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Baseline Health Survey

Randgold Resources
Kibali Gold Project
Democratic Republic of Congo
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Final Report

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Executive summary

Introduction

The Kibali Gold Project (KGP) is located in the Watsa sub-district, in the district of Haut-Uélé, in the North-East portion of the Orientale Province, Democratic Republic of Congo (DRC). The Orientale Province is the second most populated province of the DRC with approximately 8.5 million inhabitants. The district of Haut-Uélé is surrounded by the districts of Bas-Uélé, Ituri and Tsopo; and in the North and East it borders Uganda and Sudan

The project is held in a 50:50 joint venture between Randgold Resources and AngloGold Ashanti, who both hold an effective 90% interest in the project. Randgold Resources are the operator. The remaining 10% is held by OKIMO, the para-statal mining company of the DRC.

Randgold Resources requested NewFields to perform a baseline health survey (BHS) in the KGP project concession area to fulfil some of the recommendations made in the rapid health impact assessment (HIA) which was performed in August 2008. This was to support the HIA process and ensure that the project was aligned with the IFC Mining and Performance Standards on Social and Environmental Sustainability as well as the values and standards of the shareholder companies.

The objectives of the BHS included:

- To describe a robust health baseline in the communities surrounding the project by means of a descriptive study. This would support an increased knowledge of the existing health conditions and health status in the communities. It would also inform data gaps identified in the rapid HIA.
- Provide the required information that will allow for the rapid HIA to be updated into a comprehensive HIA in alignment with the IFC methodology for category A projects. This can then allow for the health impacts to be ranked based on the updated project description and the locality of potentially impacted communities.
- Provision of information that KGP can consider for the development of a community health management plan that addresses the required mitigation/management measures.
- Develop a monitoring and evaluation programme so that the health impacts can be tracked and the mitigation/management plans can be measured based on their

effectiveness. The methodology was to be selected to allow for easily reproducible and cost effective measures to undertake this surveillance.

Study methodology

The BHS had the intent to inform the health status of the potentially impacted communities around the project concession. This was performed to update specific impact and outcome indicators related to burden of disease; understand knowledge, attitude and practices (KAPs) in the community and evaluate specific environmental health determinants with the following specific study aims:

- **To measure key household-level impact and outcome indicators at selected sentinel sites (key indicator survey):**

  This was performed through the (i) assessment of a limited number of behavioural and observational indicators; (ii) determination of the prevalence of malaria in children aged 6-59 months; (iii) determination of the prevalence and intensity of anaemia in children aged 6-59 months and in women of reproductive age (aged 15-49 years); (iv) determination of anthropometric measures of children aged 6-59 months; (v) determination of the drinking water quality at community water points and selected household end user level; and (vi) determination of blood pressure in adults aged 20-40 years old.
- **To assess the prevalence and intensity of intestinal parasite infection in school-aged children (9-14 years old) at selected sentinel sites:**

  Stool and urine samples were collected among school children in schools that were readily linked to the planned sentinel sites. This had the objective to determine the prevalence and intensity of soil-transmitted helminths (STH) and schistosomiasis (bilharzia) infections.
- **To assess KAPs in relation to specific public health concerns of individuals at selected sentinel sites:**

  This included the determination of the current status of health-related KAP in the adult male and female population in the sentinel sites. This was performed using a pre-tested questionnaire in defined population groups at the selected sentinel sites. The questionnaires included a wide variety of topics which addressed both bio-physical and social determinants of health.

- **Heavy metals survey**

  Samples for arsenic and mercury exposure were collected from sites based on potential for existing and future exposure. These were selected based on the area of potential exposure and sampling was linked to similar exposure groups rather than the sentinel sites. The geographical elements were however similar. These homogenous areas considered the communities where past artisanal/traditional mining activities had occurred on the exclusion zone, as well as communities requiring relocation including the potential host sites.

The design of the study considered three different methodologies, and it was concluded that a sentinel site methodology would be the most appropriate to meet the study aims. Based on this principle, 11 sentinel sites were selected in a broad geographical distribution around the project as shown in Figure 14. These sentinel sites included communities that would be resettled, proposed host sites and communities that may be affected due to their proximity or relation to the project. This methodology will support easily reproducible surveillance at either individual areas or pooled across the whole community. It can also allow for measurement of specific elements of the study based on interventions or pure surveillance.

Individual households in the different sentinel sites were selected based on randomised procedures supported by the World Health Organisation. Each individual household had to comply with the specific inclusion criteria and after this was confirmed specific information was provided and an informed consent sheet was signed. If the household head refused then the next household that qualified under the inclusion criteria was selected.

Specific survey tools were developed for the survey. The topics and questioning routes were selected based on the data gaps and surveillance requirements identified in the rapid HIA. The questionnaires were developed using a variety of validated questionnaires that have been used in similar settings in sub-Saharan Africa, including the DRC, by different organisations and agencies. Elements of these questionnaires were selected for inclusion in the study area.

Survey activities

It was essential to obtain permission and approvals for the study. A specific survey methodology and protocol was drawn up and submitted to the Watsa health district medical officer, Dr Kulidri. He provided the required approvals.

Community consultation and awareness activities were carried out prior to the survey. This performed through radio messages and in public meeting with the communities. These messages included the survey objectives, activities and the planned sampling day in each relevant community. The day prior to the survey in a community one of the KGP community liaison officers would go to the next selected community and remind them of the pending activity.

The survey team was trained prior to the survey. This included specific training on the survey objectives, questionnaire use and technique, field laboratory procedures as well as document control and quality assurance.

The survey was initiated on the 29th of July and was completed on the 12th of August 2010. The survey team was split into three groups based on their activity including the key indicator questionnaire and field laboratory team, KAP questionnaire team and the school survey team.

As part of the ethical requirements health conditions that were identified were treated by the field team. In the field laboratory all positive malaria cases were treated in the field and an iron and vitamin supplement was provided to all participants. All children found to be ill were referred to KGP medical officer for further management. In the school survey all children were treated empirically for intestinal parasites and schistosomiasis.

In total 261 households were sampled in the key indicator survey (KIS). Only the demographic detail of the communities within the exclusion zone were known at the time of the survey and thus in only 4 of the sites could a proportion of households sampled to overall population be calculated. However, in total 752 children under 5 years of age, and 395 adults above 15 were sampled. In addition to the KIS survey, 302 households were sampled in the KAP survey. Thus in total 563 households were sampled.

401 children aged 9-14 were sampled in the school survey.

In terms of treatment 629 children were treated for malaria and approximately 870-900 doses of the multivitamin/iron supplementation were dispensed. All 401 children tested in the school survey were treated empirically for intestinal parasites and schistosomiasis.

Key findings and risks

The key findings of the survey are presented in Table 1. In addition to the key findings, a summary of the identified community health risk factors that may influence the community and project, have been described.

Table 1: Summary of key findings and community/project risks

High Level Health Impacts		
Key Findings	**Community Risk Factor**	**Project Risk Factor**
Malaria		
Malaria is regarded as highly endemic in the project area with the mean prevalence rates above 81%. The highest rates were detected in the more rural setting and in the KCD area. Malaria related anaemia was reported at a prevalence of 10.1%. Ownership of Insecticide Treated Nets (ITN) was adequate with just over 65% ownership. Utilisation was lower with just more than 47% of the respondents reporting that a child slept under the ITN the previous night. Consistent knowledge of malaria transmission was just 16.5%. 40.4% and 37.1% of the respondents reported that they would use an ITN or that protect themselves against mosquito bites to avoid getting malaria, respectively. 11.9% thought that maintaining a clean environment could be effective. In those that did not undertake prevention activities it was reported that it was because the measures were not available (47.5%) or simply not affordable (26.2%).	These findings underscore that malaria remains one of the major public health challenges in the DRC. The project may influence malaria through changes in the environment and demographics in the area linked to influx.	Malaria can have the following impacts at the workplace level: • **Absenteeism** through repeated infections: This will have a significant impact on productivity and increased costs. • **Health and safety risks**: Patients with malaria who still work may pose a risk to fellow employees and themselves. The effects of the disease and the treatment drugs may decrease alertness and hearing sensitivity. • **Increase cost of overall health care.** • **Increased burden on the site medical service.** • **Employee turnover and attractiveness.** • **Employer liability.** These can be addressed through integrated programmes.

Key Findings	Community Risk Factor	Project Risk Factor
Water and Sanitation		
All the water collection points in the community tested positive for coliform contamination, with 91% testing positive for faecal coliform contamination. 95% of end user water at the household level tested positive for faecal contamination. Only 22.5% of the community get their water from improved sources. Only 18.2% treat it in some way to make it safer to drink. 59.5% of households use improved sanitation facilities in the form of closed pit latrines. 74.8% have a latrine in their household or compound and in those who do not 93.5% reported that they share latrines. 6.5% have no formal latrine. 80.2% of school children tested had at least one parasitic infection in their stool. The overall prevalence for intestinal schistosomiasis (*S. mansoni),* was 57.6%. In soil transmitted helminths, 5% tested positive for whipworm and 49% for hookworm. No urinary schistosomiasis was described.	This data provides much needed evidence on community practices with regards to water and sanitation. Access to improved water sources is poor and the quality of water at end user level is very concerning. There is a high burden of disease related to water and sanitation serve as indicators for the poor prevailing conditions in the area Provision of safe water supplies and sanitation services through community based initiatives should be ensured at the host sites.	The possibility of acquiring water related diseases is high in the project area due to the poor sanitary conditions. This can have an impact on workplace health through productivity and absenteeism. High burden of disease in community related to sanitary conditions reduces economic benefits and educational capacity of the local inhabitants.
Nutrition and Anaemia		
0.2% of children were severely wasted while 2% were moderately wasted. This shows very low rates of acute malnutrition in the area. The mid upper arm circumference levels at 1.4% and 7.3% for severe and moderate acute malnutrition showed similar levels but the higher moderate figure should noted as this reflects both acute and chronic malnutrition. 19.6% and 42.5% of children were severely and moderately stunted respectively. This is an indication of chronic malnutrition. 3.4% and 12.9% of children were severely and moderately	Significant co-morbid factor that increases morbidity and mortality in especially children. This is a concern with the high levels of chronic malnutrition and anaemia. Nutritional and anaemia indicators serve as useful indicators for surveillance of health conditions. Influx, relocation, water management and changes in economics may all play a role in long term nutritional status. Behaviour related to balanced diet practices is equally important.	Reduced human capital in long term employment capabilities. Reduced effect of other health interventions if done in isolation to nutritional programmes. Adoption of a more “urbanised” lifestyle with change to western diet of refined foods leading to increased prevalence in chronic disease such as diabetes and heart disease.

underweight respectively which provides an indication of food availability in communities. All these rates indicate that the nutritional status in the project area is better than the past national and provincial statistics by a significant margin. 20.5% of the respondents reported that a member of the household had gone to bed the previous night without a proper meal. Lack of food availability was cited as the major reason (32.5%) with a direct link to food affordability. 33.8% of the respondents feel that malnutrition is a problem in their community. The main reasons were food costs poor nutritional practices 82.5% of the children were reported as having any anaemia with 3.8% classified as having severe anaemia.		
Key Findings	**Community Risk Factor**	**Project Risk Factor**
Sexually-Transmitted Infections, including HIV/AIDS		
Nearly all (95.4%) the respondents have heard of HIV/AIDS. While knowledge on individual routes for transmission was good, consistent knowledge was poor. Only 32.1% had consistently good knowledge related to HIV transmission modes which presents similar consistent challenges for preventive activities. There was limited knowledge on the ability to cure or vaccinate against HIV and stigma related to the disease was high. Knowledge on prevention was poor with elements such as condom use (20.5%), faithfulness to a partner (32.5%) and not having sex with a sex worker (36.1%) not commonly reported. Misconceptions included praying (10.6%) and avoiding mosquito bites (4%). In terms of local practices 57.9% reported that they would be faithful to their partner to avoid HIV, with only 16.2% reporting that they would use condoms. 11.3% reporting that praying was an effective prevention technique.	This has been raised as one of the major present and future concerns in the area. The lack of consistent knowledge and preventive activities related to sexually transmitted infections is concerning. Stigma is high will which will reduce behavioural change if not well managed through well planned and executed information, education and communication programmes. The health services are providing limited preventive and treatment/care facilities in the area. Only the KGP clinic provides regular VCT and treatment facilities in the area. Women are a vulnerable group and lack of opportunity and limited negotiating power make them more at risk. Lack of education also plays a role.	Influx into the area will play a role with mixing of high and low prevalence groups. Disposable income will increase as a direct and indirect result of the project. This may promote commercial sex work in the area. High risk groups such as transport workers also need to be considered as they may play a role in disease transmission along the transport corridors. Risk to workplace health with health and business impact from HIV.

Uptake of voluntary counselling and testing (VCT) is limited with only 20.5% reporting to undergoing a HIV test in the past. The low uptake was mainly because the respondents did not see the need to go for a test. (40.1%) or that they were afraid of the results (7.9%). Only 30% of the respondents felt that condoms were easily accessible in their community. 34.8% reported that condoms were affordable. Only 17.6% reported condom use at their last sexual encounter with the rural areas showing very low rates. It was interesting to note that 5.3% reported that they felt that you could acquire HIV from using a condom.		
Key Findings	**Community Risk Factor**	**Project Risk Factor**
Health Care Services Capacity and Access to Health Care		
The majority of caregivers (84%) take their children to health care facilities in the first instance. The use of local pharmacies was also very common. In those who did not access the formal health care sector affordability was cited as the major reason (80%). Transport costs need to be considered in this cost factor. Acceptability and accessibility appear to be less important determinants. Traditional healers were not used commonly. They do not appear to be an important source of primary care but sorcery and witchcraft do play a role in local health care beliefs. Health care services in the area are limited in terms of scope of service and human resource allocations. The KGP facility is by far the best resourced facility in the area.	The capacity of the local health facilities is limited in the area. This is in terms of infrastructure and human resource. Nevertheless, health seeking behaviour is generally directed to public health services in-spite of concerns regarding affordability. Traditional medicine does not play a major role.	The government has limited capacity to support the upgrading of health care services in the short term and will look to partners. The project needs to consider sustainability criteria with regards to this support. Available public health services will not be acceptable for the needs of the skilled workforce or their dependents. This will reduce capacity to attract skilled staff and also long term acceptability of working conditions.

Key Findings	Community Risk Factor	Project Risk Factor
Non Communicable Diseases		
43% of respondents measured in the BHS were noted to have some form of hypertension. This was higher in men than in women.	Chronic diseases were poorly reported in the local health statistics. The baseline prevalence of hypertension is thus useful as it provides a rough indication that there is potential significant burden of disease from these conditions. As the burden of communicable diseases is so high little attention is paid to chronic lifestyle related diseases. The diagnostic facilities and human resource capacity to manage these conditions is limited. The potential cost implication of managing these diseases into the future can play a major role in health care budgeting and spends. Economic development in the area will create a shift to a more "urbanised" lifestyle with associated changes in values and behaviour, predisposing to an increase in lifestyle diseases such as obesity, hypertension, diabetes and dental caries. The community may also shift their traditional practices from subsistence farming to purchasing food products. There will be a reduction in physical exercise linked to agriculture to a sedentary lifestyle with adoption of western diets and habits.	The workforce will be exposed to improved income that will allow for changes in diet and habits. The risk of non communicable diseases may increase through this. This is a long term risk that can play a significant factor in the workplace health and productivity in the medium to long term.
Social Determinants and Quality of Life		
Alcohol use was reported in 47.4% of respondents with 7.7% of these drinking on a daily basis. 27.5% smoked with the 60.2% consuming less than 6/day. 6% consumed more than 40/day 72.6% of the respondents felt that drug abuse was a problem in their community. 65.5% felt that prostitution was a problem. 47.6% felt that domestic violence is a problem in their community. 70.9% and 74% of men and women respectively have reported	The high levels of reported drug abuse and prostitution highlight the potential for increasing social challenges in the communities. Increased income may also alter this. Women and children are extremely vulnerable to these social effects.	Social challenges will be extremely important to address in the framework of the projects social management plan. This will influence community acceptability of the project and for true lasting benefits to be achieved by the community.

to ever feeling sad or depressed with the minority reporting it as a constant feeling (8%).		
Key Findings	**Community Risk Factor**	**Project Risk Factor**
Maternal and Child Health		
91% of mothers attend antenatal care which is higher than the provincial averages. However, delivery care was less good at 83%. Of this 83% that delivered in a health care setting 94% of the respondents were supported by what is defined as skilled health personnel. It was not possible to assess the level of training of the personnel but the levels of delivery assistance were encouraging. Breast feeding was poorly practised with only 7.7% reporting to exclusively breast-feed their child for more than 6 months. Only 817% of the mothers reported that their last child had completed the recommended vaccination schedule when they were under the age of one. Only 47% reported to owning a vaccination card. When evaluating anaemia in women of reproductive age it was found that pregnant women were significantly more anaemic (68.2%) than non-pregnant women (32.4%)	The health care services are limited at present and influx may place a burden on these structures. Social challenges such as high risk sexual behaviour and more disposable income in the area may pose a risk for increased unwanted or teenage pregnancies.	The project has by law an obligation to care for the health of dependents. It will be important to plan health care services in such a way that the project medical service is not overwhelmed by maternal and child health needs.
Environmental Health		
Mercury and arsenic samples in urine were collected from 5 key areas on or around the project concession. The mean mercury and arsenic levels demonstrated no meaningful exposure to the general community either on the concession or in the surrounding communities and potential host sites. There were 9 outliers for the mercury, of which one was female. There were no outliers in the arsenic samples and levels were fairly uniform. At present time 52% and 55% of the community reported a perception that noise and air pollution, respectively, was a problem in their community. The majority, 86.5% and 89.8% considered it disturbing in nature.	There is little data that has been provided on the surface and ground water in the area. The same holds true for sediment and the geochemistry of the ore. The risk of acid rock drainage and the type of ore is very important to consider with potential exposures to heavy metals. It was anecdotally reported that there are high levels of arsenic in some of the mineral bearing ore. The ASM activity in the area with use of mercury is a clear risk factor to the community and the projects reputation.	The project will be required to operate to national legislation and international best practice with regards to environmental management. This will include noise, airborne pollutants, water management and visual impact.

	Additional environmental health determinants such as air and noise pollution need to be considered with the development of the project. This can be the source of community related complaints and the perception for human health effects.	

Key recommendations

The framework of the BHS does not per objective include the provision of detailed recommendations to support the formulation of a detailed health management for the project.

However, some preliminary recommendations have been made based on the findings of the survey and are presented as a framework to initiate discussions related to the community health management plan. These recommendations need to include considerations based on alignment with national programmes, multi-stakeholder supported and sustainability elements. They also need to be in the business interest of the project. The framework plan included the following elements:

- Health Service and health systems strengthening
    - Upgrade local health care facilities as is ongoing with Project Cure. These projects need to be supported with training and capacity building and general governance support.
    - Support the timely construction, and delivery of health services in the resettlement areas so that access to health care is not detrimentally affected.
    - Support supply chain and capacity in local facilities if affected by influx or larger catchment population depending on resettlement.
    - Consideration of dependent health care as required by DRC Mining and Labour Codes.
    - Peer health educators/community health agents to support different information, education and communication programmes as part of mitigation and social investment programs.
- Malaria programs. These will be essential to consider in the immediate term with the high prevalence rates. This is both for workplace health and impact mitigation.
- Water and sanitation programs. Resettlement and host site support services. These basic services need to be supported in these sites so that the already limited safe water supplies and poor sanitation do not deteriorate. Support school deworming programs. Support access to improved sanitation services and information, education and communication programs linked to personal hygiene.
- Nutrition. Integrate nutritional programs into other initiatives. This can include child and adult nutrition.

- HIV/AIDS and sexually transmitted infections. Extend existing education and awareness programs. Challenge is to change behaviour and practices with the extension of programs.
- Environmental monitoring of surface and ground water.

Next Steps

The baseline health survey has supported the description of a robust baseline in the project area. This can serve as a tool to describe the existing health needs of the community and also information to support analysis of impacts related to the project.

The following processes can be considered within the framework of the HIA process:

- **Update the rapid HIA to a comprehensive HIA based on the current findings**

While there is still a dependency on some social and environmental data the health related information available for the project is now robust enough to update the past rapid HIA into a comprehensive assessment. The evidence base and opinions of the communities can allow for interventions to be based on actual data and identified priorities .This will allow analysis of the impacts and social development needs and support the definition of a prioritised community health plan that considers the following:

  - **Project impact mitigation:** Interventions required in order to mitigate the future health impacts of the project on the communities. These are required by the project and are not voluntary contributions.
  - **Social Development Initiatives:** Interventions suggested that will improve the existing health status of the communities. These are voluntary contributions and should improve the project sustainability.
  - **Occupational health and safety:** Interventions aimed at ensuring a healthy, safe and productive workforce.

- **Development of a community health management plan**

Based on the health impact assessment modelling a prioritised community health management plan (CHMP) will be developed. This will require stakeholder input.

- **Monitoring and evaluation plan**

A programme will need to be developed based on the CHMP which will support the surveillance of mitigation measures and health interventions.

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Acronyms

ACT	Artemisinin-based Combination Therapy
AIDS	Acquired Immunodeficiency Syndrome
ARV	Antiretroviral
ART	Antiretroviral Treatment
BHS	Baseline Health Survey
BP	Blood Pressure
BSU	Basic Sampling Unit
CHMP	Community Health Management Plan
CI	Confidence Interval
CVD	Cardiovascular Diseases
DHS	Demographic Health Survey
DOT	Directly Observed Treatment
EIR	Entomological Inoculation Rate
ELISA	Enzyme-Linked Immunosorbent Assay
EPG	Eggs Per Gram of Stool
EPI	Expanded Programme on Immunisation
GPS	Global Positioning System
HIA	Health Impact Assessment
HIV	Human Immunodeficiency Virus
HNA	Health Needs Assessment
IFC	International Finance Corporation
ICMM	International Council on Minerals and Metals
IPT_p	Intermittent Preventive Treatment in Pregnancy
IRS	Indoor Residual Spraying
ITN	Insecticide-Treated Net
KAP	Knowledge, Attitude and Practices
KII	Key Informant Interview
KIS	Key Indicator Survey
LLIN	Long-Lasting Insecticide Treated Net
MoH	Ministry of Health
PAC	Potentially Affected Community
PLWHA	People Living With HIV/AIDS
PPS	Probability Proportional to Size
PS	Performance Standards
RAP	Resettlement Action Plan
RDT	Rapid Diagnostic Tests
SD	Standard Deviation
SIA	Social Impact Assessment
SEMP	Social and Environmental Management Plan
SRS	Simple Random Sampling
SS	Sentinel Sites
STH	Soil-Transmitted Helminthiasis
STI	Sexually-Transmitted Infection
TM	Traditional Medicine
USAID	United States Agency for International Development

VCT	Voluntary Counselling and Testing
WHO	World Health Organization

Glossary

Antenatal care: Percentage of women aged 15-49 years who attended at least 4 sessions by skilled health personnel during their last pregnancy (doctors, nurses or midwives).

