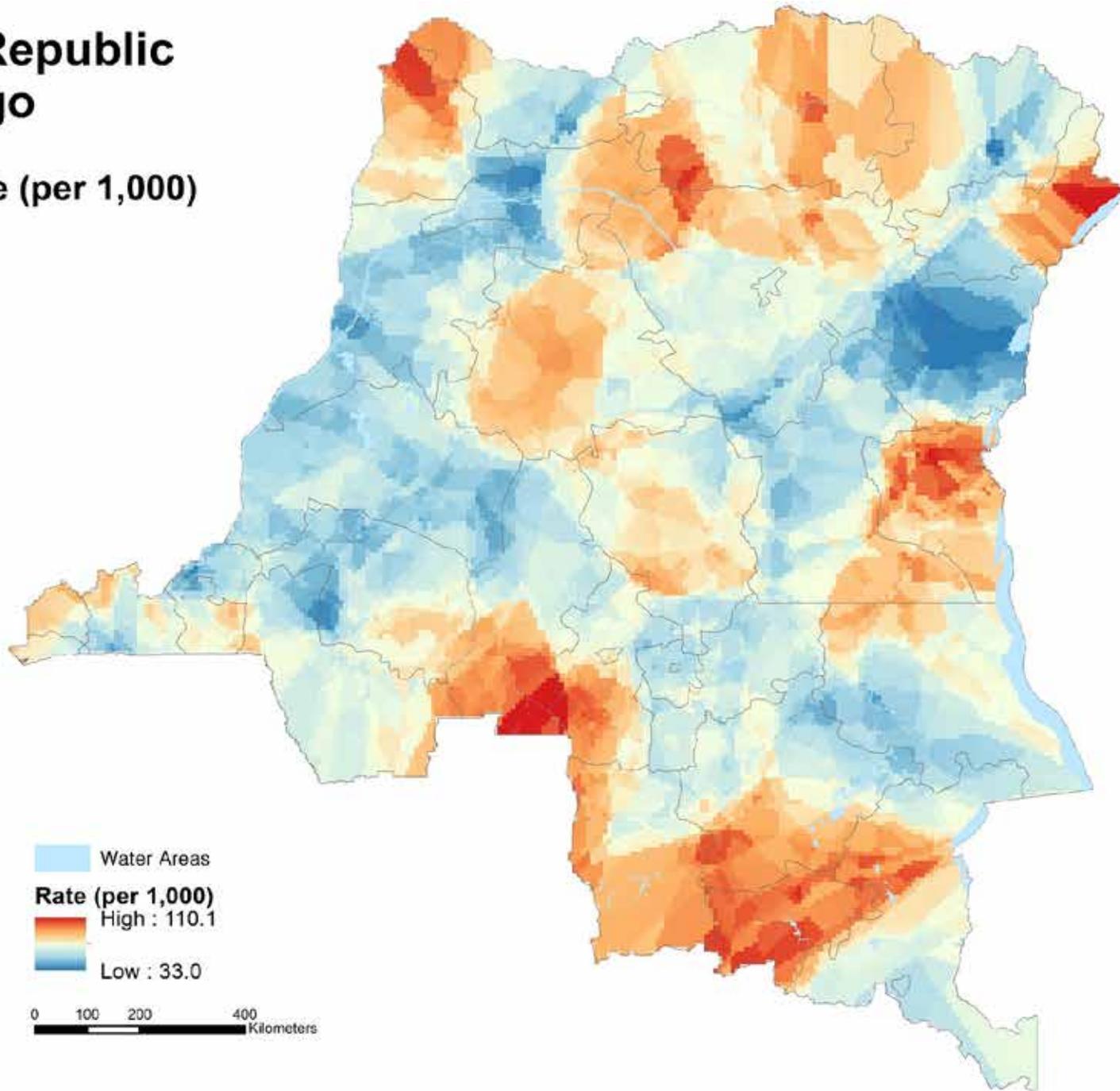
Democratic Republic of Congo

Under-5 Mortality Rate (per 1,000)

