



Health & Demographic Surveillance System Profile

HDSS Profile: The Dande Health and Demographic Surveillance System (Dande HDSS, Angola)

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Why was the HDSS set up?

An HDSS aims to systematically and continuously monitor the dynamics of a specified population in a geographically defined area, which lacks an effective system for registering demographic information and vital events.^{1–3} An initial census defines the target population and later, through periodic updating rounds, births, deaths and migrations are monitored. The first HDSS was implemented in 1940 in South Africa. There are now around 50 known HDSS worldwide, with surveyed population ranging between 13 350 and 260 000 individuals; 39 sites are spread in Africa, none of them in Central Africa or closest to Angola.⁴

Angola faced a long period of civil war between 1975 and 2002, and most of the previous existing civil registration and other social infrastructures have been severely debilitated. With the massive displacement of people moving to escape the war, the conditions became adverse to keeping effective records of structures and population dynamics.^{1,5} In 2014, the country carried out the first national population census since the country's independence (1975), and a large investment has been placed in civil registration infrastructures (particularly birth registration).⁵ However, the resources needed to implement an

accurate and complete vital statistics system are not yet available.

The Dande HDSS was set up as part of the activities of the Health Research Centre of Angola–CISA. The centre is a collaboration between the Angolan Ministry of Health, the Portuguese Institute of Language and Development and Calouste Gulbenkian Foundation. CISA's general objectives are: to conduct epidemiological research on the most prevalent diseases affecting the country's population, and its risk factors; to promote the integration of Angolan health professionals in national and international research projects; and to provide learning opportunities in its several research areas for national health professionals, graduate students and researchers.

The lack of accurate and up to date information on socio-demographic indicators constitutes a handicap for health research. Therefore, the Dande HDSS was implemented in August 2009 in the Dande municipality, to provide a platform for population-based research on the main causes of morbidity and to allow planning of contextualized health interventions.

The initial census, performed between August 2009 and March 2010, established the baseline population (15 579 households with 59 635 residents). After that, update

rounds (UR) collected data on demographics and household and socioeconomic characteristics. Data about causes of death are inferred from verbal autopsy questionnaires. The household's geographical coordinates are collected using a geographical positioning system (GPS).

The HDSS has served as a sampling platform for several studies, to inform health research activities and to support the evaluation of public health interventions.

Where is the HDSS area?

The HDSS area is located in the Dande municipality in the Bengo province, about 60 km north-east of Luanda. The study area, of approximately 4 700 km², covers all neighbourhoods located in three of the five communes of the municipality—Caxito, Mabubas and Úcua—and a smaller portion of neighbourhoods in the Barra do Dande and Kicabo communes (Figure 1).

Savannah is the main landscape feature, with gallery forest around the river banks and forest in the higher lands. The climate is tropical dry, with an average temperature of 25°C. The rainy and hot season spans from October to April, and the cool and dry season from May to September.⁶

Agriculture is the main economic activity, attracting some migrant workers. The main crops grown are maize and cassava. Fishing, in lakes and rivers, and charcoal exploitation are also important economic activities. The existing industrial activity is linked to stone and sand extraction.⁶

There are two main paved roads crossing the HDSS area. Access to several communities is made difficult, especially in the rainy season, since dirt roads constitute the main routes. Three main rivers cross the region, and nine lakes are located within the area. Man made irrigation channels are used for several purposes, namely drinking water, personal hygiene and washing clothes and dishes, which increases the risk for water-related diseases such as urogenital Schistosomiasis, a prevalent disease in the studied area.⁷

The HDSS area is served by 10 primary health care facilities, two health centres, one maternal and infant health centre, one municipal hospital and one general hospital. The number of nurses registered by the Municipal Administration is 180, 61% of them with low qualifications. Health authorities present a ratio of 19 387 inhabitants per physician and 815 per nurse, in the Municipality of Dande. For Caxito, capital of the province and the most populated commune of the study area, those ratios are 6664 and 1370, respectively.⁸

Who is covered by the HDSS?