Baseline health survey: A cross-sectional study aiming at identifying and quantifying the relevant health, environmental and demographic characteristics of the population living in a certain population group or geographical area.

Community: A group of individuals broader than the household, who identify themselves as a common unit because of shared locality, or because of recognized social, religious, economic or traditional ties.

95% Confidence Interval: is the most common statistical technique for displaying the degree of uncertainty that should be attached to any measurement, mean or proportion. It the distribution is roughly symmetrical the mean is a good measure of the central value, and the standard deviation is a reliable measure of spread.

Demographic and Health Survey (DHS): are nationally-representative household surveys that provide data for a wide range of monitoring and impact evaluation indicators in the areas of population, health, and nutrition. DHS have large sample sizes (usually between 5,000 and 30,000 households) and typically are conducted every 5 years, to allow comparisons over time.

Health: A state of complete physical, mental and social and spiritual well-being and not merely the absence of disease or infirmity.

Health determinants: The range of personal, social, economic and environmental factors which determine the health status of individuals or populations.

Health impacts: A health impact can be both positive and negative. It refers to changes in community health that are attributable to a policy, programme or project.

Health impact assessment (HIA): HIA is a combination of procedures, methods and tools that systematically judge the potential, and sometimes unintended, effects of a

project, programme or policy on the health of a population and the distribution of those effects within the population. HIA identifies appropriate actions to manage those effects.

Health outcomes: A change in the health status of an individual, group or population which is attributable to a planned intervention or series of interventions, regardless of whether such an intervention was intended to change health status.

HIV Adult prevalence rate: Percentage of adults (15-49 years) living with HIV/AIDS.

Household: A group of persons living together who share the same living facilities, and form a basic socio-economic unit. The targeted unit within the survey was the family living in a household. In the event of two or more families living in the same household, a selection was made using playing cards.

Indicator: Data which provide information about and will allow surveillance of the overall health and/or socio-economic status of an individual or family.

Insecticide-treated nets (ITN): An ITN is a bed net that was treated with insecticide within the past 12 months or that was pre-impregnated as a long-lasting insecticide treated net (LLIN).

KAP(B): Knowledge, attitudes, practices and at times behaviour assessment. This describes an individual or household's knowledge, attitude and practices towards different determinants, in this case health. These variables can outline any gaps in individual or community knowledge and practices and can inform the development of information, education and communication strategies that can support behavioural change.

KAP questionnaires: A questionnaire based on examining knowledge, attitudes and practices towards a particular health topic. These are commonly used in qualitative health surveys. Their use can support the design of information, education and communication programmes and measurement of behaviour change.

Mean: The mean is the most commonly used measure of the central value of a distribution. It is also defined as the arithmetic mean or the average. It is the sum of the observations divided by the number of observations.

Median: The median is described as the numeric value separating the higher half of a sample from the lower half.

Potentially affected community (PAC): This defines a community who may potentially be affected by the project. This can include directly those who may be affected by proximity and operations of the project and, indirectly, those affected populations that may be influenced by transport routes, local economic changes and changes in culture and lifestyles.

Prevalence rate: Total number of existing cases of a disease at a given time divided by the total population. It measures the number of people in a population who have the disease at a given time. This was the most common reference in the survey.

Primary health care: Affordable, practical methods of delivering essential health care that are scientifically sound and socially acceptable.

Safe water: As defined by the World Health Organization (WHO), access to safe water means that a family need not spend a disproportionate part of the day fetching water. It means access to piped water or a public standpipe within 200 metres (219 yards) of a dwelling or housing unit. Safe drinking water includes treated surface water and untreated water from protected springs, boreholes, and sanitary wells. The definition of what constitutes "access" to safe water varies from country to country. Generally, walking distance or time from household to water source is the principal criterion, particularly in rural areas. Access to safe water is essential in preventing water-borne diseases, and it is a minimum requirement for human health and well-being.

Sanitation: Access to sanitation is essential in preventing diseases spread by unsanitary conditions or by water contaminated by solid human waste. WHO and UNICEF in their Joint monitoring program provide the following definitions:

Improved sanitation facilities[1]

- Flush or pour–flush to:
  - piped sewer system
  - septic tank

[1] Only facilities which are not shared or are not public are considered improved

  - pit latrine
- Ventilated improved pit latrine
- Pit latrine with slab
- Composting toilet

Unimproved sanitation facilities

- Flush or pour–flush to elsewhere
- Pit latrine without slab or open pit
- Bucket
- Hanging toilet or hanging latrine
- No facilities (utilize bush or field)

Sampling: Procedure by which some members of a given population are selected as representative of the entire population.

Skilled attendant at delivery: Percentage of births attended by skilled health personnel (doctors, nurses or trained midwives).

Stakeholders: Stakeholders are all those who have rights or interests in the project and/or are affected directly or indirectly, by the project. Stakeholders can be individuals, communities, social groups, organizations, or administrative bodies.

Stunting: Stunting is defined as having a height-for-age of more than 2 standard deviations below the median of the healthy population.

STI: Sexually-transmitted infections (gonorrhoea, chlamydia, syphilis, etc). These infections increase the risk for the transmission of HIV.

Standard Deviation (SD): Standard deviation is the measure of spread used in conjunction with the mean. It is based on the deviations of the observations from the mean; that is on the difference between each observation and the mean.

Traditional medicine (TM): TM refers to health practices, approaches, knowledge and beliefs incorporating plant, animal and mineral based medicines, spiritual therapies,

manual techniques and exercises, applied singularly or in combination to treat, diagnose and prevent illnesses or maintain well-being.

Underweight: Underweight is defined as having a weight-for-age more than 2 SD below the median of the healthy population.

VCT: Voluntary Counseling and Testing for HIV.

Wasting: Wasting is defined as having a weight-for-height more than 2 SD below the median of the healthy population

1 Introduction

1.1 Project description

The Kibali Gold Project (KGP) is located in the Watsa sub-district which is in the district of Haut-Uélé in the Orientale Province, North-Eastern Democratic Republic of Congo (DRC). The Orientale Province is the second most populated province of the DRC with approximately 8.5 million inhabitants. The district of Haut-Uélé is surrounded by the districts of Bas-Uélé, Ituri and Tsopo and borders Sudan to the North and Uganda to the East, as shown in Figure 1.

The project is held in a 50:50 joint venture between, Randgold Resources and AngloGold Ashanti, which hold an effective 90% interest in Kibali Goldmines SPRL. The remaining 10% is held by OKIMO, the parastatal gold mining company of the DRC.

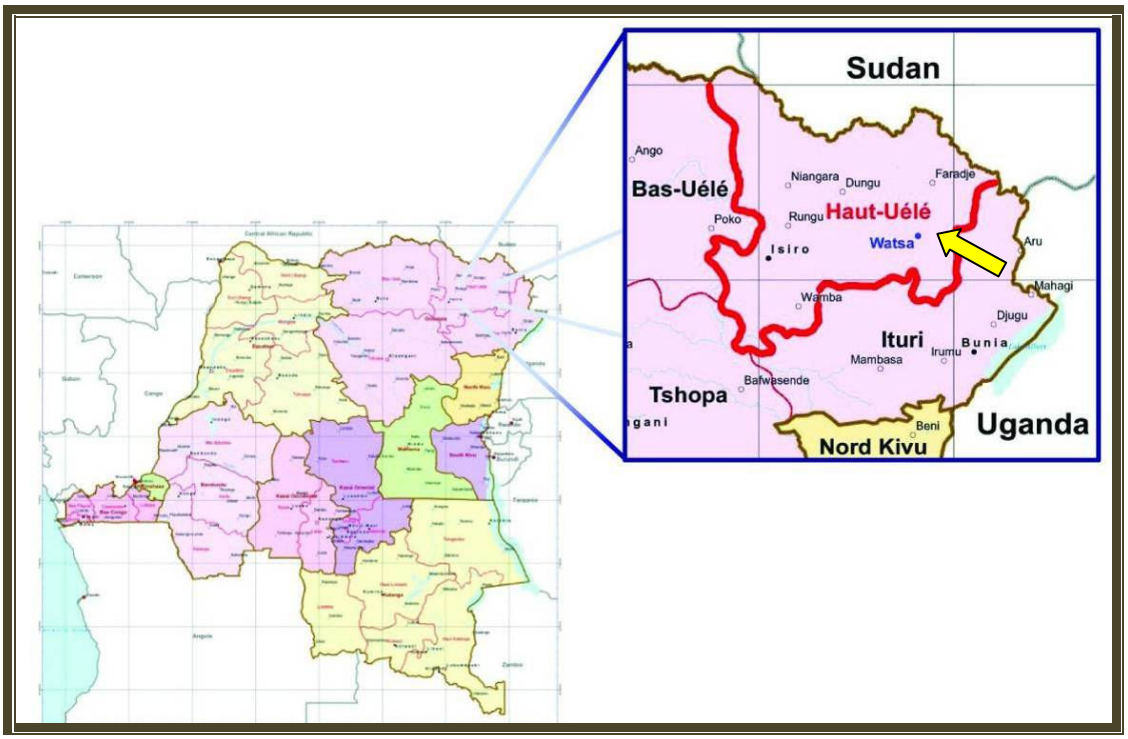

Figure 1: Location of the Kibali Gold project in north-eastern DRC.

Haut-Uélé district is administratively subdivided into the sub-districts of Dungu, Faradje, Watsa, Wamba, Rungu and Niangara, and has a total population of about 2 million inhabitants. The district capital is Isiro. The sub-district of Watsa was created in 1930 with a surface of 16,015 km² with an estimated population of 284,354 inhabitants. The territory of Watsa is divided up into three sectors, namely Mangbutu, Gombari and Kibali. KGP is located in the Kibali sector.

The district is further divided into health districts. There are two main health districts, Haut-Uélé East and Haut-Uélé West, with the Watsa health zone in the eastern district (Figure 2).

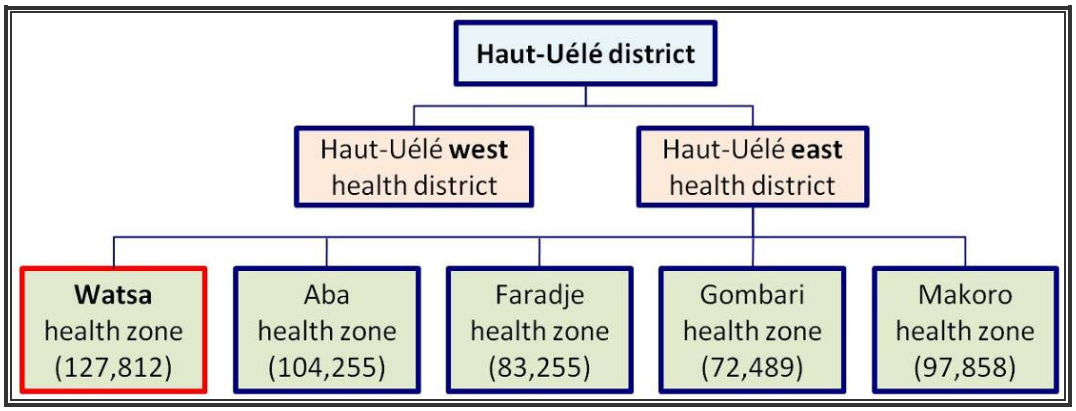

Figure 2: Organization of Haut-Uélé health districts.

A detailed overview of the project and the potentially affected communities (PACs) is described in the rapid health impact assessment (HIA), which was completed in August 2008 (Divall and Winkler, 2008). The project has evolved since this time and the final project description related to the development of the project is still being finalised. For the purposes of this baseline health survey (BHS) the project description and community profile from the rapid HIA, the information obtained from the latest versions of the Resettlement Policy Framework (RPF) and data from the community relations department was used to determine the study methodology. It is anticipated that the evidence presented in this report will be used to update the rapid HIA into a comprehensive HIA, and that a community health management plan with a monitoring and evaluation programme will be developed to support any health mitigation/management plans. This will require updated social and environmental data as well as a clear project description including a clear Resettlement Action Plan (RAP). The baseline data will serve to support the evidence for health impact categorisation.

The following key information is however important consider in terms of the project description and relevance to the BHS the final site selection as outlined in Figure 14:

- The project will be developed in different phases with the focus on Karagba/Chauffeur and Durba (KCD) as the priority development.
- Salambongo and Pakaka are the next most likely development areas.
- Resettlement will occur in phases.
- Gumu/Gatanga and Kokiza are the preferred resettlement sites.

1.2 HIA framework

1.2.1 Requirements and standards

For the purposes of the BHS and any community health assessments, or health impact assessment (HIA), it is relevant to consider the laws and regulations of the DRC as well as international principles, performance standards and best practices of the mining sector.

There are no specific references that legally require the assessment of community health or require the completion of a HIA for mining project developments in the DRC. The relevant sections of the potential legal compliance are addressed in the rapid health impact assessment completed in 2008 (Divall and Winkler, 2008).

However, to ensure compliance with best practice, the project is following the International Finance Corporation (IFC) Policy and Performance Standards on Social and Environmental Sustainability (PS) (IFC, 2006; IFC, 2007; IFC, 2009). HIA is the preferred methodology to support PS4 as defined by the IFC good practice note on HIA. Both RandGold Resources and AngloGold Ashanti subscribe to the IFC PS with clear statements to this effect on their websites regarding the IFC Guidelines on Environmental, Health and Safety as well as the IFC Mining and Performance Standards on Social and Environmental Sustainability [Randgold Resources 2010] [AngloGold Ashanti 2010]. The methodology is also supported by the International Council on Mining and Metals (ICMM) of which AngloGold Ashanti is a member .

Both RandGold Resources and AngloGold Ashanti have clear commitments to social responsibility and safeguarding communities. RandGold Resources social responsibility statement states that "*We combine a strong focus on profitability with a highly developed sensitivity to our social responsibilities and a real commitment to making a positive contribution to the countries and communities in which we operate".* AngloGold Ashanti (AGA) has clear values and business principles. These are available at www.anglogoldashanti.com/Values/Values.htm. It states: *"The communities in which we operate will be better off for AGA having been there".*

Neither organisation has specific community health standards.

1.3 HIA approach and methodology

Community health was identified as a key factor that has potential to be significantly influenced by the project. Therefore, a HIA was commissioned that considered the existing health needs of the community, the future health impacts that the project may impose on the community, and health risks to the operation both from internal and external sources. It is important that the prevailing health conditions do not impose a negative influence on the workforce, and that the employees have the correct capacity to safely and effectively performed their tasks.

The first step in the HIA process was commissioned by Moto Goldmines (MGL) in May 2007 in the form of a scoping study (Viliani and Divall, 2007). This had the objective of identifying the high level health impacts and what basic information was available. As an extension from this study, MGL commissioned a rapid HIA in August 2008. By definition this did not involve collection of new primary quantitative data but updated the existing evidence and knowledge through additional participatory data collection and secondary data analysis (Divall and Winkler, 2008). This served the following objectives:

(i) Characterise the health impacts and develop mitigation and management plans to address future health impacts and existing health needs.
(ii) Perform a gap analysis on available data to determine if any additional data was required to fully characterise the health impacts.
(iii) What data would is required to inform a robust health baseline and to support ongoing surveillance of health impacts and mitigation/management plans.
(iv) Evaluate the potential health impacts at the PAC level based on the initial project design and developments.
(v) Define the ongoing process of the HIA and identify opportunities for integration of health into social and environmental studies as well as into the overall project management plans.

Data gaps or evidence required to support the characterisation of health impacts or community health surveillance was addressed in the rapid HIA and formed the framework to develop the study protocols for the present BHS. As mentioned above it is anticipated that the BHS will provide the evidence to update the following:

- Update the HIA into a comprehensive assessment when the final project designs are complete. These health impacts should address areas that require impact mitigation. This may be to avoid or prevent negative health impacts and may result in positive impacts, or specific enhancement activities.

- Based on the ranking develop a prioritised community health management plan for the project divided into the following sections:
  - A health management plan that is related specifically to impact mitigation and which is required by the project.
  - A health development programme as part of the project's voluntary contributions to community health in the project area. These negotiated commitments are likely to enhance the social license to operate and may not be tied to a specific project impact, but may be selected because the project sees long-term benefit in measures that may enhance overall community well-being.
- As a monitoring tool linked to specific outcome indicators either from health impact mitigation or from an enhancement perspective. The BHS will support this through the development of a baseline to enable future monitoring and evaluation of defined health indicators distributed across the project concession and potentially impacted communities.

2 Baseline Health Survey Methodology

As described above the BHS is intended to inform the health status of the potentially impacted communities around the project concession. This was performed to update specific outcome indicators related to burden of disease; understand knowledge, attitude and practices (KAPs) in the community and to provide reliable baseline data for future monitoring an evaluation of health impacts and interventions.

The following chapter will describe the methodology and tools used in the BHS.

2.1 Study aims

The following were the specific study aims:

- **To measure key household-level indicators at selected sentinel sites:**
  This was performed through the (i) assessment of a limited number of behavioural and observational indicators; (ii) determination of the prevalence of malaria in children aged 6-59 months; (iii) determination of the prevalence and intensity of anaemia in children aged 6-59 months and in women of reproductive age (aged >15 years); (iv) determination of anthropometric measures of children aged 0-59 months; (v) determination of the drinking water quality at community water points and selected households; and (vi) determination of blood pressure in adults aged 20-40 years.
- **To assess the prevalence and intensity of intestinal parasite infection in school-aged children (9-14 years old) at selected sentinel sites:**
  Stool and urine samples were collected among children in schools that were readily linked to the sentinel sites with the objective to determine the prevalence and intensity of soil-transmitted helminth (STH) and schistosoma (urinary and intestinal) infections.
- **To assess KAP in relation to specific public health concerns of individuals at selected sentinel sites:**
  This was performed using a validated and pretested questionnaire at the selected sentinel sites. The objective was to define the current knowledge and practices at the local level to support the design of information, education and communication programs to promote behavioural change. These questions included bio-physical and social determinants of health.

- **Heavy metals survey**

  Similar exposure groups were selected based on existing and potential future exposure. Sampling was not linked to the sentinel sites but rather to the area of potential exposure. The homogenous areas considered the communities where past artisanal and small scale mining (KCD) had occurred, communities that will require relocation as well as potential host sites. There was no surface/ground water or sediment studies available to support the site selection so a broad geographical range was selected. If new results show high risk at areas that were not sampled then the process may need to be repeated in these areas.

2.2 Study design

In order to fulfil the study aims mentioned above, a study design was developed, considering the requirement for reproducibility of the survey to allow for subsequent monitoring of the impacts in future studies.

Different options were considered for the study design as follows:

- **A simple random sampling (SRS) method:**

  This method gives each basic sampling unit (i.e. household) an equal probability of inclusion in the study. This method is able to select a representative number of households for a specific part of the project area (or even the entire project area), but a number of constraints were identified with this approach:

  - The mapping and identification of all the households prior to the sampling is a prerequisite for SRS, but this information was not available for most of the sentinel sites outside the exclusion zone. Demographic data for the communities outside the exclusion zone was not available.
  - The present and potential future in-migration to the project area would pose an additional obstacle when considering reproducibility, as the sample sizes would grow proportionally.
  - The method would only provide a broad baseline health status across the entire survey area, and no interpretations could be made about the impacts at different community/village levels, where local level variations are likely to be amplified and thus important to analyse as part of the assessment process.

  Based on these considerations it was concluded that SRS was not an appropriate method for the present BHS.

- **Cluster sampling method:**

  A widely used alternative to SRS is the cluster sampling method, whereby clusters (i.e. communities) are sampled with a probability proportional to size (PPS). However, this method would also not allow for comparison of the impacts on community level, since large communities (such as Durba) would be over represented, while small, potentially highly impacted communities, may be missed or under represented (e.g. Kokiza, Renzi, Mengu).

- **Sentinel survey method:**

  Based on these considerations it was concluded that a sentinel survey approach with a randomization procedure at the household level would be the most appropriate method.

  This would allow a broad sample of the PACs as well as a method that is easily reproducible and could easily be adapted as the project evolves. New sentinel sites (SS) could simply be added, and as communities are relocated to the host site the sentinel surveillance can simply shift to these areas without challenges regarding proportional sizes or cluster selections. The study design will allow comparison between the different SS on an individual basis, and also allow for data to be pooled across all the SS according to similar characteristics to improve the statistical significance for analysis and surveillance purposes. This will allow for monitoring at that individual SS or pooling the data to monitor across all the sampled communities.

  The SS (i.e. clusters) were not selected using PPS method but with the following considerations:

  - The anticipated health impact as defined by the rapid HIA.
  - Information obtained from the updated RPF and associated studies.
  - Information on the proposed development activities of the project.
  - The legacy of past activities on the project site and the broader area.
  - The resettlement project and proposed host sites.

Based on these variables the SS displayed in Table 2 were selected.

Table 2: Selected sentinel sites and estimated sample sizes

	Household level		Individual level	
Sentinel site	*Number of households targeted for the key indicator survey*	*Number of households targeted for the KAP survey*	*Survey on heavy metals (all population groups)*	*Parasite prevalence survey (School-children 9-14 years old)*
Salambongo	20-30	20-30	50	60
Ndala				
Gumu			80	30
Gatanga	20-30	20-30		
Kokiza	20-30	20-30	30	30
Gorumbwa	20-30	20-30	80	
Agbarabo				30
Karagba	20-30	20-30	50	
Camp Chauffeur	20-30	20-30		60
Renzi	20-30	20-30		30
Durba Centre	20-30	20-30		30
Durba Toyota	20-30	20-30		60
Mazo	20-30	20-30		30
Mengu	20-30	20-30	30	
Total	**220-330**	**220-330**	**320**	**360**

Figure 144 shows the spatial arrangement of the SS in and around the concession area. These were chosen based on the proposed mine concession area, the proposed mine activities, resettlement considerations and also to obtain a broad geographical distribution. The final selections were conducted with input from the KGP community relations manager and the resettlement specialists.

In order to achieve the three study aims of the BHS, the data collection was conducted in 4 different survey arms, by 4 relatively independent teams:

- Key indicators survey (KIS) at household level.
- School survey.
- Survey on KAP at household level.
- Survey on heavy metals in different homogenous exposure groups.

One SS was surveyed per day. Based on the study design and the field teams, it was anticipated that the following samples sizes would be collected per SS with locations as per Table 2 :

- 20-30 households (for both the key indicator and the KAP survey).
- 30-45 adults (KIS).

- 20-50 children aged 6-59 months (KIS).
- 20-30 women aged 15-49 (KIS – anaemia study).
- 20-30 women and men aged 20-40 (KIS – blood pressure study).
- 30 children aged 9-14 years (school survey).
- 320 samples from 4 or 5 similar exposed areas for background exposure to mercury and arsenic.