Water Areas

Rate (per 1,000)
High : 196.0

Low : 47.0

0   100   200   400
                          Kilometers
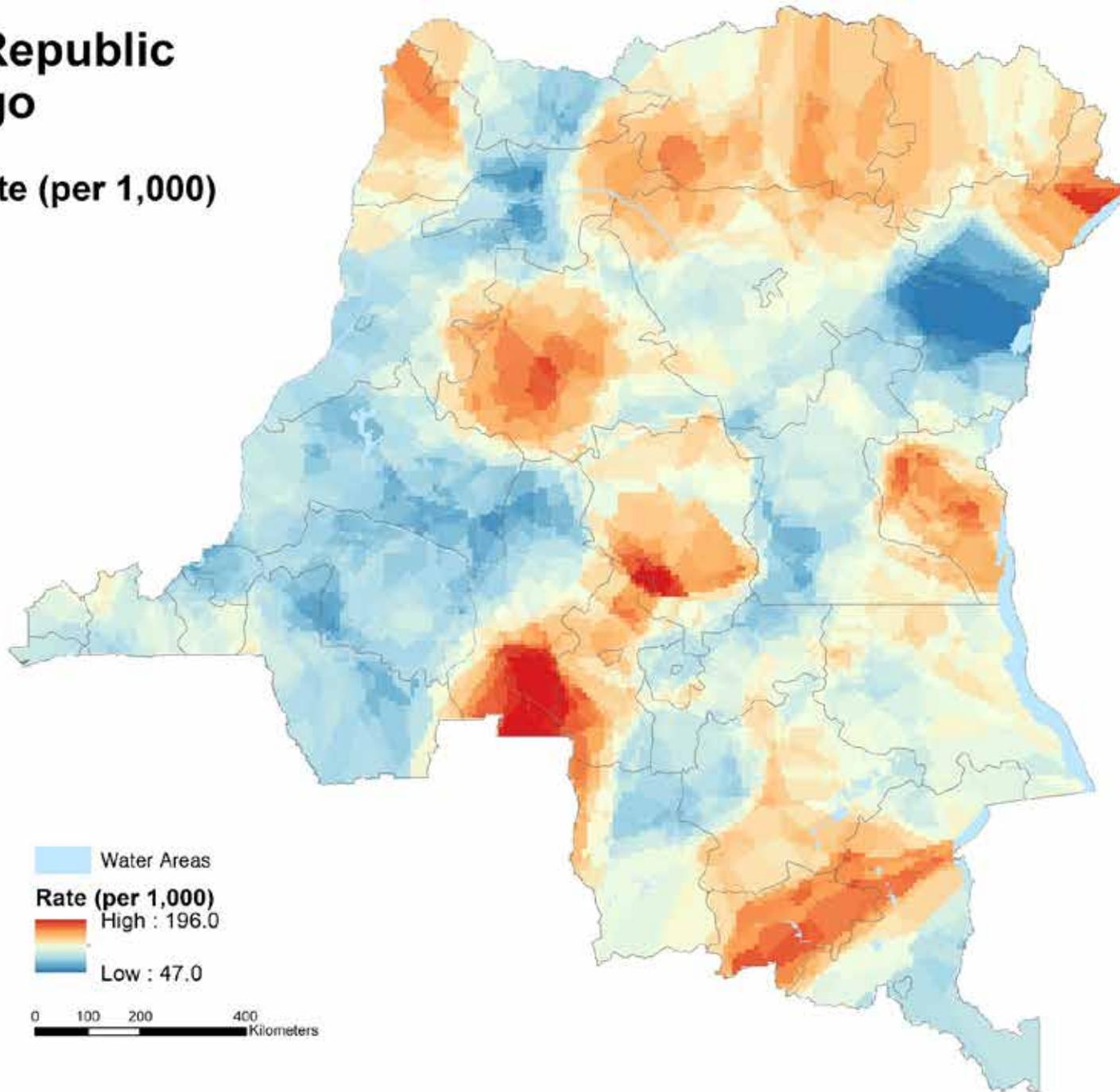
Democratic Republic of Congo

Underweight Rate (per 1,000)