The HDSS covers households and residents of the described surveillance area. A household is defined as any

group of people living together, sharing the same economy and recognizing the same household head. Some people, generally polygamous men, are heads of more than one household but are registered as residents of only one. A resident in the Dande HDSS is defined as: any person who lives, has been living or intends to stay in a household for a period of at least 3 months; or infants born to residents. People who live in more than one household are registered wherever they spend more than half of their time. A person's follow-up ends within the HDSS when he/she migrates outside the study area.⁹

The initial census established the baseline population and registered 15 579 households with 59 635 residents. Between March 2010 and December 2015, the population was enumerated nine times. Data have been collected through quarterly visits until the end of 2011, and thereafter the periodicity varied, mainly for logistical and financial reasons. One UR was carried out during 2012 and two rounds in 2013. Data collection was interrupted in 2014 for an exhaustive data cleaning process of the HDSS database. The national census was also performed in this year, the first in more than 40 years and for which there was a great awareness in the media. The CISA team did not consider appropriate the co-existence of enquirers in the field, so as to not confuse or overburden a population unaccustomed to door-to-door surveys. In 2015 one UR took place.

Participation in the project's activities, both in the initial census and UR, is voluntary and verbal consent is required. The mean participation rate is 88%, considering the number of visits with successful result for all the eligible households. The procedures include five visits per household, to have a successful result; the number of non-included households averages 12% of the total (the main obstacle to register and update all the households is finding a suitable respondent in the house at the time of the visit). The number of refusals is very low and never exceeds 0.03% per round.

What is measured and how have the Dande HDSS databases been constructed?

During the initial census, data were collected at the individual level (sex, date of birth, relationship to the head of household, literacy, parents' and spouse's identifications) and household level (walls and roofing materials, number of rooms, source of drinking water, existence of kitchen and latrines). Each individual is assigned a unique identifier (permanent ID) allowing prospective follow-up.

With the support of a household registration book, a field team visits all the houses during the UR, checking for changes on household composition or demographic events