To ensure a smooth survey process the different characteristics in each community were considered to determine the sampling schedule. This included market days, days when women would go to the field, public holidays and religious factors. The sampling schedule formed the basis of the community sensitisation and the survey schedule.

2.3 Sample selection

2.3.1 Household surveys

The sample selection of households (HH) to be surveyed was based on randomization procedures that were adopted from the widely used sampling methodology of the Expanded Programme on Immunisation (EPI) from the World Health Organization (WHO) (Henderson *et al.*, 1973).

A central place of the SS (i.e. village/cluster) was selected as starting point for the household sampling. Firstly, a spinning top with four pointers (Figure 3) was spun once to determine the four perpendicular boundaries of the community. Secondly, the field manager (or the interviewer) walked in the indicated directions and numbered the households until the border of the SS (e.g. end of the village) was reached. Thirdly, one household in each direction was selected as the first household to be surveyed using a randomly generated number out of the previously defined range (i.e. the numbered households). After this step, the closest household (door to door) to the first selected household was selected and so on (Bostoen and Chalabi, 2006). For larger settings (e.g. Durba) the interval (door to door) between the selected households was increased (e.g. second or third closest door). An equal number of households were targeted for the 4 different directions. This procedure applied separately for the KIS and KAP survey. The KAP survey team and KIS team consisted of 4 and 2 interviewers, respectively, which allowed for easy application in the different directions.

Figure 3: Spinning top used for the randomized selection of the 4 directions

For the KIS, a household, including the first one, was only surveyed if it met with the following inclusion criteria:

- Presence of at least one mother.
- Presence of at least one child <5 years.

If one or both criteria were not met, the interviewer proceeded to the next household. Subsequent households followed the same methodology.

The inclusion criteria for the KAP survey was the presence of at least one adult of the targeted gender and age group (see section 2.2).

In the event that the inclusion criteria applied to two or more individuals in a household, they were asked to draw a card from a set of playing cards and the person with the highest card value was chosen for the interview.

2.3.2 School survey

Schools were sampled in the framework of the SS selections. Schools that were closer to any water-body or riverside were given preference if there was more than one school in the selected SS.

2.3.3 Heavy metals survey

It was planned to identify 4-5 similar exposure groups and then collect urine samples based on these to test for the background prevalence of mercury and arsenic. It was anticipated to collect 80 samples in each of these groups to gain a representative sample of the community. Based on initial environmental information and past activities of artisanal miners in the area the following initial sites were selected:

- Exclusion zone at KCD.

- Exclusion zone and Salambongo.
- Area around Gorumbwa.
- Host sites in Kokiza and Gumu/Gatanga.
- Mengu area.

It was planned to cap the total sample size to 320 based on practicality and cost effectiveness.

A greater weighting was applied to those communities that are less likely to be exposed, viz. the host sites, and a lower weighting to the sites within the exclusion zones. This was based on likelihood of exposure and also the need to support the surveillance of the control zones in the future, with larger and more significant sample sizes.

It was considered essential that baseline water sampling of ground and surface water sources be conducted to support the findings of the human sampling. The project water monitoring programme will form the main surveillance system to determine if the project controls are in place and that no heavy metal exposure is occurring. Ongoing surveillance of urine is only likely to be required based on known exposures from ground, soil and air sources which are required to be measured as part of the project's Environmental Management Plan.

2.4 Survey tools

The survey tools were based on the 4 sampling arms described in section 2.2, which comprised of the following elements:

- **Questionnaires**

Questionnaires were developed for both the KAP and KIS survey limbs. These questions were based on a selection of questionnaires that have been conducted in similar settings in sub-Saharan Africa, including the DRC, by different organisations and agencies. The topics and questioning routes were selected based on the data gaps and surveillance requirements identified in the rapid HIA.

Well established standard indicators, that have been used for many years by different organizations and programmes, such as the WHO, UNAIDS, MEASURE DHS and The Global Fund to Fight AIDS/Tuberculosis and Malaria; were selected in the development of the survey questionnaires. These sources were selected as the different elements have been pretested and validated in a variety of settings. However, to ensure that the relevant key indicators that were selected were locally applicable the questionnaires were field tested prior to the commencement of the survey. The KGP and zone medical officer were asked to give input into the questionnaire to ensure that any local factors were also taken into account.

These tools were utilised with the objective to compare the results at a local level to larger national and regional surveys. It is likely that these surveys will be reproduced in other areas which will allow the project to monitor changes and compare to those at a national, regional and local level.

- **Biological sampling methods**

These are described under the field activity section.

- **Anthropometric methods**

These are described under the field activity section.

3 Survey preparation and field activities

The following section describes the detailed methodology of the BHS field activities. They have been included in the in the main body of the report so that the reader can understand the procedures and processes adopted in the survey. It also allows for an understanding of the methodology for reproducibility. The reader is encouraged to understand this section before the reporting section although it can be cross referenced as required.

The survey was completed from the 29th of July to the 13th of August 2010.

3.1 Community awareness and consultation

Community consultation and sensitization was considered as an essential initial activity. It had the objective of informing the local authorities and communities of the activity to ensure community participation; while also providing the opportunity for the community to address their concerns about the survey. Conducting health surveys requires detailed community information explaining the purpose and procedures, potential risks and benefits. This is to ally expectations and misconceptions of the survey and its objectives.

The community sensitisation activities included the following:

- Broadcasts on the local radio station.
- The KGP staff informed local and traditional authorities about the survey and its objectives and obtained permissions. In return the traditional leaders informed the communities about the pending work.
- A week prior to the survey a senior member of the NewFields (Dr Victor Andoseh) joined the community relations staff and medical director from KGP. This team then undertook specific community sensitisation with details of the upcoming survey. These were done at the different SS.
- The educational authorities and local schools principles were also informed of the surveys. Religious institutions were also informed.
- A day prior to the survey team arriving in the next planned SS, a community relations representative from KGP visited the community to remind them of the pending activity.

The information provided to the community and included the following:

- The purpose of the proposed survey.
- Where the survey will be conducted.
- Which communities will be selected to participate in the survey.

- How the communities will be selected.
- How the survey will be conducted and what kind of samples will be taken.
- How the test results will be used.
- Ethical considerations.
- Reporting of results.
- Timing of the survey for the different communities.

3.2 Instrument validation and field worker training

3.2.1 Pre-testing survey tools

The survey tools were carefully pre-tested to ensure that they were readily adapted to the local settings. In a first step, the French version of the questionnaire and informed consent sheets were translated into the local language (Lingala) and subsequently back translated into French to ensure consistency between the original version and the nuances of the local dialect. In a second step, the questionnaires were pre-tested with local people to ensure relevance to the local context. Where discrepancies were noted the content of the questionnaires (i.e. answer options) were adapted. Finally, the database was updated to reflect these changes.

3.2.2 Interviewer training

As interviewers played a crucial role in the survey, emphasis was placed on training in order to ensure a standardized interview technique. Once the interviewers were familiar with general interview techniques, the focus could be placed on the specifics of the health content of the questionnaires.

Training was conducted separately for the key indicator and KAP survey teams as the focus varied. Training was managed by the respective field supervisor so the specifics of each questionnaire and quality assurance could be addressed separately. This included role plays to refine the techniques for conducting interviews as well as handling of the global positioning system (GPS) devices (Garmin eTrex H).

The training was consolidated with a generic presentation to the full team on the overall study goals, design and programme. This served to provide sufficient background information to all the members of the survey team.

Figure 4: Training of the interviewers

3.2.3 Training of school survey team

To ensure the standardization of the survey activities and data collection methods, refresher training of the investigators was conducted prior to the start of the study. This focused on procedures and data collection, methodology for stool and urine collection, sample packing for transport to laboratory, sample preparation and examination. Health and safety and disposal of waste were also addressed.

3.2.4 Training of the field laboratory team

The field workers were trained in the laboratory techniques prior to the commencement of the field work. This included specific training on the following topics:

- Survey methodology.
- Use of data entry forms and eligibility for the survey and different laboratory components.
- Height and weight measurements – multimedia tools available from the WHO and specific training protocols on the equipment used in the survey was conducted.
- Use of the HemoCue® based on the multimedia tools provided by the supplier, including practical training using standard specific protocols.
- Malaria rapid test kits based on a specific protocol with additional practical training.
- Sharps handling and medical waste disposal.
- Treatment protocols and escalation procedures.

Figure 5: Training of the field laboratory team

3.3 Field work in the different survey arms

As part of the community sensitization, each community was informed of the date that the survey would take place in their respective area. To ensure that this was understood, and to comply with any schedule adjustment, the Kibali community relations department pre-notified each respective community the day before they would be sampled.

To minimise disruption in the communities, the survey commenced early in the morning (07h30) and was generally complete just after midday.

Figure 6: Baseline health survey team

3.3.1 Key Indicator Survey at household level

Data was collected on household level using questionnaires, direct observation, environmental sampling, anthropometric measurements and analysis of biological samples.

3.3.1.1 Selected indicators

Biomedical indicators:

- Level of malnutrition in children <5 years: Height and weight of children <5 years (WHO/UNICEF, 2009; MEASURE DHS, 2010). Middle upper arm circumference (MUAC) of children aged 6-59 months (WHO/UNICEF, 2009).
- Blood pressure in adults: Blood pressure (BP) of the adult population (aged 20-40 years) to enable indirect monitoring of risk factors for cardio vascular diseases (CVD).
- Prevalence and intensity of anaemia in children aged 6-59 months: Prevalence and intensity of anaemia in children (aged 6-59 months) and women in the reproductive age (15-49 years) (The Global Fund, 2009; MEASURE DHS, 2010).
- Malaria prevalence in children aged 6-59 months: Percentage of children aged 6-59 months with malaria infection and percentage of children aged 6-59 months with a measured haemoglobin concentration of less than 8 g/dl (The Global Fund, 2009).

Behavioural indicators:

- Use of insecticide-treated nets (ITNs): Percentage of children <5 years old, who slept under an ITN the previous night (Finn, 2007; MEASURE DHS, 2010).
- Use of intermittent preventive treatment in pregnancy (IPT_p): Percentage of women who received two or more doses of IPT_p for malaria during their last pregnancy (ORC Macro, 2005; MEASURE DHS, 2010).
- Health seeking behaviour: The initial health seeking response of the primary care giver the last time the youngest child was ill. Emphasis was placed on the reason for seeking alternative care if the public health facilities were not utilised.

Observational indicators:

- Household characteristics: Main material of floor, roof and outdoor wall (MEASURE DHS, 2008).
- Availability of improved sanitation facilities: Percentage of households that have functioning improved toilet facilities within their compounds (Finn, 2007).

- Indoor cooking: Location of the fire/stove (indoor/outdoor), whether or not a separate room within the household is used as kitchen, and what energy source is used for cooking (MEASURE DHS, 2008).
- Key indicators on health infrastructure: If any form of health facility (i.e. health centre, dispensary or hospital) was available in a SS the following indicators were assessed: Services provided; the available laboratory services; essential drugs and consumables that are permanently in stock; human resources allocations; average of outpatient consultations per day; number of beds; and availability of potable water and electricity.

Environmental indicators:

- Drinking water quality of community wells: The presence or absence of coliforms and faecal coliforms quality was tested at different community water sources by means of colitag test kits (Colitag, 2010).
- Drinking water quality at household level: Quality of drinking water as available from the tap/container at the household user level, by assessing the presence or absence of coliforms and faecal coliforms by means of colitag test kits (Colitag, 2010).

3.3.1.2 Field procedures

As the initial step, the interviewer explained the aim and procedures of the study to the household head. The questionnaire content and the procedures for the biological sampling activity were also explained and the household head was invited to sign an informed consent sheet. If the head of the household refused, then this was noted, the respondent thanked for their time, and the interviewer would move to the next household as per the methodology.

After written informed consent was obtained, the interviewer assessed the behavioural, observational and environmental indicators using a standardised questionnaire and recorded the GPS coordinates of the household.

The details of the household were captured on a separate laboratory control form and the adults (aged >15 years) and children <5 years were requested to visit the field laboratory. This form was used as a control by the laboratory staff to ensure that the household had been selected as part of the survey and thus eligible for the sampling. This was crucial as informed consent was obtained prior to laboratory entry.

Figure 7: Field laboratory in the community of Toyota

The laboratory was located at a well known, central place in the community and was selected to ensure it was appropriate for the collection of biological samples. The laboratory was set up in a structured manner to ensure a smooth flow from initial reception, measurements and finally the dispensing of health education and treatment.

The laboratory form was designed in such a way that the measurement requirement for each individual household member was defined so that unnecessary tests were not performed.

Height, weight and MUAC of children <5 years

The height and weight measurements were based on WHO standards (WHO, 2010). Training was completed based on the WHO job aid to ensure a consistent methodology (WHO, 2010).

Children under 2 years of age (less than 15 kg) were either weighed using a tared method with the floor scale, or with a hanging scale. Children older than 2 years were measured using a floor scale (measures to 2 decimal points) which was placed on a levelled surface.

For children of less than 2 years of age their height was measured on a recumbent length board (infantometer). If this was not possible the child (<2 years) was measured in the standing position and 0.7 cm was added to the final measurement. Children older than 2 years were measured with a standard height measurement rod (Frisancho, 1990). Two height measurements were taken and the mean recorded.

In addition to the height and weight, the middle upper arm circumference (MUAC) of children aged 6-59 months was measured according to WHO/UNICEF guidelines (WHO/UNICEF, 2009).

Figure 8: Weight and height measurement

Blood pressure measurement in the adult population

Blood pressure (BP) of adults was taken using an automated sphygmomanometer. Two readings were taken from the upper arm with the participant in a sitting position. The arm was placed in relaxed manner with the cuff at the same level of the heart. Two readings were taken within a 1 min interval and the average was recorded. If there was >5 mm Hg difference between the first and second readings, one or two additional readings were obtained, and then the average of these multiple readings were recorded.

Figure 9: Blood pressure measurement

Malaria and anaemia tests

A standard finger prick blood sampling method was used to obtain a capillary blood sample for children <5 years of age and women of reproductive age (15-49 years). This was performed using universal protection and according to best practices.

In children <5 years of age, the sample was analysed for the presence of malaria parasites and for anaemia (haemoglobin level). In women of reproductive age the sample was only analysed for anaemia.

Samples were analysed in the field and results were available within 5-15 minutes, which supported the ethical requirements of the survey in providing treatment.

Figure 10: Malaria and anaemia testing

Malaria diagnosis was performed using a malaria rapid diagnostic test (RDT). This RDT technique was based on the detection of Histadine rich protein-II (HRP-II). The RDT selected was specific for *Plasmodium falciparum,* which is the most common form of human malaria parasite found in the area. The other 3 parasite groups that can be detected by RDT were specifically excluded as they are less important in this setting and add little value as indicators. The tests used were ICT® kits (Global Diagnostics) which is WHO approved for quality (WHO and UNICEF, 2009). The tests were performed using standard protocols provided by the manufacturer and guidelines from the WHO (WHO, 2010).

The HemoCue® test was used to assess haemoglobin levels (HemoCue, 2009). This is a highly reliable and accurate field test device, which is used by organisations such as UNICEF in malaria indicator studies. Studies have shown a highly accurate correlation with values from the HemoCue® compared to formal laboratory tests (NIH, 2010). The tests were performed according to standard protocols as defined by the manufacturer.

Drinking water testing

Presence/absence (PA) test kits were used to screen for biological parameters of water drinking quality at community water sources and at household level. This was conducted with PA kits manufactured by 'Colitag', which contain a broth that would support the growth of microorganisms. The kits tested for coliforms and faecal coliforms (Colitag, 2010). At community wells, water was directly poured into the bottles, avoiding the use of any interim container. At the household level water was taken from the drinking water source after the seal of the container was removed. Bottles were incubated at 35°C for 24 hours and analysed on a basic colour change. If the solution changed from red to brown it would indicate coliform contamination. If the sample changed colour to brown it was fluoresced under a UV lamp provided by the manufacturer. If this was positive faecal coliform contamination was indicated (Figure 11).

Figure 11: Water testing using colitag test kits

At least one community water source was sampled per SS. Every second household was sampled per sentinel site to test for biological contamination at end user level.

3.3.1.3 Treatment and referral

As part of the ethical requirements each child that was tested positive for malaria was treated with an artemisinin-based combination therapy using the national first-line drug, i.e. arthemeter-amodiaquine. Treatment was administered according to the child's weight.

Additionally, all children were provided with a combination iron and vitamin supplement as an incentive. Those children found to have symptomatic anaemia were referred to the KGP Medical Director for decision on the further care and referral as required. Malnourished children were also referred to the KGP Medical Director.

All adults found with hypertension (i.e. systolic blood pressure >130 mmHg; diastolic blood pressure >90 mmHg) were counselled regarding lifestyle modification and referred to the local facilities if found to have severe blood pressure (stage 2 and above).

Figure 12: Treatment station

3.3.2 School survey

A cross-sectional survey was conducted in schools linked to the 14 SS. Thirty to forty children between the ages of 9 and 14 years were selected and requested to provide stool and urine samples. Stool samples were diagnosed for the presence and intensity of soil-transmitted helminth (STH) (e.g. hookworm spp. *Trichuris trichiura*, *Ascaris lumbricoides*) and *S. mansoni*. Urine samples were examined for *S. haematobium* eggs.

3.3.2.1 Field procedures

The school survey was integrated into the household survey. The initial sensitization activities included the planned activities in the schools.

Prior to the sample collection for the day, additional sensitization activities were carried out in the community. Informed consent was obtained from the community leaders and

head teachers to select only children from parents that had consented to participate in the study.

At each of the selected SS, 30 to 40 children (boys and girls) between 9 and 14 years were included in the sample, with the aim of a total sample size of 350 to 400 children. Schools that had attracted pupils from 2 separate communities were treated separately, i.e. 30 to 40 children were sampled from each separate community (Ndala School – Ndala 1 and Ndala 2 as well as Anzokudo and Modegi). In the event that no school was available at a SS (i.e. Kokiza and Renzi), children in the same age group, were sampled with the help of community leaders and with consent from their parents.

Children were clerked on a standard form and then weighed prior to sample collection. Fresh stool samples were collected from each participating child, under the supervision of the clinical team. Fresh urine samples were collected in 500 ml honey jars so that a full urine sample could be collected during the hottest time of day, i.e. 10h00 to 14h00, after the child had exercised for a period of time. The exercise increases the excretion of *S. haematobium* and the concentration increases in the terminal sample as the bladder contracts. This procedure increases sensitivity of *S. haematobium* diagnosis.

After the samples were collected, each child's stool and urine were assigned a unique ID number next to his/her personal information (i.e. name, age, weight and gender) as clerked on the 'Sample Collection Data Sheets' provided.

3.3.2.2 Laboratory procedures

Once collected, all samples were transferred to the field laboratory and examined within 24 hours after collection.

Stools were prepared by a laboratory technician and an experienced medical technologist examined the samples by means of the Kato-Katz method [Katz *et al.*, 1972] as recommended by the WHO. All samples were examined within 24 hours of collection.

A single Kato-Katz thick smear [Katz *et al.*, 1972] was prepared from each stool sample, using 50 mg standard templates. Slides were examined quantitatively for the presence of hookworm eggs within 30 min of sample preparation and subsequently for all other helminth eggs. Results were expressed as prevalence rates per SS. The eggs of each helminth were counted and recorded separately to determine the intensity of infection.

Infection intensity was estimated by multiplying the numbers of eggs per slide by a factor of 20 and expressed as eggs per gram (epg) of faeces.

Figure 13: Preparation and examination of stool samples

Urine samples were analysed within 8 hours of collection. Most of the children passed very small amounts of urine, so when there was sufficient, one 10 ml aliquot of urine was measured out per urine and when there was insufficient, the full amount was measured out and the volume recorded so that the resultant egg counts could be extrapolated to eggs per 10ml urine. All samples were centrifuged for 5 minutes after which the supernatant fluid was poured off. The remaining sediment was then transferred onto a slide using a 3 ml plastic disposable pipette, covered with a cover slip and examined under a light microscope. The results were expressed as intensity of infection (i.e. as number of eggs per 10 ml of urine (e/10 ml) and as prevalence of *S. haematobium* per SS.

3.3.2.3 Treatment

Empirical treatment was offered to all participants with a single dose of Mebendazole (500 mg) and praziquantel (50 mg/kg). This was given under the supervision of the local health staff or clinical team, using directly-observed treatment (DOT) after the child had eaten.

3.4 Knowledge Attitude and Practices survey at household level

KAP studies have been widely used around the world in public health and other programmes. They are more cost-effective and resource conserving than other social research methods because they are highly focused in scope. Information gained from the assessments can be used to define opportunities for information, education and communication (IEC) programmes within the local communities to support behaviour change activities. By repeating the KAP surveys the behaviour change communication strategies can be evaluated for effectiveness..

The KAP survey was based on a structured questionnaire and focused on the following public health determinants:

- HIV/AIDS and sexually-transmitted infections (STIs);
- Malaria;
- Water and sanitation practices;
- Health seeking behaviour;
- Maternal and child health;
- Nutrition;
- Social determinants of health;
- Quality of life; and
- Traditional medicine.

Traditional medicine was addressed with a separate questionnaire where they were traditional healers present in the SS.

3.4.1 Field procedures

Participants of the KAP survey were sampled on household level according to the sampling procedure that was previously described (see section 2.3.1).

In order to obtain a sample that represented the different age groups and genders in equal portions, the following population groups were targeted equallly (with the exception of the traditional healers):

A. Women aged 15-34 years;
B. Women aged >34 years;
C. Men aged 15-34 years; and
D. Men aged >34 years.

The KAP survey was carried out by four interviewers. They explained the aim of the study and obtained signed informed consent before proceeding. In order to have balanced participant numbers within the demographic groups A-D, the interviewers rotated the targeted cluster after each household (A → B → C → D → A → B → etc.), according to the indications that were pre-posted on the questionnaire.

The field manager of the KAP survey identified traditional healers that were present within a SS and performed the interview with them, using a structured questionnaire. Informed consent was obtained prior to the interview and confidentiality was assured. The interviews were conducted with the aid of a translator who translated the messages from the interviewer to the traditional healer and from the traditional healer back to the interviewer.

3.5 Quality assurance

3.5.1 Key indicator survey

The questionnaires used were based on validated survey instruments that were comprehensively pre-tested prior to the field work as described above.

An internal quality assurance process was conducted in the field whereby the data manager, Mr. Astrid Knoblauch, signed off all questionnaires before the SS was judged to be completed. Data entry in the field also allowed for continuous quality assurance as any errors could be corrected with the interviewers immediately.

The field laboratory followed internal quality assurance mechanisms that were supported by the initial training. Dr. Hermann Luhavo, Dr. Mark Divall and Mirko Winkler supervised all laboratory activities. The other laboratory staff comprised experienced locally recruited nurses and laboratory technicians.