Water Areas

Rate (per 1,000)
High : 389.6

Low : 5.6

0   100   200   400
Kilometers
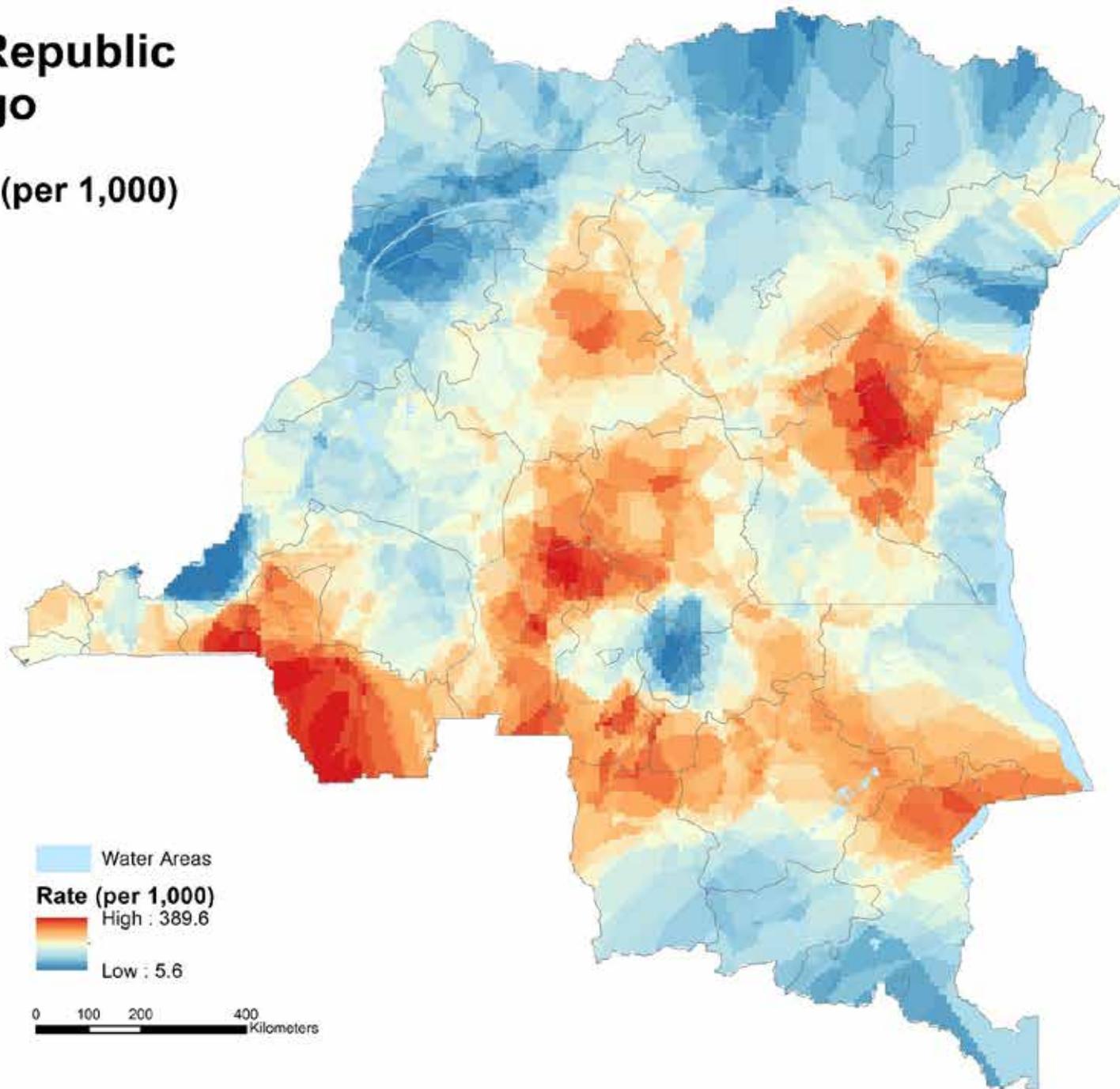
Democratic Republic of Congo

Stunting Rate (per 1,000)