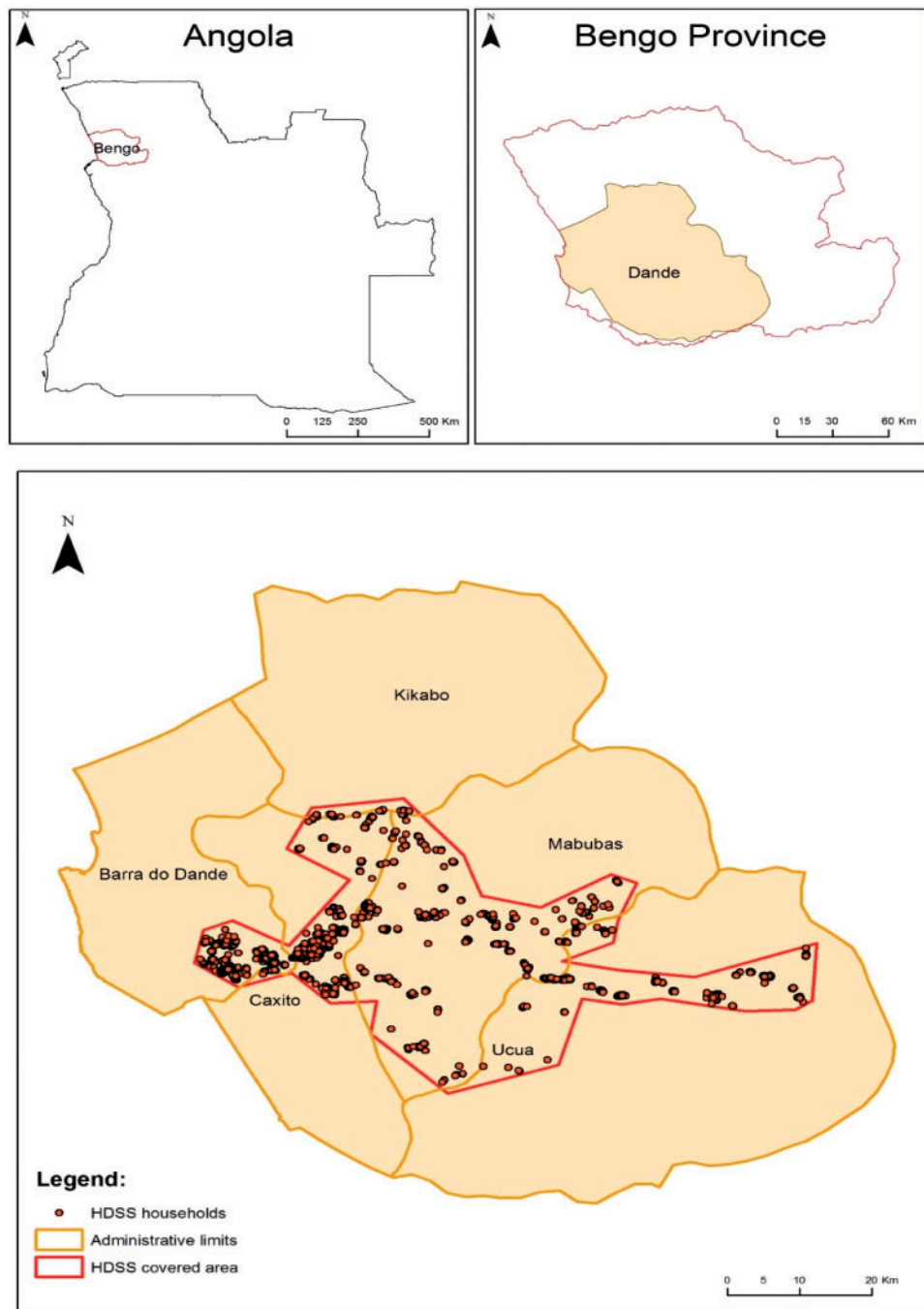


Figure 1. Map of the Dande Health and Demographic Surveillance System study area.

(births, deaths, migrations and pregnancies). At the end of 2011, during the fifth UR, additional variables were included, namely school attendance of all residents, place of birth and socioeconomic assets of the household (Table 1). All households and relevant locations such as roads, paths, rivers, lakes, irrigation channels and public buildings were georeferenced using handheld GPS.

A verbal autopsy system (VAS) has also been implemented in the Dande HDSS area since October 2010. Verbal autopsies are performed for all identified deaths

reported in the study area since the initial census (August 2009). Three different versions of VA questionnaires are used (for neonatal deaths, for children and for adults) based on standard INDEPTH/WHO models^{10,11} adapted to include the main pathologies known in the region and linguistic local terminologies. Fieldworkers specifically trained to apply the VA tool visit the households of the deceased (after a mourning period of about a month and a half), and interview the deceased's caregiver or other close relative. To ascertain the probable cause of death, each

Table 1. Data collected by the Dande HDSS

Data	Frequency of follow-up	Description of the data collected
Household	Fifth UR (Sept–Dec 2011) and ninth UR (Jun–Dec 2015)	Material of walls, roof and floor, number of rooms, existence of kitchen and latrine, sources of water used to drink and bathe, water treatment, main source of energy used to cook, ownership of electrical generator, radio, TV, cellphone, satellite dish, fridge, freezer, car, motorcycle, bicycle, wheelbarrow and animal breeding
Geographical coordinates	In all UR	Geographical coordinates of every new household
Individuals	In all UR	An individual identifier (ID) is assigned to each resident. Name, nickname, birth date, relation with the head of household, educational level and school attendance. For individuals under 15 years of age, their mother and fathers' ID are collected and for adults, spouse's ID is gathered
Births	In all UR	Name and individual ID of mother, date of birth, pregnancy outcome and place of delivery. Name and sex of the child, relation to the household head and father's name and ID
Pregnancies	In all UR	Name and individual ID, estimated stage of pregnancy (in months)
Deaths	In all UR	Name, sex and individual ID of the deceased, date of death. VA is performed to assess a probable cause of death
Migrations	In all UR	Name and individual ID of the migrant, date of migration, place where they previously lived or where they plan to settle. The names of the household head and other household members of the new house are collected
Other health-related Characteristics	Ninth UR (Jun–Dec 2015)	Health-related characteristics are collected during demographic UR, according to different ongoing project activities (e.g. access to health care, malaria prevention behaviours, reported fever)

questionnaire is interpreted independently by two physicians with local experience and previously trained for VA review. Causes of death are then encoded by a trained physician using the 10th Revision of the International Classification of Diseases (ICD-10).¹² A custom-designed double entry system, written in HTML, Javascript, PHP and POSTGRESQL (database system) is used for data entry and cleaning. Data quality is assured by built-in validation tests. All questionnaires are entered twice by two different data clerks and then verified by comparison of both entries.