Mirko Winkler carried out KIIs on key indicators of health infrastructure with the staff of the health facilities where these were present.

3.5.2 Knowledge Attitude and Practices survey

The questionnaire process was managed in an identical fashion as the key indicator questionnaires. This included in the field review and approval by Dr. Victor Andoseh in the field and immediate data entry.

The four interviewers were recruited from the local community and were thus familiar with language and were respected in the communities.

3.5.3 School survey

Quality assurance in the field was managed by Mrs. Colleen Archer at sample collection and analysis. Sample collection was based on the standard operating procedures and Mr. Ibrahim Fofana managed this together with Mr. Franco Kakule. The laboratory procedures were managed as per the WHO guidelines for Kato-Katz and urine sedimentation methods (Katz *et al.*, 1972).

3.6 Data management and statistical analysis

To ensure real-time capturing and reporting, the database was managed in the field by Ms. Astrid Knoblauch, an epidemiologist from the Swiss Tropical and Public Health Institute, using EpiInfo version 3.5 (EpiInfo Association; Odense, Denmark) and Excel (Microsoft Office). If any inconsistency was found at the data entry point, this was clarified with the interviewer and if required the interviewer was returned to the respective household.

Statistical analysis was carried out using EpiInfo, STATA (Stata Corp LP, Texas, USA) and SPSS v18 (IBM SPSS Inc. Chicago, Illinois, USA). In summary, frequency tables were generated for most of the variables and summary statistics, consisting of measures of central tendency and dispersion, were calculated for some numerical variables.

Responses from the open-ended questions from the traditional healer questionnaire were analyzed by identifying common themes across the entries for each response, coding the responses using letters or numbers, and then synthesizing them into categories and sub-categories.

The data analysis of the school survey was managed by entering data into a Microsoft Excel spreadsheet, and analyzing the data using SPSS software. Frequency tables with 95% confidence intervals (CI) were prepared. Arithmetic mean intensity of infection was used in the analysis (Montresor, 2007). Degree of intensity of infection for individual parasites was categorized according to WHO recommendations (WHO, 2002). Differences were analyzed using one-way ANOVA for mean age, Kruskal-Wallis test for intensity of infection and Pearson's χ^2-test for prevalence. The co-ordinates of each

sample site were obtained using GPS co-ordinates. Prevalence thresholds were categorized according to WHO guidelines (WHO, 2006).

3.7 Ethical considerations

A study protocol was submitted for ethical clearance to Dr. Amayo Kulidri, the Zone Medical Officer of the Haut-Uélé West District. A copy of the approval is attached in appendix A.

4 Limitations of the study

It is recognised that any epidemiological study will present some limitations in the design. The baseline health survey had some limitations as discussed below but based on the intent to describe a robust and measurable baseline for the PACs located in close proximity to the mining project these were regarded as acceptable.

Limitations include:

- Findings of the present study are not directly applicable to communities that were not sampled within the BHS and do not represent a regional average due to the strategic selections of the SS.
- Some of the SS cannot be directly compared to each other for certain indicators due to limited sample sizes required for direct comparison (e.g. nutrition).
- The survey had an extensive scope but this was nevertheless limited and not all indicators for all the disease profiles could be obtained, hence selected indicators that were easy to measure and reproduce were chosen; and
- The project area and the general health status of the community will change over time. At present the project has a long life cycle and the present health priorities are likely to change and new ones identified. Thus, the surveillance activities may need to have new indicators added as the project moves ahead.

5 Findings of the Baseline Health Survey

The survey finding will be discussed under the four different survey arms to aid in the definition of indicators and support the reproducibility of different elements of the survey.

5.1 Demographics and sample sizes

It is important to consider the demographics of the area for the BHS activities. The will allow an estimation of the total sample size and the proportion of the community sampled in comparison to the overall population.

There is however a scarcity of data in the communities outside of the concession area as these had not been sampled in the social-economic studies that have been performed to date. In addition information from the local authorities was lacking. This was a noted challenge during the study design and supported the survey design using sentinel sites as the preferred methodology. Only 4 of the 11 sampled SS were on the proposed mine concession area and this makes it extremely challenging to estimate the proportion of households sampled in comparison to the overall population in the specific communities or the broader project affected area. These studies are underway and it will be important to update the sampled population as described in Table 3, Table 4 and Table 5 with the overall population. This will allow the description of the sample sizes to the overall population and the population in the different SS and compare them to the samples collected.

Figure 14 depicts the spatial arrangement of the selected SS. The actual activities are represented in the keys to the diagram. 11 SS were selected in total as shown by the red flags. They were chosen based on the variables discussed in section 2.2. Schools were selected based on proximity to the SS and are depicted by the yellow flags. The heavy metal sampling was displayed by the green triangles with size proportion to sample sizes.

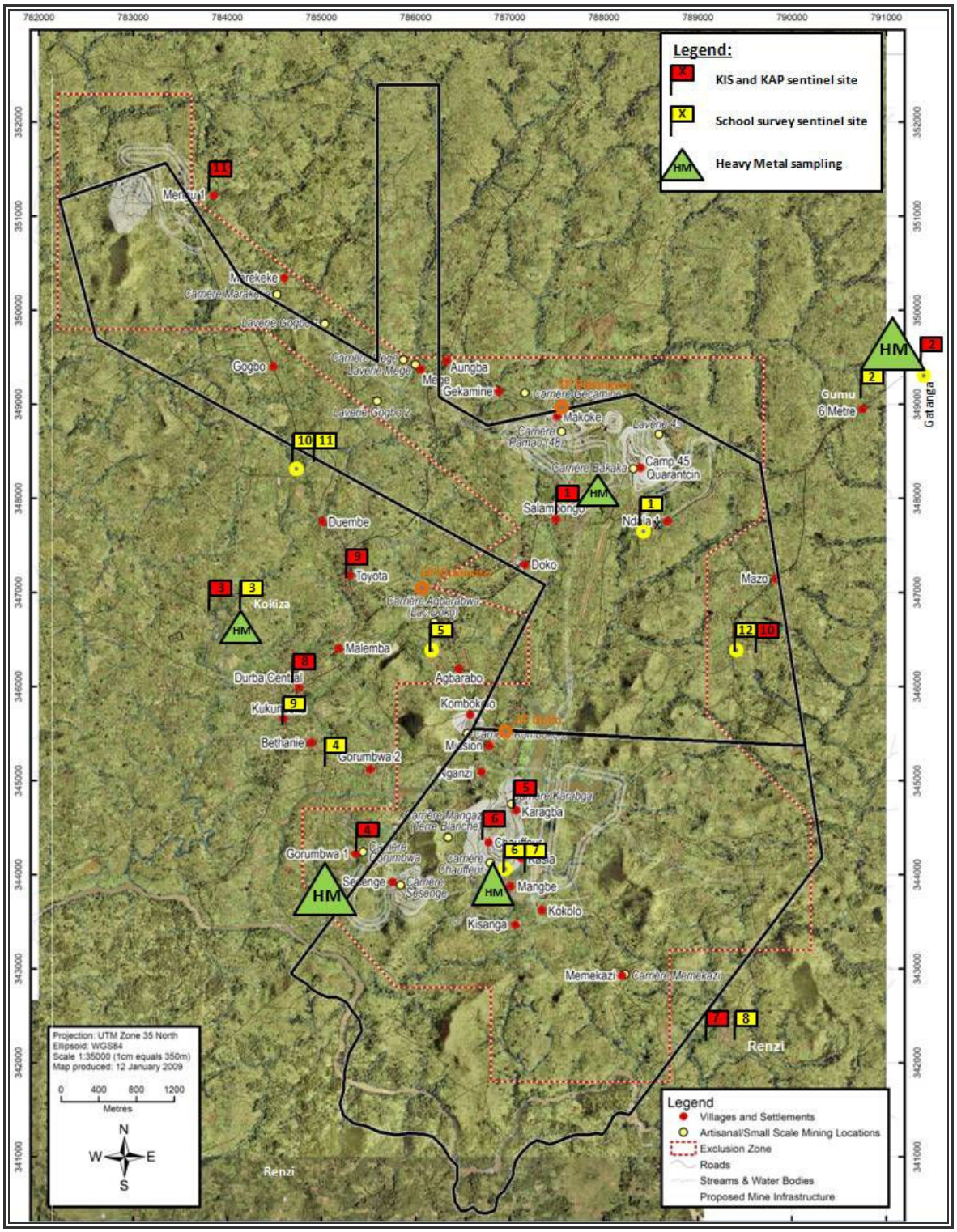

Figure 14: Map showing the different sentinel sites/activities

Table 3: Sample distribution of the KIS

Sentinel site (SS)	Household level			Population level						
				Children 6-59 months			*Adults > 15 years*			
	No. of HH sampled	*Estimated No. of HH*	*% of HH sampled per SS*	Male	Female	**Total**	Male	Female	**Total**	**Total no. of individuals**
Salambongo	26	490	5.3	27	21	**48**	1	23	**24**	**72**
Gatanga	31	?	?	35	36	**71**	6	39	**45**	**116**
Kokiza	15	?	?	20	22	**42**	3	19	**22**	**64**
Gorumbwa	30	146	20	46	47	**93**	0	47	**47**	**140**
Karagba	24	291	8.2	34	37	**71**	1	41	**42**	**113**
Camp Chauffeur	24	260	9.2	31	51	**82**	3	40	**43**	**125**
Renzi	20	?	?	35	33	**68**	2	34	**36**	**104**
Durba Centre	23	?	?	45	45	**90**	3	37	**40**	**130**
Durba Toyota	26	?	?	32	46	**78**	2	33	**35**	**113**
Mazo	23	91	25.2	27	34	**61**	4	32	**36**	**97**
Mengu	19	191	10	18	30	**48**	6	19	**25**	**73**
Total	**261**			**350**	**402**	**752**	**31**	**364**	**395**	**1,147**

Table 4: Sample distribution of school survey

	EP Ndala 1&2	**Kokiza community**	**EP Siloé**	**EP Agbarabo**	**EP Anzokudo 1&2**	**Renzi community**	**EP Drati**	**EP Modegi 1&2**	**EP Nzoro**	**Total**
Total number of schoolchildren	**72**	**32**	**35**	**34**	**63**	**33**	**35**	**64**	**33**	**401**

Table 5: Sample distribution of the KAP survey

Sentinel site	Household level		Population level				No. of HH sampled
	No. of HH sampled	*% of HH sampled in community*	***Adults 15-30 years***		***Adults >30 years***		
			Male	Female	Male	Female	
Salambongo	28	5.7	7	7	7	7	**28**
Gatanga	29	?	7	8	7	7	**29**
Kokiza	22	?	5	4	7	6	**22**
Gorumbwa	28	19	4	9	9	6	**28**
Karagba	29	10	6	8	7	8	**29**
Camp Chauffeur	28	10.7	7	7	7	7	**28**
Renzi	31	?	9	8	7	7	**31**
Durba Centre	29	?	8	7	7	7	**29**
Durba Toyota	30	?	8	7	8	7	**30**
Mazo	28	30	6	7	7	8	**28**
Mengu	20	10.5	6	5	4	5	**20**
Total	**302**		**73**	**77**	**77**	**75**	**302**

5.2 Number of participants treated

As part of the ethical requirements of the survey, treatment was provided to those who were diagnosed with specific conditions in the survey. Specifically this included:

- ACT was provided to 629 children who tested positive for malaria. This was given in accordance to national treatment policies based on weight of the child. Health education was provided to the primary care-giver on treatment schedule and the need to complete the full course.
- Approximately 850-900 children were provided with a multivitamin and iron supplement (Reniron®). The supplement was also provided to all siblings under the age of 7 who may not have qualified for sampling.
- The 401 schoolchildren sampled received a single dose of the antihelmintics, mebendazole (500 mg) and praziquantel (50 mg/kg). These drugs treat a broad range of parasitic diseases.

5.3 Findings of the Key Indicator Survey

5.3.1 Biomedical indicators

5.3.1.1 Prevalence of malaria in children aged 6-59 months

Introduction:

Malaria is one of the most serious public health challenges in the DRC, with 97% of the country classified as endemic for malaria transmission (Figure 15). The project lies within the highly endemic zone where malaria transmission occurs throughout the year (MARA, 2002; AMP, 2008). This is reflected at the local level, where malaria was reported to be the most important health concern by the communities as well as by the local health authorities (Divall and Winkler, 2008). However, exact prevalence data was not available in the region to serve as a true baseline. It was thus important that data on the baseline prevalence was established before the project commences or any interventions performed.

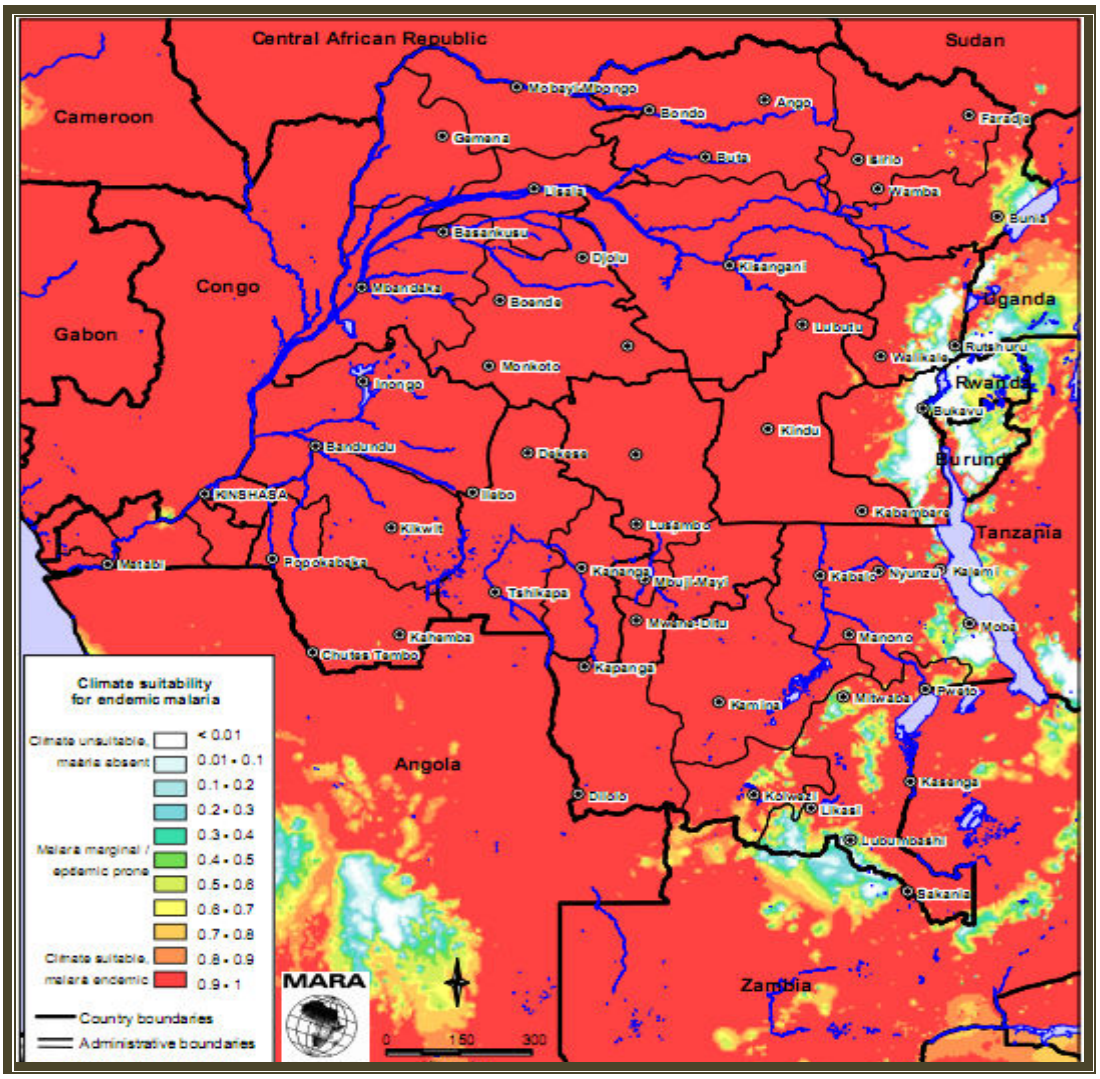

Figure 15: Predicted malaria endemicity in the DRC

Key findings:

Samples were collected from690 children from the 11 SS. These children were selected randomly as per the study methodology as thus were not screened to see if they had any signs of malaria. Most were thus asymptomatic at the time of the survey and thus reported as positive/negative for *P. falciparum* malaria rather than as having clinical malaria.

Of the 690 children tested 561 tested positive, giving a point prevalence rate for *P. falciparum* malaria of 81.3%.

The endemicity of malaria has been traditionally defined into the following categories by means of parasite rates in children aged between 6-59 months:

- Hypoendemic: Parasite rate 0-10%
- Mesoendemic: Parasite rate 10-50%
- Hyperendemic: Parasite rate 50-75%
- Holoendemic: Parasite rate >75% and parasite count high in first year of life.

Thus the mean rates for the sampled SS reveal a holo-endemic transmission status. These are extremely high rates and have not been often been described at these levels in pre-wet season sampling. The burden of disease from malaria is thus extremely high. Table 6 summarizes the observed prevalence, stratified into the different SS. Gatanga has lowest malaria prevalence at 68% and Karagba has highest prevalence at 95.5%. The highest prevalence was found in a) the seemingly poorer and more rural settlements of Kokiza, Renzi, Mazo and Mengu and b) the cluster settlements of Karagba, Camp Chauffeur and Gorumbwa (all with prevalence higher than 84%). The more peri-urban settlements, such as Durba Centre and Durba Toyota had as expected slightly lower prevalence. However, Gatanga was also in a rural remote setting and its comparatively low rate was surprising.

Table 6: Malaria prevalence per sentinel site

Sentinel site	Male	Female	Total	
	%	%	%	Number
Salambongo	87.0	79.0	83.3	42
Gatanga	64.5	71.4	68.2	66
Kokiza	83.3	100.0	89.5	38
Gorumbwa	80.5	79.1	79.8	84
Karagba	93.8	97.1	95.5	67
Camp Chauffeur	88.5	85.4	86.5	74
Renzi	90.3	89.3	89.8	59
Durba Centre	59.5	67.5	63.4	82
Durba Toyota	77.4	74.4	75.7	74
Mazo	76.9	93.9	86.4	59
Mengu	87.5	89.7	88.9	45
Age in months				
6-23	70.3	71.7	70.8	250
24-59	84.5	89.7	87.3	440
Total	**78.6**	**82.8**	**81.3**	**690**

Girls were more vulnerable to malaria than boys across the SS. The overall parasite prevalence rate was 82.8% in girls compared to 78.6% in boys, but this was not a statistically significant difference (p-value: 0.387).

When comparing age groups, there was a significant difference (p-value <0.01) in children aged 24-59 months, where mean malaria prevalence was 87.3%, compared to children aged 6-23 months, where the mean prevalence was 70.8%. Figure 16 outlines the clear increasing trend of malaria prevalence after 11 months with the different gender splits. This is an expected trend in areas of high transmission where children under the age of 6 months retain some of their mother's acquired immunity. As this is lost and the child is frequently exposed clinical signs will appear more frequently. The child can be treated but with repeated exposure the rates of acquired immunity increase and subclinical malaria is the result.

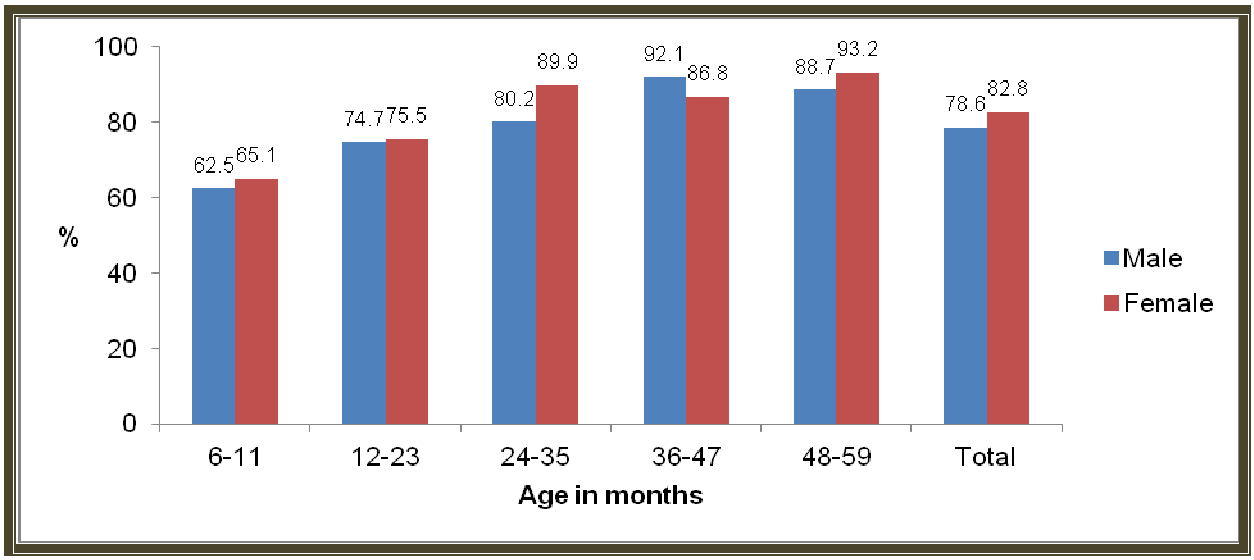

Figure 16: Percentage of children tested positive for malaria by age group (n = 690)

The variation in prevalence across the SS is spatially depicted in Figure 17. This map does not have the intent to directly compare SS to one another but rather to support surveillance activity at each SS over time.