Water Areas

Rate (per 1,000)
High : 639.4

Low : 94.9

0   100   200   400
                        Kilometers
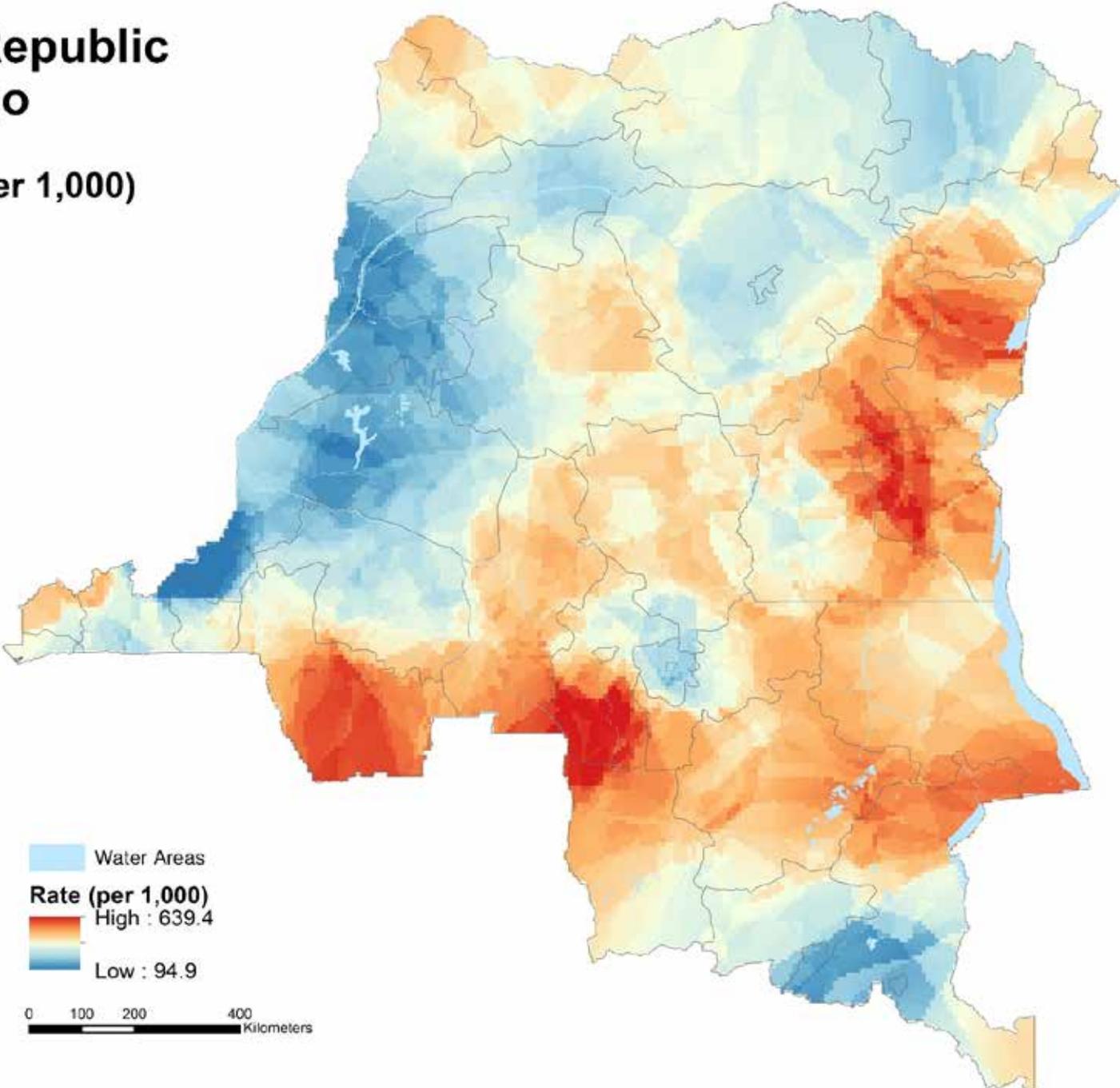
Democratic Republic of Congo

ARI Rate (per 1,000)