Key findings and publications

Basic demographic information for the period 2010 to 2014 is presented in Table 2. The population under analysis is typical of a developing country with both high fertility and high mortality: the population is growing rapidly, and is mostly young, with a low proportion of older persons.

The variation observed in the indicators between different years suggest that the reduction in the number of rounds contributes to a under-reporting of events, consequently impacting on the accuracy of data collected. In 2012 only one UR was conducted, and all fieldwork stopped during 2014.

The neonatal, infant and under-five mortalities reported by the National Institute of Statistics of Angola for the years 2011–15 are 24, 44 and 68 per 1000 for the country, respectively. The total fertility rate for the period 2013–16 is

6.2.¹³ Comparing with the Dande HDSS data, a probable under-reporting of neonatal deaths is perceived. These events are very likely not to be reported some time after their occurrence, particularly if the child was not listed in the household registration book. Also, cultural aspects or embarrassment of respondents to talk about deceased relatives might contribute to the omission of death events. This is in line with previously published data, and has been documented as one of the reasons why child mortality is most probably underestimated in many surveys in sub-Saharan Africa.¹⁴ Implementation of new projects in the area of maternal and child health are planned, including a birth cohort which will enable accuracy and a thorough knowledge of these events.

The HDSS has served as a sampling platform for several epidemiological studies regarding infectious diseases and non-communicable diseases. In 2010 (May–August) a cross-sectional study was conducted aiming to understand the distribution of malnutrition, anaemia, malaria, schistosomiasis and geohelminths in the HDSS study area.⁷ This community-based random sampling survey included 1237 preschool children (< 6 years old), 1142 school-aged children (6–15 years old) and 960 women (\geq 15 years old). The main findings are shown in Table 3.

Malaria

Bayesian geostatistical models were developed to predict small-scale spatial variation of malaria. Large high-risk

Table 2. Demographic characteristics of the Dande HDSS population, 2010–14

Indicators	2010		2011		2012		2013		2014	
Total resident population	63081		62000		60807		62910		58645	
Male:female ratio	97:100		95:100		98:000		94:100		91:100	
Life expectancy at birth (years)	65.1		66.4		67.1		68.9		63.8	
Crude birth rate/1000 per year	40.4		35.5		32.2		27.2		24.2	
Crude death rate/1000 per year	9.1		8.2		7.3		6.7		8.5	
Total fertility rate	4.8		4.8		4.5		3.9		3.7	
Neonatal mortality rate	7.1		10.8		6.2		15.4		4.8	
Infant mortality rate	52.5		45.9		35.2		40.4		25.6	
Under-5 mortality rate	92.1		90.6		63.3		58.2		60.1	
Percentage of population	2010		2011		2012		2013		2014	
0–4 years old	Fem	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Male
	8.8	8.9	8.6	8.7	6.3	8.3	7.6	7.9	7.2	6.7
5–14 years old	Fem	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Male
	12.3	12.6	13.1	13.1	13.7	13.9	13.9	14.1	14.7	14.8
15–49 years old	Fem	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Male
	23.0	22.7	22.7	22.0	23.4	22.2	23.1	21.6	23.5	21.4
50–64 years old	Fem	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Male
	4.5	3.6	4.6	3.6	4.8	3.7	4.6	3.5	4.7	3.3
65+ years old	Fem	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Male
	2.2	1.3	2.2	1.4	2.3	1.4	2.3	1.4	2.4	1.4

Demographic indicators are computed annually and based on data collected during the UR. Population is yearly average. Births and deaths refer to the number of events during calendar year. The variation in the indicators depends on the number of rounds per year.

Fem, female.

Table 3. Main prevalence of infective conditions: malaria, schistosomiasis, geohelminths and anaemia, 2010⁷

Condition	Pre-school-aged children 1237	School-aged children 1142	Women 960
Malaria	18.4	18.2	9.6
Schistosomiasis	10.0	16.6	21.7
Geohelminths			
<i>Ascaris lumbricoides</i>	15.3	17.3	10.7
<i>Trichuris trichiura</i>	7.2	13.9	9.7
Hookworms	4.2	6.7	13.7
Anaemia	56.9	41.5 ^a 43.8 ^b	44.3 ^c 44.5 ^d

^aChildren (6–12 years old).