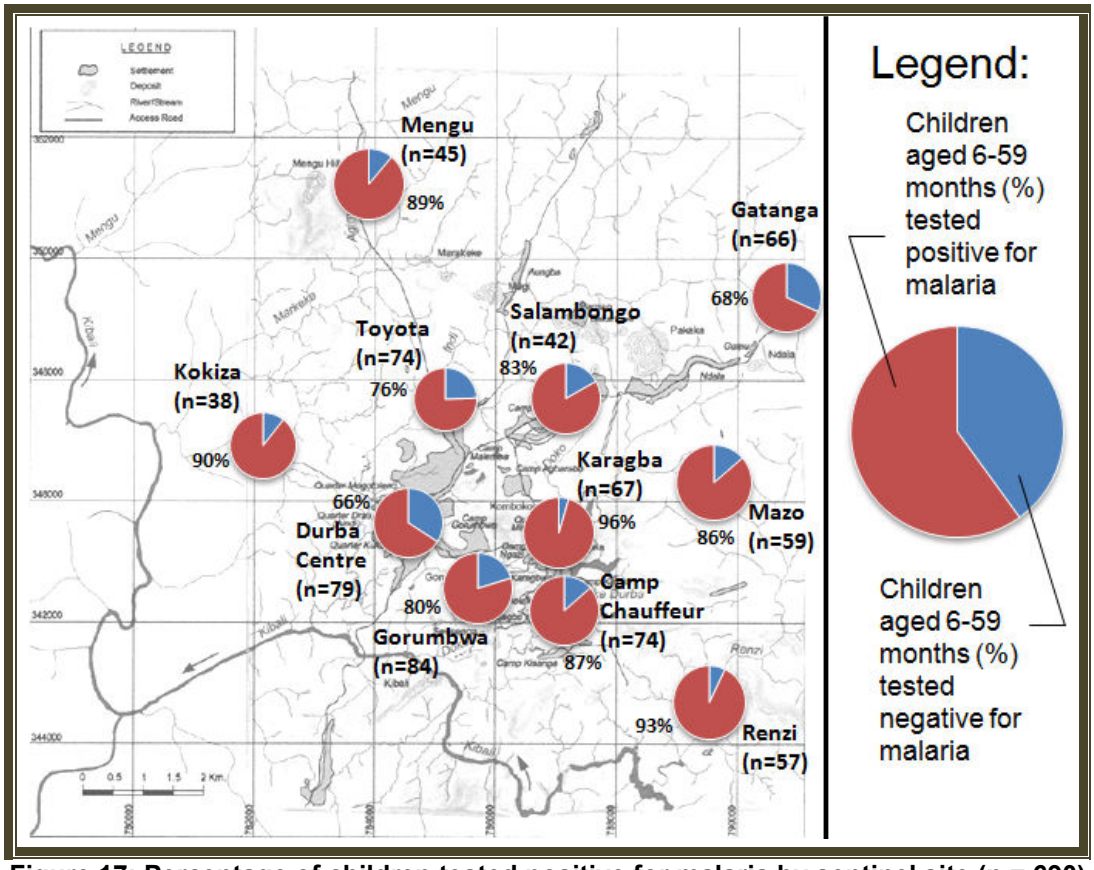

Figure 17: Percentage of children tested positive for malaria by sentinel site (n = 690)

An important note that although malaria transmission is perennial in the DRC, any follow-up surveys must be conducted at the same time of the year in order to allow non-biased comparisons due to minor seasonal fluctuations. Thus any repeat malaria parasite prevalence surveys must be performed in late July / early August.

5.3.1.2 Malaria-related anaemia in children aged 6-59 months

Key findings:

Malaria causes anaemia through the constant haemolysis of red blood cells and co-morbid effects linked to nutrition and other infectious diseases. The Global Fund to Fight AIDS, Tuberculosis and Malaria uses malaria related anaemia as an impact indicator, with a threshold value of below 8 g/dl regarded as the measure for severe to moderate anaemia (The Global Fund, 2009).

Out of the 690 children (aged 6-59 months) sampled, 76 were reported as having haemoglobin levels below 8 g/dl indicating moderate to severe anaemia, giving a point prevalence rate of malaria related anaemia of 10.1%. 9.1% of boys and 11.0% of girls were found to have malaria related anaemia but with no significant gender differences across the different age groups (p-value: 0.122) as shown in Figure 18. The highest rates of anaemia were found in the second year of life for both genders.

When comparing the 6-23 and 24-59 months age groups a significant difference was found in haemoglobin levels (p-value: 0.009) where mean haemoglobin levels for children aged 6-23 months was 9.8 (SD ± 5.0) compared to 10.8 (SD ± 4.3) for children aged 24-59 months. 14.4% of boys and 20.1% of girls had malaria related anaemia in the <24 month age group compared to 7.3% and 6% in the >24 month age group, respectively.

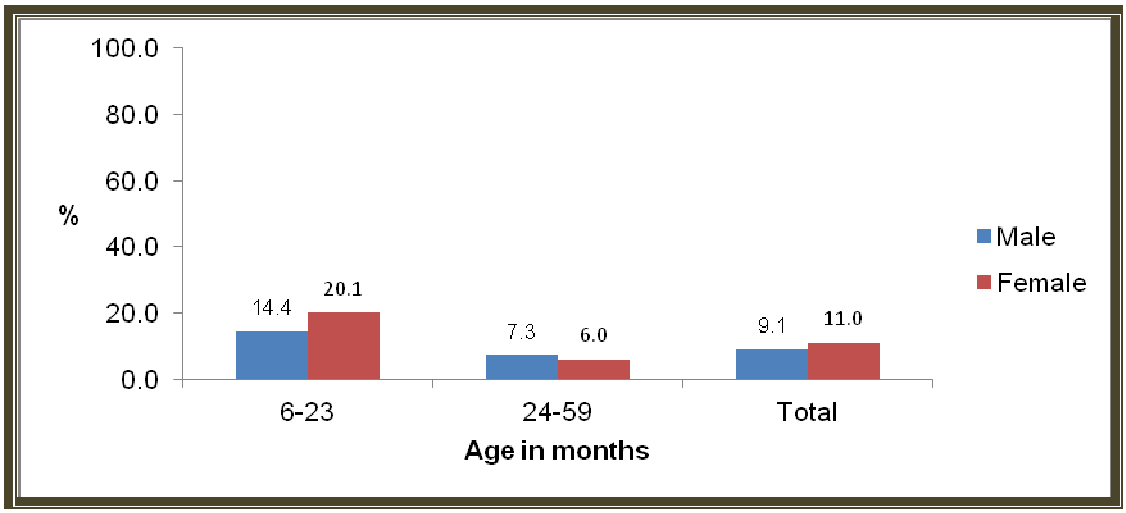

Figure 18: Children (%) with a hemoglobin level of <8 g/dl by age group (n = 690)

The proportion of severe anaemia in the 11 SS is depicted in Figure 19. These are useful as it can be compared to any future malaria control interventions and determine the effects on malaria-related anaemia (in children aged 6-59 months) in relation to malaria parasite prevalence rates.

The rates of malaria-related anaemia are higher in the age group <24 months which differs from the malaria peak in the older age group. It is thus important to establish a logistic regression to determine the relationship between malaria and haemoglobin. It is thus important to determine the relationship between malaria and haemoglobin through a logistic regression analysis. A negative correlation was established between a positive malaria status and low haemoglobin level, where children with haemoglobin levels above 8 g/dl are significantly less likely to have a malaria infection (OR: 0.41, 95%-CI: 0.19-0.92). This underscores the link between malaria and severe anaemia

Discussion:

It is regarded as extremely useful to follow trends in anaemia prevalence as it is a reliable indicator of malaria morbidity in this age group. Malaria control interventions have been associated with a 60% reduction in the risk of moderate to severe anaemia. Studies have shown that malaria control interventions reduce the prevalence of moderate to severe anaemia (<8 g/dl) more than it reduces the prevalence of mild anaemia (<11 g/dl).

In the context of the project area, where malaria is shown to be holo-endemic (prevalence >75%) in children under the age of 5 years, a child is generally repeatedly inoculated with malaria in the first years of life. For the first six months of life, antibodies acquired from the mother during pregnancy protect the child against malaria. While this acquired immunity is gradually lost, the child will start to develop its own immunity over a period of time. This results in the blood stage of the life cycle rarely becoming severe and manifesting with complications such as cerebral malaria. In this epidemiological context the main clinical impact of *P. falciparum* malaria in the 1-3 year old age group is generally severe anaemia. This becomes chronic and the child becomes prone to infectious diseases and malnutrition as a result of the chronic malaria exposure (Cook and Zumla, 2002).

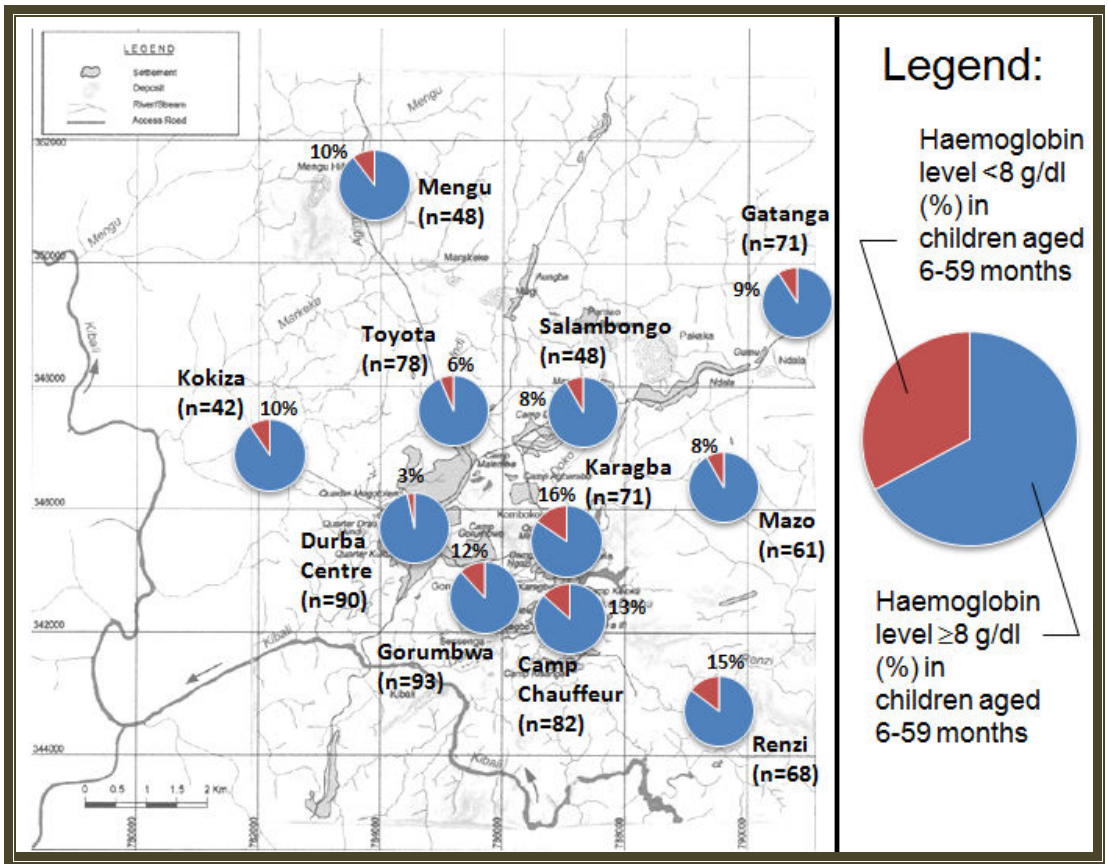

Figure 19: Children (%) with a haemoglobin level of <8 g/dl by sentinel site

5.3.1.3 Nutrition

Introduction:

Malnutrition is one of the largest contributing factors to childhood mortality in DRC. The United Nations Food and Agriculture Organization reported that 76% of all Congolese (43 million) where undernourished in the period from 2003-2005 (FAO, 2009). In developing countries such as the DRC, the main cause for malnutrition is linked to under-nutrition through a variety of factors including lack of food, mal-absorption of nutrients, inadequate intake of protein, micronutrients and vitamins. Infections and parasitic disorders often cause or can exacerbate malnutrition.

Malnutrition has been known to not only result from, but also perpetuate poverty and undermines socio-economic growth in the affected communities. It remains as one of the greatest concerns in public health and the largest contributing factor to child mortality in developing countries, where the majority of children who are malnourished are found. Malnutrition links into more than half the deaths of children, as a co-morbid factor, as malnourished children are more likely to acquire infections through low levels of inherent resistance. They are more likely to die from common childhood illnesses like diarrhoea and respiratory infections, and if they survive these initial insults, they often enter a continuous cycle of illness with further failure to thrive, until they do eventually succumb to an infection. It is very important to understand that **¾ of children that die** with a link to malnutrition only have **moderate levels** of under-nourishment thus not making this that visible in general communities.

Over and above its impacts on child morbidity, the effects of malnutrition transcend to adulthood where they are characterized by inter-alia, mental retardation, physical deformities and general underdevelopment. It may also have negative implications on childbirth in young women through stunting (Chhabra and Rokx, 2004; Setboonsarng, 2005).

Poor maternal schooling can play a major role in nutrition. In a study completed in Ghana it was found that maternal education is a key factor for good care-giver practices related to child feeding as well as health and hygiene. It was found that child feeding practices were more dependent on the mother's education than on household food availability and economic resource; and that limited household resources were only a constraint for preventative health and hygiene practices. This could result in an "obese mother/malnourished child" scenario suggesting inequitable use of resource rather than severe poverty or lack of resource (Armar-Klemesu *et al.*, 2000).

Undernourishment can be indicated both by anthropometric indices and micronutrient deficiencies. In the survey, four global indicators of malnutrition were assessed: Stunting; wasting; underweight; and middle-upper arm circumference (MUAC). A total of 752 children under the age of 5 years had their height/length and weight measured and age recorded. The WHO reference anthropometric standards were used to determine stunting (height for age), wasting (weight for height) and underweight (weight for age) among the children (WHO, 1999).

The findings of the survey are compared in the analysis tables, where possible, to the findings of the DRC Demographic and Health Survey (DHS), completed in 2007 and the multiple cluster indicator study completed in 2001 (CNSEE, 2008) (UNICEF, 2001).

Key findings:

Table 7 summarizes the nutritional indicators gathered in the survey. The values for the project region show that nutritional indicators are consistently below the national values. Boys showed higher rates of chronic malnutrition (stunting) and being underweight compared to girls, who in turn appeared more prone to acute malnutrition (wasting). Boys also showed higher rates of reduced MUAC. It is important to note that data is provided across the pooled SS as individual SS sample sizes are generally too small for accurate analysis.

Table 7: Summary nutritional indicators

Background characteristic	Severely wasted % < -3 SD	Wasted % < -2 SD	Stunted % < -2 SD	Underweight % < -2 SD	MUAC % < -2 SD	Total of sampled children
Sex						
Male	0.6	1.7	47.4	16.3	9.2	344
Female	0.5	2.3	38.4	10.0	6.6	399
Total	**0.5**	**2.0**	**42.5**	**12.9**	**7.8**	**743**
DHS DRC 2007	*4.3*	*10.0*	*45.5*	*25.1*	-	*3,631*
DHS DRC 2007 Orientale	*2.5*	*7.7*	*46.2*	*21.4*	-	*433*
MICS 2001	*9.2*	*29.2*	*36.0*	*12.1*	-	*4,302*

Important age variations can be observed in nutritional indicators as shown in Figure 20. Stunting and underweight reach their peak between the ages of 24-35 months, while wasting has it peak in the age groups from 6-23 months. Stunting increases dramatically from 6 months to reach a peak at between 24-35 months, affecting 56.9% of children

sampled in this age group. This is likely to reflect weaning from breast feeding and poor nutrition and the effects of disease in this period. These findings are comparable to the findings from the DHS where stunting rates increase steadily until 35 months. The only difference is that while stunting rates continue to rise after 36 months in the DHS, a gradual improvement is shown in this study. Children that are underweight in the study area also show a far more gradual increase compared to the DHS.

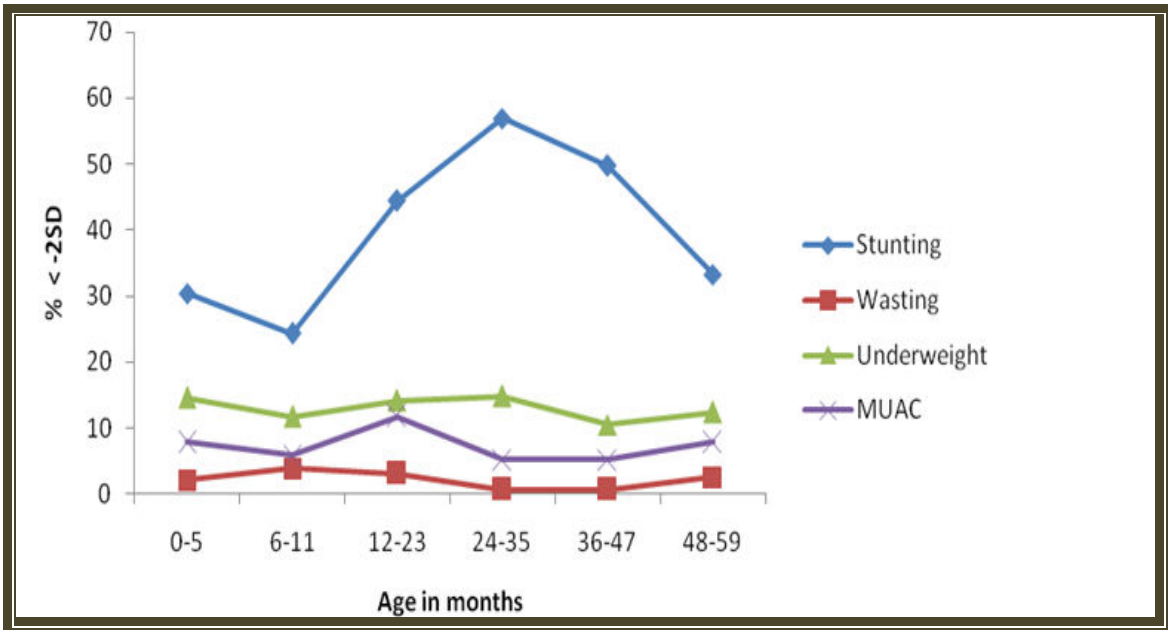

Figure 20: Nutritional status of children under 5 years by age

Wasting (weight-for-height)

Children, who are wasted, are those that have a low weight-for-height/length z-score which is below -2 standard deviations (SD) from the median weight-for-height of the WHO reference population.

Wasting, also referred to as acute malnutrition, provides a good reflection of food availability or of high burden of disease in the affected population. It is thus prone to show significant seasonal variations associated with food availability or increased disease prevalence. The situation can thus change rapidly. It is often a consequence of low intake of energy and high loss of nutrients due to concurrent infection. Follow-up surveys should therefore preferably be conducted at the same time of the year.

Of the 743 children measured, **2.0 % (-2SD)** were moderately wasted with **0.5% (-3SD)** severely wasted. It is relevant that the proportion of severe wasting was significantly below the values found in both studies referenced above (CNSEE, 2008; UNICEF, 2001).

Using weight-for-height, WHO and UNICEF recommend the use of a cut-off for weight-for height of below -3 SD to identify infants and children as having severe acute malnutrition (WHO/UNICEF, 2009). This cut-off value has been selected for the following reasons:

- Children below this cut-off have a higher risk of death (Figure 21 shows the increasing odds ratio for mortality where children with a weight for height below -3 SD have a risk of death more than 9 fold a child with a weight for height above -1 SD).
- Children show a higher weight gain when receiving a therapeutic diet compared to other diets, which results in faster recovery.
- In a well-nourished population there are virtually no children below -3 SD (<1%).

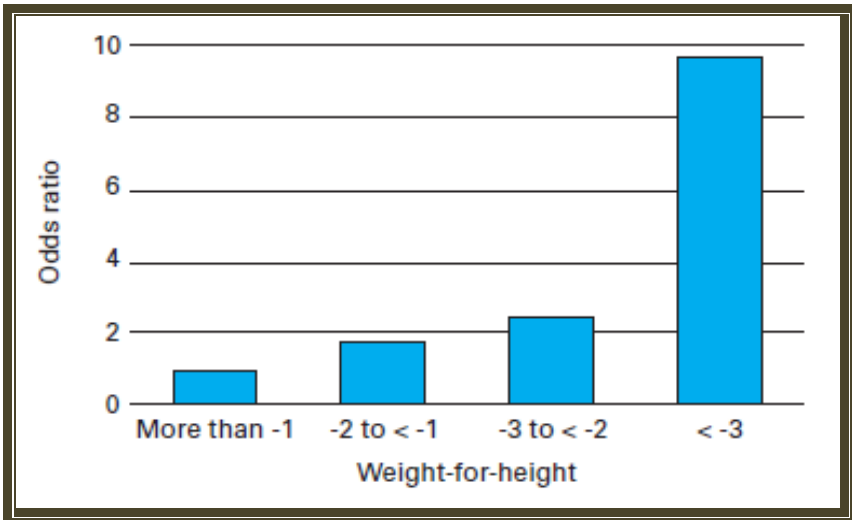

Figure 21: Odds ratio for mortality based on wasting (WHO/UNICEF, 2009)

Table 8 stratifies rates of wasting in different age groups. The most severely affected groups were between 6-11 months and 12-23 months. This might reflect the inability to deal with changes in nutrition (poor breastfeeding and supplemental feeding) and disease. Severe wasting was only above 1% in the 6-11 month age group showing that severe acute malnutrition is not a major concern in the area. These figures showed a marked difference from those presented at national and provincial level (CNSEE, 2008). This may be reflected by the adequate subsistence agricultural practices and the relative wealth generated by artisanal mining.

Table 8: Percentage of children under 5 years classified as wasted (weight-for-height)

Background characteristic	Weight-for-height		No. of children sampled
	Severe wasting % < -3 SD	Moderate wasting % < -2 SD	
Age in months			
<6	-	2.1	48
6-11	1.9	3.9	103
12-23	0.6	3.1	162
24-35	-	0.7	153
36-47	-	0.7	153
48-59	0.8	2.5	120
Sex			
Male	0.6	1.7	344
Female	0.5	2.3	396
Total	**0.5**	**2.0**	**740**
DHS DRC 2007	*4.3*	*10.0*	*3,631*
DHS DRC 2007 Orientale	*2.5*	*7.7*	*433*
MICS 2001	*2.8*	*12.1*	*4,302*

Findings of this survey were compared and plotted against WHO standards and results are shown in Figure 22. The green outlines the WHO standards and the red line the findings from the BHS findings. This figure represents an extremely positive finding that there is a slight shift of the curve to the right showing that wasting is not a major concern in children. However, it is important to notice that numbers of severe and moderate wasting is highly dependent on seasonal fluctuations and hence these 'positive' findings need to be interpreted with care. It will also be essential to evaluate this critical and sensitive indicator as the project progresses as it can link to loss of livelihood, access to land and food inflation. Over-nutrition will also be important to evaluate.