Water Areas

Rate (per 1,000)
High : 281.8

Low : 45.6

0   100   200   400
                    Kilometers
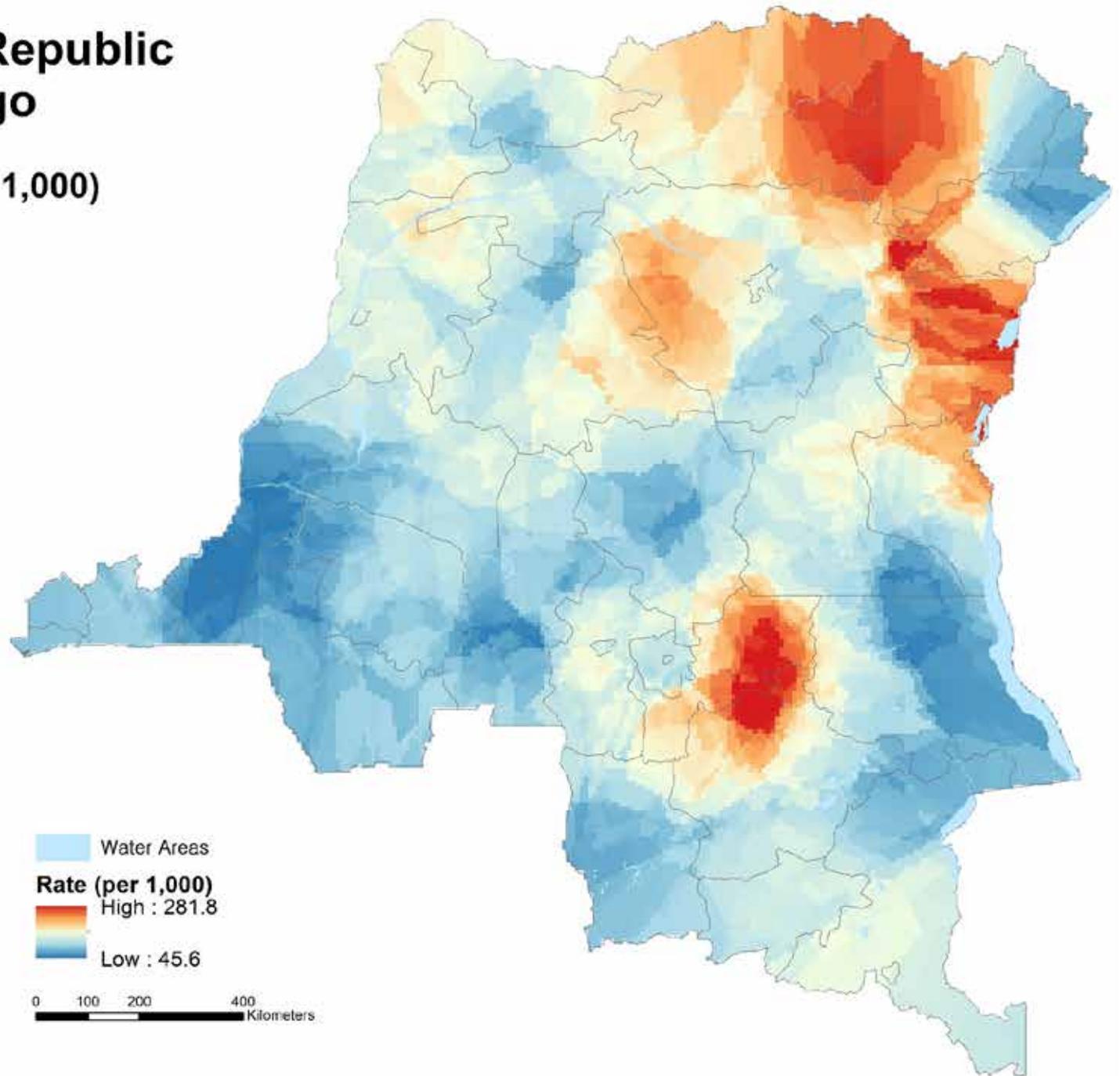
Democratic Republic of Congo