^bTeenagers (13–15 years old).

^cPregnant women.

^dNon-pregnant women.

The results of the previously mentioned survey served as the basis for other studies.

areas of infection (prevalence > 50%) were found in the northern and most eastern areas of the municipality, in line with the observed prevalence.¹⁵

The prevalence of human *Plasmodium* species was determined by polymerase chain reaction (PCR) using DNA from blood spots collected during the mentioned

2010 survey. *P. falciparum* in the study area comprises an approximately equal mix of genotypes associated with chloroquine (CQ) sensitivity and with CQ resistance, suggesting either lower drug pressure due to poor access to treatment in rural areas or a rapid impact of the policy change away from the use of standard monotherapies. Considering the selective advantage of one *pfmdr1* haplotype found under the artemether-lumefantrine treatment (the first-line therapy in Angola), the results raised concern regarding the future artemisinin-based combination therapy (ACT) efficacy within this area.^{16,17}

Schistosomiasis

The prevalence survey of 2010 identified *S. haematobium* as the main species responsible for schistosomiasis in the Dande HDSS area. Between December 2012 and July 2013, another study aiming to evaluate the impact of a generalized community treatment, with single doses of praziquantel plus albendazole on urinary schistosomiasis and geohelminthiasis, was set in Cabungo, a hamlet with high prevalence of schistosomiasis; 113 schoolchildren (6–15 years old) participated in the study. At baseline, 70.5% of the children were infected with *S. haematobium*, 29.5% with geohelminths and 14.8% with *H. nana*. Despite the decrease of infection with *S. haematobium* and

geohelminths a month after chemotherapy, at the 6 months follow-up the prevalence was similar to the baseline estimates.

Anaemia

A study on the role of malnutrition and parasite infections in the spatial variation in children's anaemia risk in northern Angola found that an estimated 12.5%, 15.6% and 9.8% of anaemia cases could be averted by treating malnutrition, malaria and *S. haematobium*, respectively.¹⁸

Cardiovascular disease risk factors

In 2011, a community-based survey of a representative sex- and age-stratified random sample was drawn from the Dande HDSS database and 1464 individuals older than 18 years were recruited and evaluated, following the World Health Organization (WHO) Stepwise Approach to Chronic Disease Risk Factor Surveillance (STEPS).¹⁹ This study showed an overall prevalence of hypertension of 23%. Older ages, lower level of education, higher body mass index and abdominal obesity were associated with hypertension. In 2013, participants without hypertension at baseline ($n=303$, 29.3% of the eligible participants) were approached and offered a new evaluation, following the same data collection protocol.¹⁹ The incidence of hypertension was 12.2%, much higher in those aged more than 40 years (21.3% versus 8.1%) and living in rural areas (25.0% versus 10.3% in urban areas). Regular alcohol drinkers and overweight or obese individuals presented a higher risk of developing hypertension. This work was integrated in CardioBengo, a cross-sectional community-based study implemented between 2013 and 2014²⁰ to serve as a new baseline for the prevalence of cardiovascular disease risk factors (e.g. obesity, tobacco and alcohol consumption, hypertension, diabetes and dyslipidaemia) among 2484 individuals aged between 15 and 64 years. Preliminary data show an overall prevalence of 18.0% for hypertension, 9.2% for diabetes and 4.0% for hypercholesterolaemia, with associated low levels of awareness, treatment and control for all conditions.²¹

Verbal autopsy

The VAS implemented within the Dande HDSS allowed the description of the main causes of death that occurred in the study area. Among a total of 1488 deaths registered between 2009 and 2012, 1009 verbal autopsies were performed and 798 of these were assigned a cause of death based on ICD-10. Mortality was led by Communicable Diseases (61.0%), followed by Indeterminate causes

(18.3%), Non Communicable Diseases (11.6%) and Injuries (9.1%). Intestinal infectious diseases, malnutrition and acute respiratory infections were the main contributors to under-five-years-old mortality. Malaria was the most common cause of death among children under 15 years old. Tuberculosis, traffic accidents and malaria were the leading causes of death among adults aged 15–49, and diseases of the circulatory system were the most frequent causes of death for adults aged 50 or more.²²

Future analysis plans

The Dande HDSS plans to maintain the provision of data and long-term indicators of demographic trends in mortality, fertility and migration rates. HDSS residents' causes of death will continue to be assessed through VAS. Reproductive, maternal and child health will comprise an important study target, and several analyses on maternal age and access to and adequacy of antenatal care are currently in progress, to better describe its trends.