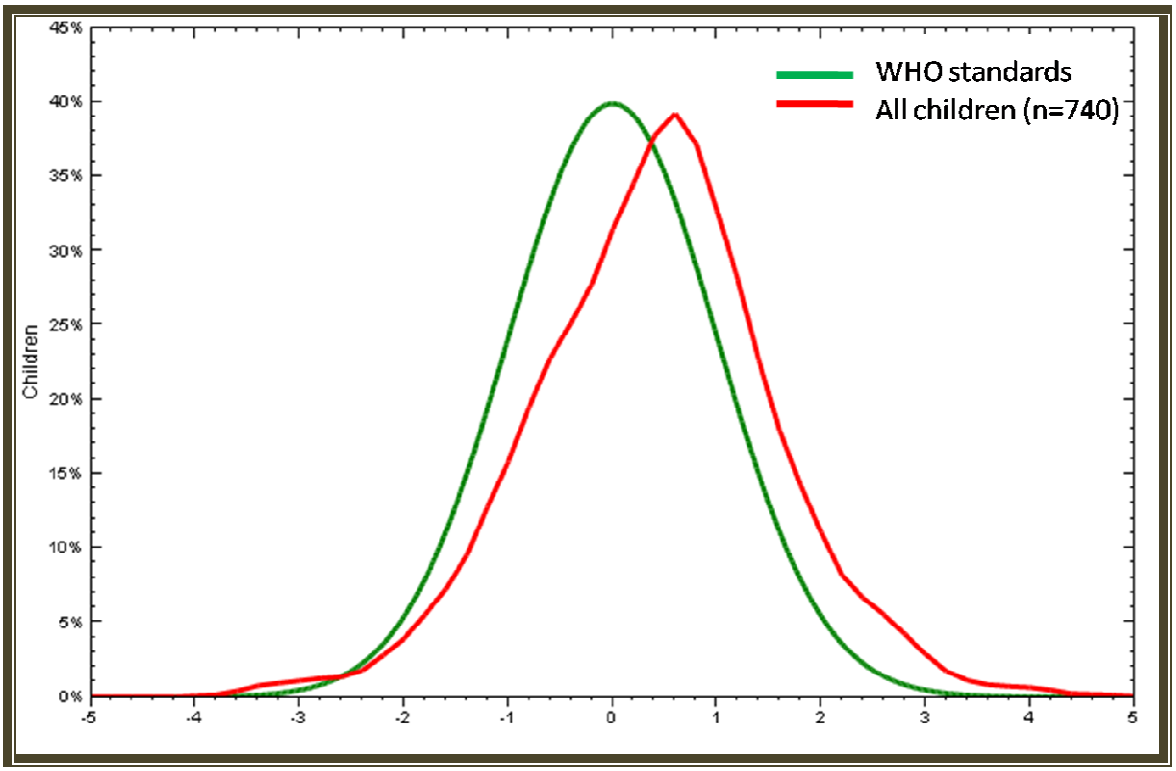

Figure 22: Distribution of children <5 years found wasted compared to WHO standards

MUAC (middle-upper arm circumference) for age

MUAC is, similar to wasting, a sensitive indicator for acute malnutrition in the population. It is recognised that MUAC is a more precise indicator for mortality risk than weight-for-age (underweight). Therefore, to complete the picture of (acute) malnutrition in the community, MUAC was measured of all children under 5. Although, MUAC can miss older children with low weight-for-age, together, they are provide a comprehensive picture of malnutrition in the community (Bern and Nathanail, 1995).

In a well nourished population, there are very few children aged 6-59 months with a MUAC less than 115mm (WHO/UNICEF, 2009). Children with MUAC less than 115mm have a significantly increased risk of dying, with malnutrition as a co-morbid factor, compared to those with values above this. The BHS found that 1.4% of children had MUAC values below -3 Z-scores, which indicates severe acute malnutrition. 7.3% were found in a condition of moderate malnutrition. These proportions are higher than those found for wasting (weight-for-age) and provide a good correlation of these figures.

Table 9: Percentage of children under 5 years, MUAC-for-age

Background characteristic	MUAC-for-age		No. of children sampled
	MUAC (severe) % < -3 SD	MUAC (moderate) % < -2 SD	
Age in months			
<6	2.9	8.6	35
6-11	0	5.9	102
12-23	1.2	11.7	163
24-35	1.3	5.2	155
36-47	0.7	5.2	153
48-59	3.3	7.8	123
Sex			
Male	1.2	9.2	338
Female	1.5	6.6	393
Total	**1.4**	**7.3**	**731**

Figure 23 depicts the MUAC distribution curve of the survey children, which displaced to the left compared to the WHO standard. The average is about -1 SD below the WHO predicted values and the fact that the figures were significantly worse than those for wasting means that acute malnutrition cannot be discounted in the area and ongoing surveillance through the local health services would be beneficial to pick up early cases.

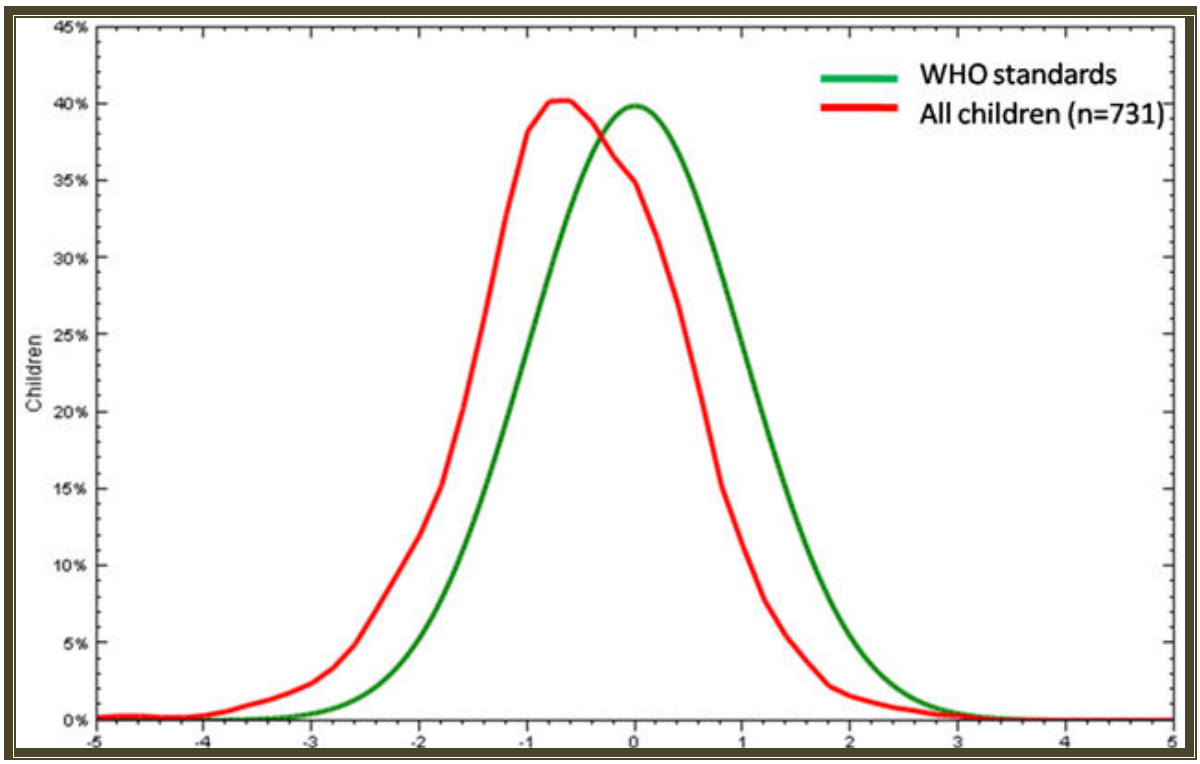

Figure 23: Distribution the MUAC in children under 5 years compared to WHO standards

Stunting (height-for-age)

Stunting is also referred to as chronic malnutrition. It reflects a deficit in the consumption of micro- and macro-nutrients consumed and also potentially exposure to infections and poor water and sanitary conditions. Low Z-scores indicate long-term chronic malnutrition in children under the age of 5 years. Affected children are shorter than expected and experience long-term sequelae such as poor physical growth, cognitive and general development which is often irreversible. Poor productivity is a likely long-term effect.

Of the 731 children sampled, 19.6% were severely stunted (-3 SD) and 42.5% were moderately stunted (-2 SD). Children aged 12-47 months were most affected with a peak at 24-35 months as described in Figure 20.

Boys were significantly more stunted than girls at levels of severe and moderate stunting. Studies have shown that this is often the case in sub-Saharan Africa although the causes are multifactorial (Sahn and Stifel, 2002).

Table 10: Percentage of children under 5 years classified as stunted (height-for-age)

Background characteristic	Height-for-age		No. of children sampled
	Severe stunting % < -3 SD	Moderate stunting % < -2 SD	
Age in months			
<6	19.6	30.4	46
6-11	7.8	24.3	103
12-23	21.3	44.4	160
24-35	28.8	56.9	153
36-47	19.5	49.7	149
48-59	15.8	33.3	120
Sex			
Male	24.4	47.4	340
Female	15.3	38.4	391
Total	**19.6**	**42.5**	**731**
DHS DRC 2007	*24.2*	*45.5*	*3,631*
DHS DRC 2007 Orientale	*25.3*	*46.2*	*433*
MICS 2001	*19.4*	*36.0*	*4,302*

Proportions of severely and moderately stunted children found in the project region were below national averages found in the 2007 DHS in the DRC (CNSEE, 2008) but similar to the findings of the 2001 MICS (UNICEF, 2001).

The comparison of the BHS findings to the WHO height-for-age standards revealed that there is a string shift to the left as could be predicted with the high levels of chronic malnutrition. This is shown in Figure 24. Only 12% of children in this survey were in the mean for height-for-age measurements, while 40% of children should actually meet this condition according to the WHO standard.

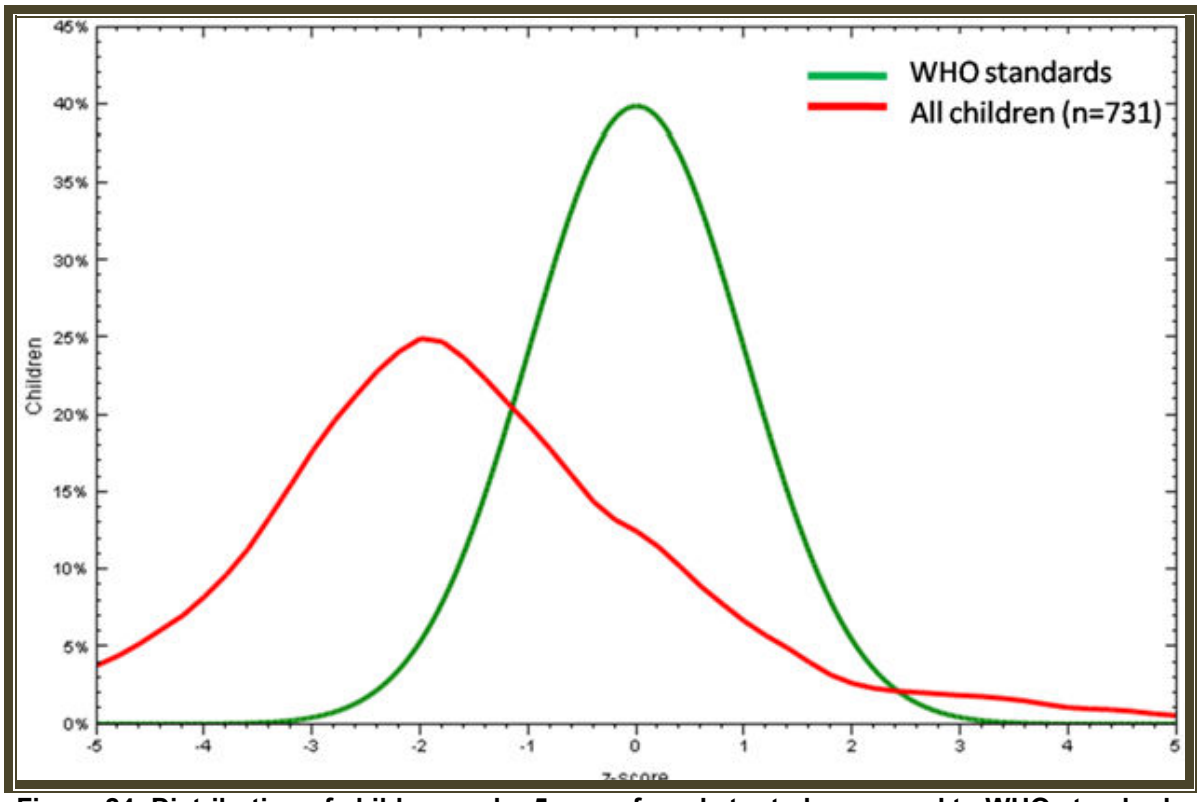

Figure 24: Distribution of children under 5 years found stunted compared to WHO standards

Underweight (weight for age)

Underweight reflects both, the poor past (chronic) and/or present (acute) under nutrition of the (under 5 years of age) population. This has a particular reference to food availability in the community over time.

Table 11: Percentage of children under 5 years classified as underweight

Background characteristic	Weight-for-age		No. of children sampled
	Severe underweight % < -3 SD	Moderate underweight % < -2 SD	
Age in months			
<6	2.1	14.6	48
6-11	-	11.7	103
12-23	4.3	14.1	163
24-35	5.8	14.8	155
36-47	3.9	10.5	153
48-59	0.8	12.4	121
Sex			
Male	4.4	16.3	344
Female	2.5	10.0	399
Total	**3.4**	**12.9**	**743**
DHS DRC 2007	*8.4*	*25.1*	*3,631*
DHS DRC 2007 Orientale	*6.4*	*21.4*	*433*
MICS 2001	*9.2*	*29.2*	*4,302*

3.4% of children were found severely underweight and 12.9% were found moderately underweight. Children under 6 months were reported as the group most commonly underweight followed by children in the second and third year of life which mirrors the stunting trend. Boys were more affected for moderate and severe underweight conditions than girls. The curve in Figure 25 is skewed to the left which indicates an increased level of underweight children in the study population.

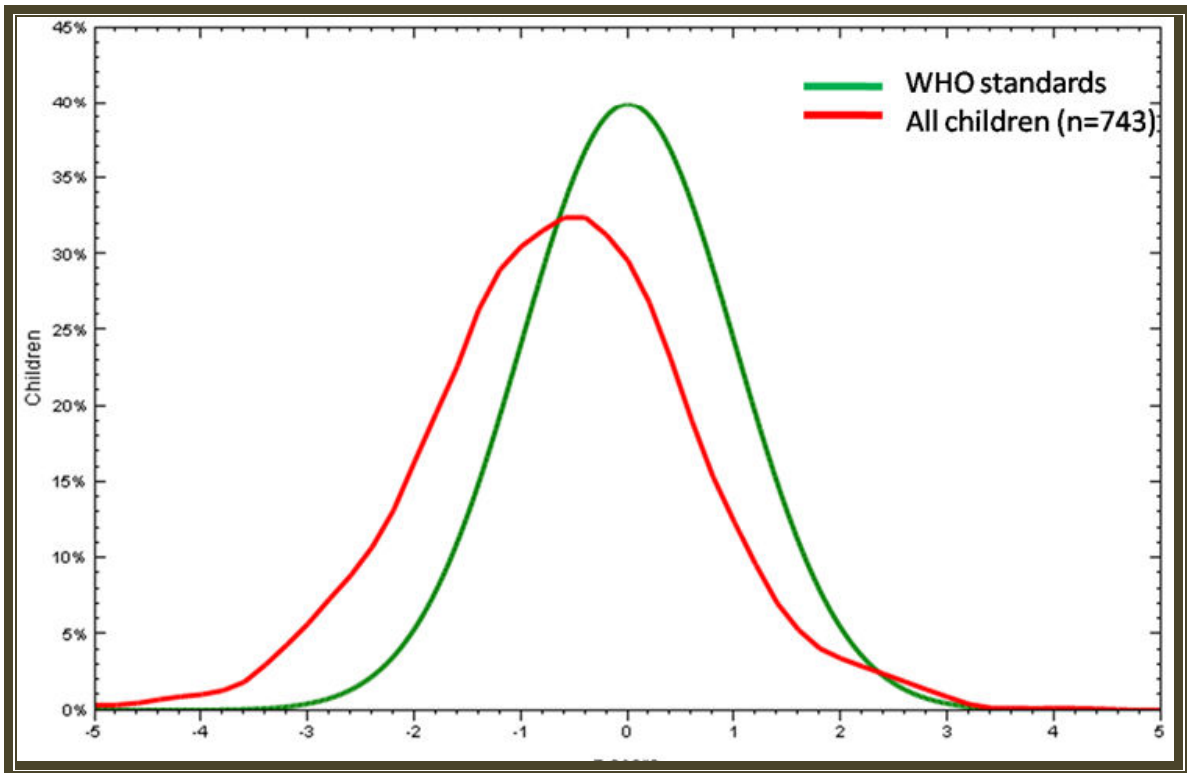

Figure 25: Distribution of underweight children (<5 years) compared to WHO standards

Anaemia, malaria and malnutrition as discussed, all contribute significantly to the morbidity/mortality of children under 5 years of age in sub-Saharan Africa, but it is respected that the individual roles for conferring disease is complex. In a study completed in Ghana in 2002 all three components were evaluated in areas of hyper-endemic malaria transmission (>75%). Anaemia was noted in 64% of the children and was associated with young age and season but also with nutrition. In addition to this, malnutrition was also associated independently to fever and malaria. The conclusion of this study was that malnutrition was a fundamental factor contributing to malaria-associated anaemia and morbidity and that malaria control programmes **will not have the desired impact in childhood mortality** without supporting nutritional programmes (Ehrhardt *et al.*, 2006).

5.3.1.4 Prevalence and intensity of anaemia in children aged 6-59 months

Anaemia is a common cause of morbidity and mortality in resource-poor settings especially with the burden of chronic disease such as malaria, intestinal parasites (e.g. hookworm infections) and malnutrition. Although other causes of anaemia, such as haemorrhage, infection, genetic disorders, and chronic disease have been identified, nutritional deficiency, due primarily to a lack of dietary iron, accounts for the majority of anaemia cases. About half of the global burden of anaemia is the result of iron deficiency. Iron deficiency, in turn, is caused by inadequate dietary intake of bio-available iron, increased iron requirements during rapid growth periods (such as pregnancy and infancy),

and increased blood loss due to hookworm or *Schistosoma* infections. Nutritional anaemia includes the anaemic burden from iron deficiency, plus deficiencies in folate, vitamin B_{12}, and certain trace elements involved with red blood cell production. Anaemia in children is associated with impaired mental and physical development and with increased morbidity and mortality.

The WHO have supported the following reference ranges for use in nutritional and general anaemia, which is different to anaemia related to malaria as described in section 5.3.1.2. The following classifications were used:

- >12 g/dl: Normal.
- 10-11.9 g/dl: Mild anaemia.
- 7-9.9 g/dl: Moderate anaemia.
- <7 g/dl: Severe anaemia.

690 children aged 6-59 months were sampled. In total, **82.5%** of the participants were reported as anaemic (<11.9 g/dl). 3.8% were severely anaemic, 39.4% moderately anaemic and 39.3% were mildly anaemic. These findings are compared to the findings of the DHS (CNSEE, 2008) in Table 12.

Table 12: Anaemia in children aged 6-59 months by age group and gender (n = 690)

	Anaemia (%)				Not anaemic (%)	Number of children
	Mild (10-11.9 g/dl)	Moderate (7-9.9 g/dl)	Severe (<7 g/dl)	Any anaemia		
By age groups						
6-8	25.0	58.3	12.5	95.8	4.2	24
9-11	35.5	47.5	8.5	91.5	8.5	59
12-17	24.0	60.6	5.8	90.4	9.6	104
18-23	38.1	49.2	1.6	88.9	11.1	63
24-35	40.4	39.7	3.9	84.0	16.0	156
36-47	42.9	31.4	2.6	76.9	23.1	156
48-59	50.8	19.5	0.8	71.1	28.9	128
By gender						
Male	39.8	37.2	4.4	81.4	18.6	317
Female	38.9	41.3	3.2	83.4	16.6	373
Total	**39.3**	**39.4**	**3.8**	**82.5**	**17.5**	**690**
DHS DRC	*23.4**	*43.7*	*4.2*	*71.4*	*28.6*	*3,656*
DHS DRC (Orientale Province)	*19.1**	*46.3*	*7.4*	*72.7*	*27.3*	*440*

*In the *DHS DRC*, mild anaemia as classified as haemoglobin level 10-10.9 g/dl.

By applying the same cut-off for mild anaemia (10-10.9 g/dl) as in the DHS, the proportion of mild anaemia would decrease to 21.1% in the BHS population and the portion of children found not to be anaemic would increase to 35.7%. The BHS findings so thus anaemia level similar to but slightly below the national average. Mild anaemia was more frequent in the project region compared to the average in Orientale province. This was in contrast to moderate and severe anaemia that was more common at the provincial level.

Anaemia levels for the different age groups are shown in Figure 26. Severe anaemia was most prevalent in children aged 6-8 months with decreasing levels in older age groups. In general, moderate and severe anaemia showed a declining trend in older age groups, with mild anaemia the opposite. Mean haemoglobin levels for the different age groups were 9.8 g/dl [9.19-10.45 g/dl] and 10.76 g/dl [10.36-11.16 g/dl] for the 6-23 and 24-59 months age groups, respectively.

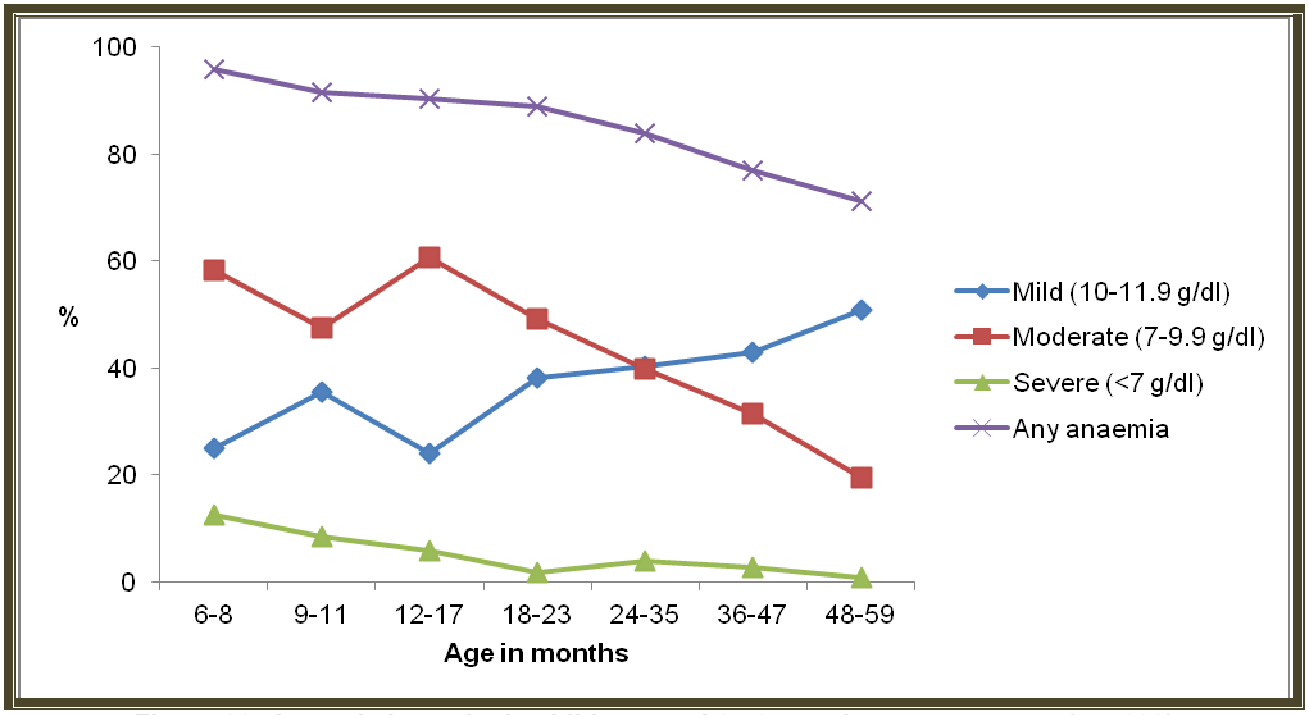

Figure 26: Anaemia intensity in children aged 6-59 months per age group (n = 690)

Gender disparities are not significant, with girls being slightly more anaemic (83.4%) than boys (81.4%). The opposite is true for severe anaemia, with boys more affected (4.4%) than girls (3.2%).