Percent of Children Fully Immunized

Water Areas

% of Children
High : 61.5

Low : 7.9

0   100   200   400
Kilometers
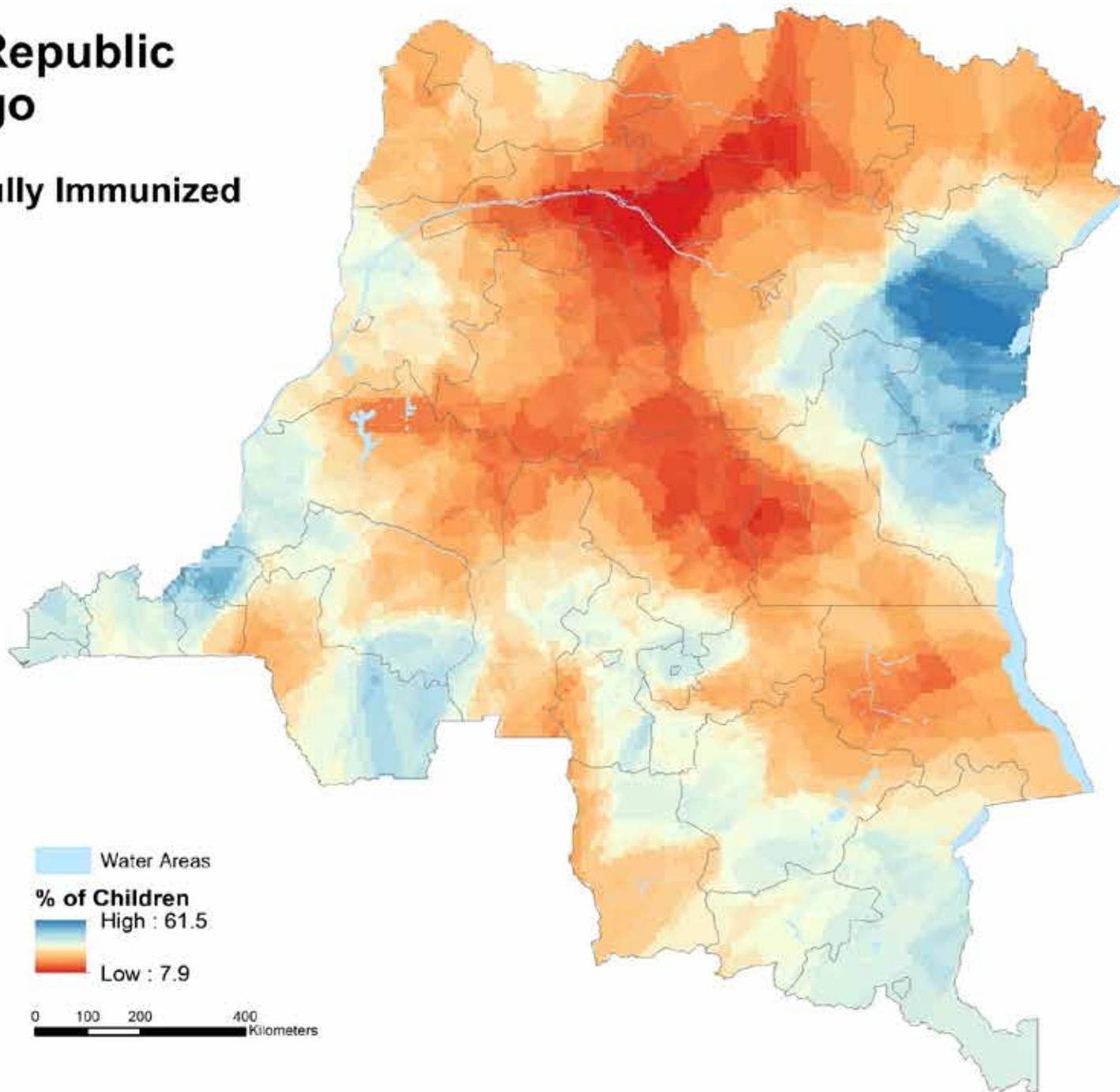
Democratic Republic
of Congo

Percent of Babies Breastfed

Water Areas

% of Babies
High : 71.1

Low : 51.1

0   100   200   400
Kilometers