The community- and hospital-based epidemiological studies conducted suggest that integrated interventions might be more effective, given the coexistence of several communicable diseases. Malaria, schistosomiasis, soil-transmitted helminthiasis, hymenolepiasis, anaemia and malnutrition are co-endemic and closely related, in turn associated with common behavioural risk factors. Integrating treatment and focused community-based educational interventions could be a strategy to control simultaneously these diseases and reduce their associated morbidity. Accordingly, a community randomized controlled trial to assess the efficacy of a nutritional and a Water, Sanitation and Hygiene (WASH) educational intervention in reducing anaemia, malnutrition and their aetiological agents in preschool children is being implemented in the Dande HDSS area. The results from this study are also expected to extend the knowledge on the aetiological agents.

The centre's diverse scientific agenda includes several other clinical research projects guided by previous findings (e.g. on monitoring of anti-malaria drug efficacy and prevalence of molecular markers of resistance, bacterial infections) and population studies (e.g. socioeconomic inequalities in access to health care) that will provide contextualized and valid information to inform local and national public health stakeholders.

Strengths and weaknesses of the Dande HDSS

The Dande HDSS is the only surveillance system that can serve research purposes in Angola and in the region of Central Africa. It provides updated socio-demographic

information for more than 60 000 inhabitants in an area where vital records are practically inexistent. Additionally, the VAS implemented is a major strength to inform about the main causes of death in the area, complementing the existing official records.

One of the main strengths of the Dande HDSS is to provide support for health research, serving as a sampling frame for various epidemiological studies, allowing the longitudinal follow-up of the population and the assessment of specific interventions in health. It covers a large area, including rural and urban regions and populations with different accessibilities, lifestyle and socioeconomic conditions, which has unique value for the implementation of research projects closely related to health interventions.

The study area faces a process of reconfiguration and rapid growth, particularly in the peri-urban and urban areas. To avoid under-report of demographic events, particularly neonatal deaths and stillbirths, a great logistic and financial effort is required to maintain biannual UR. During 2012 only one round was performed, and none in 2014, which affected the number of reported events and indicators in addition to the acknowledged recall bias. As a recently established platform, the Dande HDSS is gathering the experience that will allow the projection of several scientific publications in a consolidated fashion.

Data sharing and collaboration

The Dande HDSS provides basic aggregated descriptive data to students, researchers or other interested entities. Research instruments, forms and manuals used by the HDSS are also publicly available by request. The centre is available to create close collaborations with other entities, including those performing multi-site large-scale research projects. The proposal for collaborative projects should be addressed to the scientific committee through formal request at [(info@cisacaxito.org)].

Dande HDSS in a nutshell

- Dande HDSS covers an area of approximately 4700 km², in the Dande municipality, Bengo Province, about 60 km north-east of Luanda, Angola. It was established to support the evaluation of public health interventions and to inform health research activities, serving as a sampling platform for epidemiological studies on infectious diseases and non-communicable diseases.
- The initial census, performed between August 2009 and March 2010, established the baseline population. In 2014, 58 645 individuals were residing in 15 787 households.

- Data have been collected through quarterly visits until the end of 2011, and thereafter the periodicity was reduced to one (2012 and 2015) or two (2013) update rounds per year. Data collection includes demographic, household and socioeconomic characteristics. Geographical coordinates are registered and integrated in a geodatabase. Data on probable causes of death are inferred from a verbal autopsy system.
- Main research lines include clinical studies on malaria (the influence of serum iron levels on *Plasmodium falciparum* infection; optimization of malaria treatment) and antibiotic resistance. Ongoing projects in epidemiological research focus on nutrition, aetiology of anaemia, maternal and newborn health and social determinants of health.
- Aggregated data are available for students or research purposes and collaborations will be considered upon request to the scientific committee.

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