Table 13: Age and gender splits for anaemia (n = 690)

Age Group (months)	Anaemia (%)								Not anaemic	
	Mild (10-11.9 g/dl)		Moderate (7-9.9 g/dl)		Severe (<7 g/dl)		Any anaemia			
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
6-23	32.2	28.8	51.6	56.8	6.3	5.8	90.1	91.4	9.9	8.6
24-59	43.7	44.9	29.6	32.0	3.4	1.7	76.7	78.6	23.3	21.4
Total	**39.8**	**38.9**	**37.2**	**41.3**	**4.4**	**3.2**	**81.4**	**83.4**	**18.6**	**16.6**

The anaemia prevalence and classification intensities for the different sentinel sites are described spatially and in tabular format in Figure 27 and Table 14, respectively.

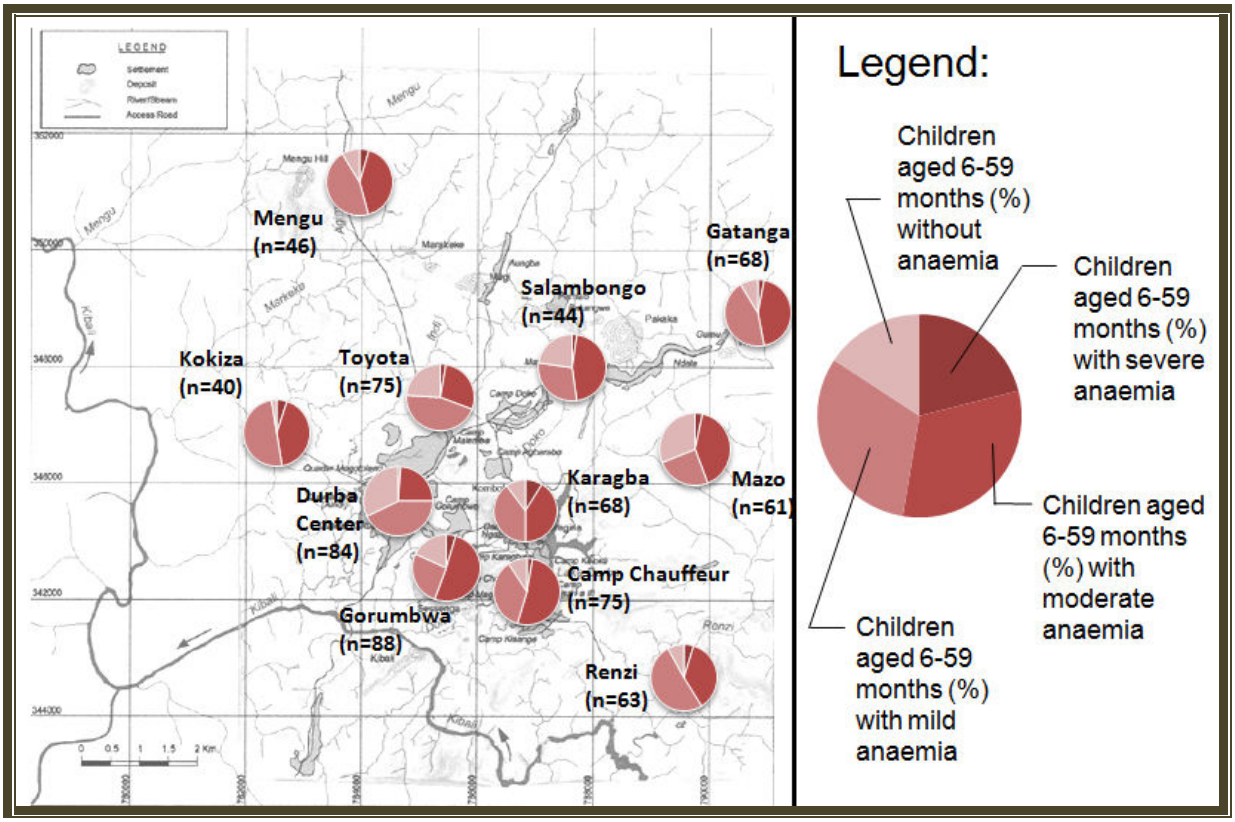

Figure 27: Anaemia in children aged 6-59 months in the project region (n = 690)

High rates of anaemia were found in a number of SS. Kokiza had the highest rate at 97.4% followed by Camp Chauffeur and Mengu with 91.9% and 91.1%, respectively. The lowest prevalence was found in Durba Centre and Mazo with 34.3% and 32.2%, respectively. Karagba was found to have the highest rate of severely anaemic children (9%), with Camp Chauffeur with the highest rate of moderately anaemic children (52.7%). Renzi and Kokiza have the highest rate of mildly anaemic children (52.5% and 50.0%, respectively).

Table 14: Anaemia in children aged 6-59 months by sentinel site (n = 690)

	Anaemia (%)				Not anaemic (%)
	Mild (10-11.9 g/dl)	Moderate (7-9.9 g/dl)	Severe (<7 g/dl)	**Any anaemia**	
Salambongo	28.6	47.6	2.4	78.6	21.4
Gatanga	42.4	45.5	1.5	89.4	10.6
Kokiza	50.0	42.1	5.3	97.4	2.6
Gorumbwa	27.3	50.0	4.8	82.1	17.9
Karagba	40.2	40.3	9.0	89.5	10.5
Camp Chauffeur	36.5	52.7	2.7	91.9	8.1
Renzi	52.5	30.5	5.1	88.1	11.9
Durba Centre	41.3	23.2	1.2	65.7	34.3
Durba Toyota	46.0	27.0	2.7	75.7	24.3
Mazo	25.4	39.0	3.4	67.8	32.2
Mengu	46.7	40.0	4.4	91.1	8.9
Total	**39.3**	**39.4**	**3.8**	**82.5**	**17.5**

5.3.1.5 Prevalence and intensity of anaemia in women (15-49 years)

Anaemia in women of reproductive age is an important indicator of maternal well-being and can be a particularly serious problem for pregnant women, leading to premature delivery and low birth weight. It can also increase post-partum complications leading to higher maternal mortality rates.

A total of 356 women of reproductive age (15-49 years) were examined for anaemia. Similar reference ranges to childhood anaemia were analysed with any value below 11.9 g/dl considered as too low and thus anaemic. Additionally, the pregnancy status of women was recorded as anaemia is a particularly serious problem in pregnant women, since it can lead to premature delivery and low birth weight of the newborn. It can also increase post-partum complications leading to higher maternal mortality rates. In the setting with high malaria rates it is an important co-morbid factor.

A total of 356 women of reproductive age (15-49 years) were examined for anaemia. Of these 44 women were pregnant with 312 non-pregnant. In some SS only a few pregnant women were available to participate in the survey. Similar reference ranges to childhood anaemia were analysed with any value below 11.9 g/dl considered as low.

In general, pregnant women are more likely to be anaemic than non-pregnant women and this was borne out in the BHS where pregnant women were significantly more anaemic

(68.2%) than non-pregnant women (32.4%) (p-value <0.01). This pattern was found for all forms of anaemia, from mild to severe.

The highest proportion of pregnant women was found in Gatanga and Karagba. In these SS, two thirds of the surveyed women were found to be anaemic, although mostly with mild anaemia (50%). Renzi and Kokiza (the two most remote SS of the survey) had the highest portions of non-pregnant women that were anaemic with rates of 50% and 47.8%, respectively.

Table 15: Anaemia in women (15-49 years) by sentinel site (n = 356)

	Anaemia (%)								Not anaemic (%)	
	Mild (10-11.9 g/dl)		Moderate (7-9.9 g/dl)		Severe (<7 g/dl)		Any Anaemia			
Pregnancy status	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**
Salambongo	11.8	66.6	0.0	16.7	0.0	0.0	11.8	83.3	88.2	16.7
Gatanga	22.6	50.0	6.4	25.0	0.0	0.0	29.0	75.0	71.0	25.0
Kokiza	42.1	0.0	5.3	0.0	0.0	0.0	47.4	0.0	52.6	0.0
Gorumbwa	32.6	50.0	4.6	25.0	2.3	0.0	39.5	75.0	60.5	25.0
Karagba	27.3	50.0	0.0	25.0	0.0	0.0	27.3	75.0	72.7	25.0
Camp Chauffeur	42.9	20.0	0.0	40.0	0.0	20.0	42.9	80.0	57.1	20.0
Renzi	40.6	100.0	9.4	0.0	0.0	0.0	50.0	100.0	50.0	0.0
Durba Centre	11.8	33.3	2.9	0.0	0.0	0.0	14.7	33.3	85.3	66.7
Durba Toyota	25.8	100.0	0.0	0.0	0.0	0.0	25.8	100.0	74.2	0.0
Mazo	28.0	50.0	4.0	4.0	0.0	0.0	32.0	50.0	68.0	50.0
Mengu	25.0	25.0	0.0	0.0	0.0	0.0	25.0	25.0	75.0	75.0
Total	**28.9**	**47.7**	**3.2**	**18.2**	**0.3**	**2.3**	**32.4**	**68.2**	**67.6**	**31.8**

5.3.1.6 Blood pressure in adults aged (20-40 years)

Blood pressure (BP) was evaluated as an indicator for chronic disease.

The health care services in the area have limited resources and capabilities to recognise, diagnose and manage the diseases. Thus there is a paucity of data. In 90-95% of cases hypertension is caused by an interaction of genetic and environmental factors, such as diet and physical activity. Hypertension damages body tissues and is a risk factor for strokes, heart attacks, heart failure, damage to the eye and the leading cause of chronic renal failure. High blood pressure is a risk factor for premature death in adults.

BP was measured in 310 participants. Five different categories were considered based on the criteria presented in Table 16 (NICE, 2006).

Table 16: Classification of blood pressure for adults (aged 20-40 years)

Category	Systolic, mmHg	Diastolic, mmHg
Hypotension	<90	<60
Normal	90-120	and 60-80
Pre-hypertension	121-139	or 81-89
Stage 1 hypertension	140-159	or 90-99
Stage 2 hypertension	≥160	or ≥100

Based on these stages, 43.6% of those tested were classified as hypertensive. This was consistently higher in men than in women.

Table 17: Percentage distribution of BP in adults (20-40 years) by category (n = 310)

Category	Male	Female	Total
Hypotension	0.0	14.1	13.2
Normal	15.0	45.2	43.2
Pre-hypertension	65.0	26.6	29.0
Stage 1 Hypertension	15.0	10.7	11.0
Stage 2 Hypertension	5.0	3.5	3.6

Mean blood pressure for all adults was measured at 113/74 mmHg. This was higher for men than for women, at 127/80 mmHg and 113/73 mmHg, respectively. Thus, the mean values per the gender groups showed prevailing pre-hypertensive state for men and normal state for women.

It must be emphasised that these levels may be falsely high due to the stress of the examination. All attempts were made to minimise this, but “white coat” hypertension may exist.

5.3.2 Behavioural indicators

5.3.2.1 Insecticide-treated nets

Introduction:

In areas with high malaria transmission and poor access to facility-based health care, as it is the case in the current project area, insecticide-treated nets (ITN) are the principal strategy for preventing malaria. The use of ITNs is widely considered a highly effective intervention with various community-based trials and studies showed that ITN use cut malaria transmission and reduces malaria-related morbidity and all-cause child mortality in a variety of study settings (Greenwood, 1987; Lengeler, 2004). For example, in a study in Tanzania, ITN distribution with a strong social marketing campaign was associated with a 27% increase in survival, as well as 65% reduction in anaemia, among children aged between 1 month and 4 years (Schellenberg, 2001).

The cost-effectiveness of ITN use, compared with other prevention measures, has also been widely demonstrated, but the challenge has been to increase ownership and use of ITN (Wiseman *et al.*, 2003). This has a multi-factorial base and may need to be studied further.

The Global Fund and the WHO Roll Back Malaria Program have defined a number of indicators linked to ITN ownership and use. It was not considered practical to cover all the outcome and impact indicators within the scope of the survey and thus a few key areas were selected.

Key Findings and discussion:

Proportion of households with at least one ITN

This indicator measures household possession of ITNs amongst the surveyed population.

Of the 563 households questioned in the KIS and the KAP survey, 390 reported that they owned at least one bednet, which equates to 69.5% ownership of at least one bednet. Among these 390 bednets, 366 were confirmed as ITNs. Thus, 93.8% of bednets were verified as ITNs and **65% (366/563) of all households surveyed possessed at least one ITN**. In those households that do not possess bednets, the majority reported that they were not available or simply unaffordable.

Table 18: Bednet ownership and barriers for bednet ownership

Sentinel site	Percentage of households owning at least one bednet	Reasons not to have a bednet			Number of households
		Do not like	Not available	Cannot afford	
Salambongo	74.1	0.0	57.1	42.9	**54**
Gatanga	67.8	0.0	47.4	52.6	**60**
Kokiza	48.7	0.0	42.1	57.9	**37**
Gorumbwa	67.2	0.0	63.2	36.8	**58**
Karagba	73.6	0.0	57.1	42.9	**53**
Camp Chauffeur	61.5	0.0	50.0	50.0	**52**
Renzi	76.5	0.0	75.0	25.0	**51**
Durba Centre	73.1	0.0	71.4	28.6	**52**
Durba Toyota	75.0	7.1	35.7	57.1	**56**
Mazo	82.4	0.0	77.8	22.2	**51**
Mengu	55.3	0.0	64.7	35.3	**39**
Total	**69.5**	**0.6**	**56.3**	**43.1**	**563**
DHS DRC 2007	*28.0*	-	-	-	*8,886*
DHS DRC in Province Orientale 2007	*14.2*	-	-	-	*1,023*

Table 19 shows ITN ownership per SS compared to national averages from the DHS conducted in 2007. Ownership of at least one ITN was particularly high in Mazo, Durba and Renzi (range 71.2-80.4%). Kokiza had the lowest ITN coverage with only 40.5% of households possessing at least one ITN.

39.3% of the households reported owning more than one ITN. This ranged from 52% in Mazo to 8.1% in Kokiza. The average number of ITN per household remains low at only 0.6.

It was reported that the government distributed ITN in the beginning of 2010 as part of the outreach vaccination program to children under 5 in the area. This accounts for the relatively good coverage in the area.

Table 19: ITN ownership by sentinel site

Sentinel site	Percentage of households with at least one ITN	Percentage of households with more than one ITN	Average number of ITNs per household	Average number of children that slept under an ITN*	Number of households
Salambongo	63.0	38.9	0.6	0.6	**54**
Gatanga	63.3	38.3	0.6	0.5	**60**
Kokiza	40.5	8.1	0.4	0.3	**37**
Gorumbwa	63.8	36.2	0.6	0.5	**58**
Karagba	66.0	47.2	0.7	0.6	**53**
Camp Chauffeur	57.7	44.2	0.6	0.4	**52**
Renzi	72.5	51.0	0.7	0.6	**51**
Durba Centre	71.2	46.2	0.7	0.6	**52**
Durba Toyota	73.2	46.4	0.7	0.7	**56**
Mazo	80.4	52.9	0.8	0.7	**51**
Mengu	56.4	23.1	0.6	0.4	**39**
Total	**64.4**	**39.3**	**0.6**	**0.5**	**563**
DHS DRC	*9.2*	*1.9*	*0.1*	-	*8,886*
DHS DRC in Province Orientale	*5.9*	*1.0*	*0.1*	-	*1,023*

*the night preceding the survey. Only included households with children under the age of 5 years.

Proportion of children who slept under an ITN the previous night

Use of an ITN is crucial as ownership does not by itself imply use, or offer any form of protection against malaria. Thus the indicator of the number of children (under the age of 5 years) that slept under an ITN the previous night was selected. The analysis considered the actual number of children that slept under an ITN divided by all the children surveyed, including those household that do not own an ITN, as this gives a better representation of the overall coverage.

Out of the 752 children surveyed across all communities, 355 (47.2%) of the children were reported having slept under an ITN the previous night. This is considerably higher than the Oriental Province regional rate of 8.6%, as reported in the DHS of 2007, and could be an indication of coverage of the outreach programs.

Table 20 compares the ownership and actual use of the ITN found in the KIS and KAP survey (n = 563). 90.9% of households that owned an ITN had children sleep under them the previous evening. These ranged from 100% in Karagba and Mazo to 76.5% in Mengu. Although ITN ownership was lowest in Kokiza (40.5%), 81.8% were reported to have slept under an ITN the night preceding the survey indicating good utilisation, if an ITN is available.

Table 20: Ownership and use of ITN by sentinel site

Sentinel site	Percentage of households with at least one ITN	Proportion of children who slept under a ITN the previous night if there was an ITN in the household
Salambongo	63.0	89.7
Gatanga	63.3	84.4
Kokiza	40.5	81.8
Gorumbwa	63.8	92.3
Karagba	66.0	100.0
Camp Chauffeur	57.7	88.9
Renzi	72.5	96.2
Durba Centre	71.2	93.1
Durba Toyota	73.2	97.0
Mazo	80.4	100.0
Mengu	56.4	76.5
Total	**64.4**	**90.9**

Other valuable prevention indicators, such as indoor residual spraying (IRS), were not sampled as these activities were not ongoing in the area.

5.3.2.2 Use of intermittent preventive treatment in pregnancy

Introduction:

Pregnant women are more susceptible to malaria infection and are considered a vulnerable group for this disease. Pregnant women are more prone to acquiring a severe form of the disease leading to high maternal mortality as a direct consequence of the infection and indirectly from the effects of anaemia which is often caused or exacerbated by malaria. Anaemia often results in premature or low birth weights with poor foetal outcome.

One of the strategies for malaria control is intermittent preventive treatment in pregnancy (IPT_p) with sulphadoxine-pyrimethamine (SP), often referred to as per the brand name, Fansidar. Under this strategy it is recommended that all pregnant women in malaria-endemic areas receive a full three tablets single dose of SP at least twice during the second and third trimester of pregnancy. Antenatal care (ANC) clinics thus are considered an important entry point to target the pregnant women and deliver this preventive medication. Pregnant women generally have higher malaria prevalence and parasitaemia levels, which is often highest between 20-36 weeks of pregnancy. Thus the aim is to eliminate the parasitaemia in this phase of pregnancy and studies have shown good results in reducing parasitaemia, anaemia and low birth weight babies with this intervention (Schulman *et al.*, 1999).

Key Findings:

Out of 344 women questioned, 60.5% reported to have received any kind of anti-malarial treatment during an ANC visit and 38.6% of women reported to have received two or more doses of SP/Fansidar during their last pregnancy. The level of IPT_p coverage found in the BHS is considerably above national and regional averages as shown in Table 21.

A potential explanation for these differences could be the relatively large number of health facilities that can be found in the study area. Furthermore, there might be a certain degree of recall bias associated with this finding as, unlike in the DHS, where only mothers were questioned that had had a baby within the last five years, in the BHS all mothers, no matter the age, were questioned. Therefore, the results of the BHS have to be considered with caution and the rates of coverage are likely to be overestimated. It nevertheless serves as a useful indicator.

Table 21: Prophylactic use of IPT_p by women during last pregnancy

Sentinel site	Percentage who received any SP/Fansidar during an ANC visit	Percentage who received at least 2 doses of SP/Fansidar during an ANC visit	Number of mothers included in the survey
Salambongo	72.7	54.6	33
Gatanga	57.9	36.9	38
Kokiza	44.4	27.8	18
Gorumbwa	57.9	28.6	42
Karagba	45.5	45.4	33
Camp Chauffeur	66.7	45.4	33
Renzi	63.6	27.2	22
Durba Centre	63.9	41.6	36
Durba Toyota	69.4	36.1	36
Mazo	53.9	30.8	26
Mengu	63.0	44.4	27
Total	**60.5**	**38.6**	**344**
DHS DRC	*12.1*	*5.1*	*3,435*
DHS DRC in Orientale Province	*8.4*	*4.4*	*385*

5.3.2.3 Health seeking behaviour

Introduction:

Information on health seeking behaviour is particularly important in understanding and addressing the barriers individuals may face in seeking care for themselves and for their children. Many factors can prevent individuals from getting medical advice or treatment when they are sick. Parents also face barriers in accessing a health facility when their child is sick.

Key Findings:

Parents were asked where medical advice was obtained the last time their youngest child was sick (n = 476). These variables are summarized in Table 22. In the event that they did not consult a health facility the rationale behind this was explored as described in Table 23.

Table 22: Locality of medical advice in last childhood illness

Sentinel site	Health Facility	Pharmacy	Boutique / kiosk	Traditional Healer	Prepared herbal remedy	Friend / Relative	Did nothing	Number of parents asked
Salambongo	85.1	12.7	0.0	0.0	0.0	0.0	2.1	**47**
Gatanga	57.4	31.5	0.0	0.0	3.7	0.0	7.4	**54**
Kokiza	70.4	14.8	0.0	0.0	11.1	0.0	3.7	**27**
Gorumbwa	86.0	14.0	0.0	0.0	0.0	0.0	0.0	**50**
Karagba	90.9	6.8	0.0	0.0	2.3	0.0	0.0	**44**
Camp Chauffeur	88.6	9.1	0.0	2.3	0.0	0.0	0.0	**44**
Renzi	83.3	16.7	0.0	0.0	0.0	0.0	0.0	**42**
Durba Centre	97.8	2.2	0.0	0.0	0.0	0.0	0.0	**45**
Durba Toyota	95.7	4.3	0.0	0.0	0.0	0.0	0.0	**47**
Mazo	85.0	15.0	0.0	0.0	0.0	0.0	0.0	**40**
Mengu	83.3	5.5	0.0	0.0	5.6	0.0	5.6	**36**
Total	**84.0**	**12.4**	**0.0**	**0.2**	**1.7**	**0.0**	**1.7**	**476**

A majority of the parents (84%) attended a health facility the last time their youngest child was sick. It was evident that the main choices were between health facilities (84%) and local pharmacies (12.4%). There were no responses related to small kiosks/boutiques and this is because there are generally pharmacies that fulfil the same function. Use of traditional healers (TH) was also low and only reported from Camp Chauffeur. This is supported by the low number of TH in the area as further described in section 5.5.5 of the report.

The use of health facilities varied between the surveyed SS, with Gatanga showing a remarkably lower rate (57.4%) compared to all the other sites. This was in spite of a health centre being available in the community. Kokiza, which has poor accessibility, was reported that 70.4% utilise health facilities primarily and the rest of the SS where all above 83%. In general the community consulted the small health posts ('dispensaires'), which are quite well dispersed in the project area. The larger health facilities in and around Durba are visited on a less frequent basis. The capabilities of these facilities are noted in Table 25.

The preparation of herbal home remedies was especially important in the two remote villages of Mengu and Kokiza with 5.6% and 11.1% of the communities, respectively, reporting this practice. This is likely to be related to poor accessibility to health facilities in these areas.

Among parents who did not primarily take their children to a health facility, there was a variety of reasons and barriers. 'Affordability' was mentioned by 79.9% of the respondents and is most important barrier to accessing formal health care services (Table 23). Of note, transport costs are also major determinants influencing affordability.

Table 23: Reasons for not primarily consulting a health facility

Sentinel site	Accessibility	Acceptability	Affordability	Prefer to go to traditional healer	Prefer self treatment	Other	Number of respondents
Salambongo	0.0	0.0	100.0	0.0	0.0	0.0	**7**
Gatanga	0.0	0.0	81.8	4.5	4.6	9.1	**22**
Kokiza	0.0	0.0	100.0	0.0	0.0	0.0	**7**
Gorumbwa	0.0	14.3	71.4	0.0	0.0	14.3	**7**
Karagba	0.0	0.0	75.0	0.0	0.0	25.0	**4**
Camp Chauffeur	0.0	0.0	50.0	0.0	25.0	25.0	**4**
Renzi	0.0	0.0	57.1	0.0	0.0	42.9	**7**
Durba Centre	50.0	0.0	0.0	0.0	50.0	0.0	**2**
Durba Toyota	0.0	0.0	50.0	0.0	0.0	50.0	**2**
Mazo	0.0	0.0	100.0	0.0	0.0	0.0	**6**
Mengu	0.0	0.0	100.0	0.0	0.0	0.0	**6**
Total	**1.2**	**1.3**	**79.7**	**1.6**	**4.0**	**12.2**	**74**

Accessibility and acceptability seem to be of minor importance in relation to health seeking behaviour. 'Other causes' accounted for 12.2% of responses, with 'sickness not severe enough to go to a health facility' reported most commonly. Gender disparities were not significant (p-value: 0.925).

Seeking health other than in a health facility or pharmacy is risky and access to such (including affordability and geographical accessibility) should ideally be guaranteed for all individuals in a population. Moreover, health education is closely linked with health seeking behaviour and timely provision of professional health care.

5.3.3 Observational indicators

5.3.3.1 Household characteristics

Household characteristics, such as sanitation facilities, drinking water quality, availability of electricity and the type of dwelling are important indicators of socio-economic status and also general wellbeing and health.

Table 24 provides detailed information on characteristics of community dwellings, availability of latrines, nature of materials used for the floor, roof and walls, type of cooking arrangement and type of cooking fuel. These were considered as it was important to describe as baseline environmental health conditions at the household level note how these may change over time, especially with the changing socio-economic factors and potential migration. Resettlement is also an important factor to consider when comparing the household characteristics. The definitions of housing materials are provided in the same table.

In summary it was found in the study area that houses are mainly constructed from natural floors (86.4%), rudimentary walls (89.6%) and rudimentary (87.6%) roofs. Cooking is most commonly performed outdoors (59.2%), and then generally on an open fire (43.1%) or in a separate room within the household (27.3%). 40.7% of households cook indoors with 13.4% cooking indoors in the living quarters. The majority of households (60.8%) use charcoal as the main material for cooking. Nearly two thirds of households (63.9%) have at least one functional improved latrine, while 34.9% do not have any latrine within their household or compound.

Table 24: Household dwelling characteristics by sentinel site

	Salambongo	Gatanga	Kokiza	Gorumbwa	Karagba	Camp Chauffeur	Renzi	Durba Centre	Durba Toyota	Mazo	Mengu	Mean
Flooring material												
Natural floor[1]	100.0	100.0	100.0	58.6	75.0	75.0	100.0	78.3	76.9	100.0	100.0	**86.4**
Rudimentary floor[2]	0.0	0.0	0.0	3.5	4.2	20.8	0.0	17.4	15.4	0.0	0.0	**5.8**
Finished floor[3]	0.0	0.0	0.0	37.9	20.8	4.2	0.0	4.3	7.7	0.0	0.0	**7.7**
Walling material												
Rudimentary wall[3]	95.8	100.0	100.0	50.0	79.2	91.7	100.0	95.7	88.5	100.0	100.0	**89.6**
Solid wall[4]	4.2	0.0	0.0	50.0	20.8	8.3	0.0	4.3	11.5	0.0	0.0	**10.4**
Roofing material												
Rudimentary roof[5]	92.3	100.0	100.0	50.0	79.2	91.7	100.0	95.6	76.0	95.6	100.0	**87.6**
Solid roof[6]	7.7	0.0	0.0	50.0	20.8	8.3	0.0	4.4	24.0	4.4	0.0	**12.4**
Place for cooking												
Living/sleeping room	11.5	22.6	20.0	3.4	25.0	12.5	0.0	17.4	23.1	8.7	0.0	**13.4**
Separate room within HH	30.8	22.6	26.7	44.8	25.0	29.2	15.0	17.4	23.1	26.1	36.8	**27.3**
Separate room outside HH	3.9	0.0	0.0	17.2	20.8	29.2	30.0	4.4	11.5	39.1	26.3	**16.2**
Open fire	53.8	54.8	53.3	34.5	29.2	29.2	55.0	60.9	42.3	26.1	36.8	**43.1**
Cooking fuel												
Charcoal	76.9	16.7	6.7	80.0	87.5	91.7	45.0	100.0	100.0	26.1	5.3	**60.8**
Wood	23.1	83.3	93.3	20.0	12.5	8.3	55.0	0.0	0.0	73.9	94.7	**39.2**
Number of functional improved latrines within compound												
0	31.2	43.5	28.6	20.0	50.0	30.4	38.9	54.5	34.6	21.7	31.6	**34.9**
1	68.8	52.2	71.4	80.0	50.0	69.6	61.1	45.5	57.7	78.3	68.4	**63.9**
2	0.0	4.4	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.0	**0.8**
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.0	0.0	**0.4**
Total number of HH	**26**	**31**	**15**	**30**	**24**	**24**	**20**	**23**	**26**	**23**	**19**	**261**

[1]Natural floor (earth, sand, dung), [2]Rudimentary floor (wood, bamboo, curtain) [3]Finished floor (ceramic tiles, cement, polished wood), [3]Rudimentary wall (wood and mud), [4]Solid wall (cement blocks, bricks), [5]Rudimentary roof (thatch, palm leafs), [6]Solid roof (corrugated roof, cement roof, bricks)

The more rural settlements of Gatanga, Kokiza, Renzi, Mazo and Mengu had a higher proportion of housing constructed from natural or rudimentary materials.

Gorumbwa and Karagba, which were part of the old OKIMO housing estates, presented with the majority of houses with finished floors and solid structures. Other than roofing material in Durba Toyota there was very little difference between the other communities in the type and nature of the building material.

Cooking is performed most commonly over an open fire in an outdoor setting (43.1%). The most widely used energy sources are charcoal (60.8%) and wood (39.2%). 16.2% of households cooked outdoors in a separate building providing a total of 59.3% that cooked outside of the sleeping arrangement. However, people can still be exposed to indoor smoke in these structures, so when considering that 13.4% cook inside the living area and 27.3% cook in a separate room in the household provides an overall figure of 56.9% of households that could be potentially exposed to indoor air pollution. The lowest proportion of households that cooked outdoors was found in Karagba and Camp Chauffeur. Durba centre had the highest proportion of households cooking outdoors followed by the more rural settings. The wide variety of cooking arrangements may also show a seasonal variation as reported in the rapid HIA with indoor cooking reported in the wet season (Divall and Winkler, 2008).

The use of improved sanitation facilities (latrines- see glossary)) was also evaluated. It was interesting to note that Durba centre and Karagba has lowest coverage of latrines. Gorumbwa and Mazo had the highest coverage in the communities sampled that had at least one latrine. A small proportion of communities had more than one latrine within their compound, with Durba Toyota having the highest proportion.

5.3.3.2 Key indicators on health infrastructure

A variety of health facilities are distributed over the project and study area. The majority of these provide very basic services in the form of small dispensaries.

8 health facilities were visited during the BHS and an interview and some focussed observational assessments were completed in each of these facilities. Key parameters were accessed in terms of the functionality of the facility, services offered, availability of essential drugs, human resource component, case load and availability of essential services. These are presented in Table 25.

Table 25: Key indicators on health infrastructure

Services provided

Health Facility Name; Name and position of person interviewed	Primary health care	Maternal health care	Emergency care	Ambulance service	Intensive care	Laboratory services	General surgery	Orthopaedic surgery	Specialist care	Radiology	Vaccination service	Blood transfusion
Centre médical de Kibali; Dr Luhavo Hermann	X	X	X	X	X	X	X				X	X
Centre de santé de référence Durba; Mandango Gilbert	X	X	X			X	X				X	X
Centre de santé de Toyota; Tuama Filomen	X	X				X					X	
Centre de santé Bolingo; Taslie Mark	X	X									X	
Dispensaire sauver la vie, Salambongo; Gbundu Jean-Claude	X	X				X						X
Dispensaire Jerusalem Ndala; Likiso Bhanda	X					X						
Centre de santé Gatanga; Ansoyo Taboulé	X	X				X					X	X*
Centre de Santé Doko; Loiche Gudza, Mogo Madragule	X	X			X	X					X	

Laboratory services

Health Facility Name; Name and position of person interviewed	Malaria testing: Microscopy	Malaria testing: RDT	HIV/AIDS testing: ELISA	HIV/AIDS testing: Rapid Tests	HIV/AIDS testing: CD4 count	TB diagnostic	Haematology	Biochemistry	Parasitology
Centre médical de Kibali; Dr Luhavo Hermann	X	X		X			X	X	X
Centre de santé de référence Durba; Mandango Gilbert	X	X				X	X		X
Centre de santé de Toyota; Tuama Filomen	X	X*		X*			X		X
Centre de santé Bolingo; Taslie Mark	X	X*		X*					
Dispensaire sauver la vie, Salambongo; Gbundu Jean-Claude	X			X*					X
Dispensaire Jerusalem Ndala; Likiso Bhanda	X						X		
Centre de santé Gatanga; Ansoyo Taboulé				X*					
Centre de Santé Doko; Loiche Gudza, Mogo Madragule	X	X					X		X

Reliable availability of essential drugs and supplies

Health Facility Name; Name and position of person interviewed	ACTs(Arthermeter/amiodiaquine)	IPT_p (Fansidar/SP)	Antiretroviral drugs	TB drugs	EPI vaccinations	Antihelmintic drugs	Oral rehydration solution	Oxytocin √	Penicillin/Ampicillin	Erythromycin	Doxycycline	Vitamin A	Vitamin K	Iron supplements	Folic acids	Insecticide treated nets
Centre médical de Kibali; Dr Luhavo Hermann	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Centre de santé de référence Durba; Mandango Gilbert	X	X		X	X	X	X	X	X	X	X		X	X	X	
Centre de santé de Toyota; Tuama Filomen	X	X				X	X	X	X	X	X		X		X	
Centre de santé Bolingo; Taslie Mark	X					X	X	X	X				X		X	
Dispensaire sauver la vie, Salambongo; Gbundu Jean-Claude		X				X	X	X	X	X		X	X	X	X	
Dispensaire Jerusalem Ndala; Likiso Bhanda	X	X				X	X						X	X	X	
Centre de santé Gatanga; Ansoyo Taboulé		X				X	X		X						X	
Centre de Santé Doko; Loiche Gudza, Mogo Madragule		X		X		X	X	X			X			X	X	

Infrastructure

Health Facility Name; Name and position of person interviewed	Piped potable water available	Reliable electricity supply available	Number of beds: Inpatient	Number of beds: Outpatient	Number of beds: Post-natal care	Number of beds: TOTAL beds	∅ outpatient consultations per day
Centre médical de Kibali; Dr Luhavo Hermann	X	X	20			**20**	25
Centre de santé de référence Durba; Mandango Gilbert			45	3	12	**60**	30
Centre de santé de Toyota; Tuama Filomen		X	7	1	7	**15**	10
Centre de santé Bolingo; Taslie Mark			5	1	7	**13**	8
Dispensaire sauver la vie, Salambongo; Gbundu Jean-Claude			14		4	**18**	10
Dispensaire Jerusalem Ndala; Likiso Bhanda			8			**8**	5
Centre de santé Gatanga; Ansoyo Taboulé			8			**8**	6
Centre de Santé Doko; Loiche Gudza, Mogo Madragule		X	22		11	**33**	12

Human resources

Health Facility Name; Name and position of person interviewed	Medical doctor	Medical specialist	Medical assistant	Specialized nurse	Ward nurse	Midwife (educated)	Traditional midwife (non-educated)	Laboratory technician	Radiologist	Community health volunteer	Nurse assistant	TOTAL Staff
Centre médical de Kibali; Dr Luhavo Hermann	1		5	3	3			1			2	**15**
Centre de santé de référence Durba; Mandango Gilbert				6	7	1		1			3	**18**
Centre de santé de Toyota; Tuama Filomen				1	3	1		1				**6**
Centre de santé Bolingo; Taslie Mark				2	2	1						**5**
Dispensaire sauver la vie, Salambongo; Gbundu Jean-Claude				1	3	1		1				**6**
Dispensaire Jerusalem Ndala; Likiso Bhanda					3			1			1	**5**
Centre de santé Gatanga; Ansoyo Taboulé					3	2					1	**6**
Centre de Santé Doko; Loiche Gudza, Mogo Madragule	1		5	5	3	3		2			5	**23**

* Not permanently available

5.3.4 Environmental indicators

5.3.4.1 Water quality at community source and household level

It was recognised as important to get a baseline indication of the quality of potable water in the SS. The project by nature of its location will influence water sources in the surrounding communities and resettlement will also play a role. It was thus important that some key indicators of potable water quality were collected.

The most common community source of water in each SS was sampled. This was thus regarded as the community's current preferred water supply. If there were more sources within the SS then a selection of these were also sampled and analysed.

As part of the KIS, every second household was invited to provide a sample of their household drinking water. This allows for the determination of water quality at the end user level and provides an indication of the challenges which the community faces in collecting, transporting and safely storing water.

The samples were analysed for the presence or absence of total and faecal coliforms. According to the WHO and EU drinking water standards (WHO and UNICEF, 2009; European Comission Environment, 2010) coliforms should be absent in drinking water, and the presence of these organisms indicates inadequate treatment or pollution. The presence of total coliforms in distribution systems and stored water supplies can reveal regrowth and possible biofilm formation or contamination through ingress of foreign material, including soil or plants. *Escherichia coli* are a subset of the total coliform group and they are present in very high numbers in human and animal faeces.

In total, 22 community drinking water points and 135 households were sampled. Table 26 summarizes the results of the end user water quality and the sampled community wells.

Table 26: Drinking water – total coliforms and *E. coli* at well and household level

	Community wells			Houshold water samples		
Sentinel Site	**Wells sampled**	**Positive for coliform**	**Positive for *E. coli***	**Housholds sampled**	**Positive for coliform**	**Positive for *E. coli***
Salambongo	2	100.0%	50.0%	14	100.0%	100.0%
Gatanga	2	100.0%	100.0%	16	100.0%	100.0%
Kokiza	2	100.0%	100.0%	9	100.0%	100.0%
Gorumbwa	3	100.0%	100.0%	14	100.0%	78.6%
KCD - Karagba	2	100.0%	100.0%	13	100.0%	100.0%
KCD - Chauffeur	1	100.0%	100.0%	13	100.0%	100.0%
Renzi	2	100.0%	100.0%	13	100.0%	92.3%
Durba Centre	2	100.0%	100.0%	15	100.0%	86.7%
Durba Toyota	2	100.0%	50.0%	9	100.0%	100.0%
Mazo	3	100.0%	100.0%	11	100.0%	90.9%
Mengu	1	100.0%	100.0%	8	100.0%	100.0%
Total / mean (%)	**22**	**100.0%**	**90.9%**	**135**	**100.0%**	**94.8%**

The community water sources were in general simple hand dug shallow wells in the rural areas. In the peri-urban areas these were improved sources. All of the community water sources showed coliform contamination and of these only two did not test positive for faecal coliforms contamination. *E. coli* is considered the most suitable index of faecal contamination and is thus the organism of choice for surveillance of drinking-water quality. These findings are concerning as *E. coli* is rarely found in the absence of faecal pollution, although there is some evidence for growth in tropical soils (WHO and UNICEF, 2009). The presence of *E. coli* (or, alternatively, thermo-tolerant coliforms) provides evidence of recent faecal contamination, and detection should lead to consideration of further action, which could include further sampling and investigation of potential sources of contamination.

Not surprisingly the drinking water samples obtained at household level were also all contaminated with coliform bacteria. 94.8% of the samples collected at the households showed contamination with *E. coli.*

Due to the existing high levels of contamination at community water collection points, the extent of additional contamination on the way from the source to the 'glass' at household level is difficult to estimate. However, these findings clearly describe the existing poor levels of drinking quality in the project region.

5.4 Findings of the school survey

5.4.1 Introduction

The aim of the school survey was to determine the prevalence and intensity of schistosome and soil-transmitted helminth infections for the 11 SS.

Schistosomiasis and soil-transmitted helminthiasis (STH) are two of the most important neglected tropical diseases (NTDs) and cause serious public health problems in sub-Saharan Africa and other developing country settings (Steinmann *et al.*, 2006). There is no effective school health deworming or national control programme for schistosomiasis in the country.

At least 30 schoolchildren, aged from 9-14 years old, were randomly collected from 7 schools and 2 communities that surrounded the 11 SS. In general it was attempted to sample the children who originated in the 11 SS in their relevant schools. Figure 14 outlines the schools sampled in relation to the SS. Three of the 7 schools, viz. EP Ndala, EP Anzokudo and EP Modegi attracted children from two separate communities to each school. Consequently, these children were separated into 2 groups for each school, i.e. Ndala 1 & 2, Anzokudo 1 & 2 and Modegi 1 & 2.

A range of 31 to 37 children were tested from each of these communities. Stool and urine samples were collected from the same children however seven of these study participants were unable to pass urine. The total sample size was 401 stool and 394 urine samples.

Although the aim was to sample an equal number of males and females for the study, it was not always possible. In order to maintain a good representation of subjects from each sampled community, the sex ratio could not always be maintained, e.g. in Renzi it was extremely difficult to find enough females and the final ratio in that community was 2:1 males to females. In some of the sites the ratios were even, but overall males comprised 214 (53.4%) and females 187 (46.6%) of the total sample size. The mean age of males was 10.92 and that of females 10.91 years.

Table 27: Sampling locations and sizes for stool and urine

School or Community	EP Ndala 1	EP Ndala 2	Kokiza Community	EP Siloé	EP Agbarabo	EP Anzokudo 1	EP Anzokudo 2	Renzi Community	EP Drati	EP Modegi 1	EP Modegi 2	EP Nzoro
No. of Stool Samples	37	35	32	35	34	31	32	33	35	33	31	33
Ratio of Males: Females	22: 15	16: 19	20: 12	16:19	17: 17	15: 16	16: 16	22: 11	17: 18	19: 14	14: 17	20: 13
No. of Urine Samples	36	34	31	35	34	29	30	33	35	33	31	33

5.4.2 Summary of findings

None of the 394 children whose urine was tested for *Schistosoma haematobium (urinary bilharzia)* were positive and none had visible hematuria.

Of the 401 children whose stool samples were tested for the presence of helminths, 20 (4.99%) tested positive for the whipworm, *Trichuris trichiura* (Tt), 196 (48.88%) tested positive for Hookworm sp. (Hk), 231 (57.61%) were positive for *Schistosoma mansoni* (Sm) and 77 (19.20%) had no parasites seen (NPS).

It should be noted that given the relatively low sensitivity of a single Kato-Katz thick smear from one stool sample the actual prevalence of *S. mansoni* and STH in this area could have been considerably higher (Ebrahim *et al.*, 1997). The single slide was chosen for the indicator study based on time and logistics with the rationale that adequate data would be obtained to describe the baseline.

The summary parasite prevalence results are presented in Table 28.

Table 28: Summary of school stool parasite prevalence survey

Location	No. samples	*T. trichiura*	% Tt	Hookworm sp.	% Hk	*S. mansoni*	% Sm	NPS	% NPS
EP Ndala 1	37	0	0	23	62.2	7	19	11	29.7
EP Ndala 2	35	7	20	23	65.7	5	14.3	10	28.6
Kokiza Community	32	4	12.5	19	59.4	15	46.9	7	21.9
EP Siloe	35	1	2.9	8	22.9	31	88.6	3	9.4
EP Agbarabo	34	0	0	13	38.2	17	50	11	32.4
EP Anzokudo 1	31	0	0	8	25.8	25	80.7	5	16.1
EP Anzokudo 2	32	0	0	8	25	26	81.3	5	15.6
Renzi Community	33	4	12.1	19	57.6	29	87.9	2	6.1
EP Drati	35	0	0	10	28.6	26	74.3	7	20
EP Modegi 1	33	1	3	22	66.6	23	69.7	4	12.1
EP Modegi 2	31	1	3.2	20	64.5	23	74.2	2	6.5
EP Nzoro	33	2	6.1	23	69.7	4	12.1	10	30.3
TOTALS	**401**	**20**	**5**	**196**	**48.9**	**231**	**57.6**	**77**	**19.2**

Only 9 children (2.24%) harboured the 2 STHs, *Trichuris* and Hookworm, as well as schistosomiasis, i.e. all 3 parasites.

More than half of the children (211, 52.62%) were infected with only one parasite: 83 (20.70%) with Hookworm sp. and 128 (31.92%) with *Schistosoma mansoni*.

There were 3 different 2-parasite combination infections: 10 (2.49%) infections with *Trichuris*/Hookworm, 1 (0.25%) with *Trichuris*/*S. mansoni* and 93 (23.19%) with the combination, Hookworm/*S. mansoni*.

5.4.3 Prevalence and intensity of STH infection

The summary of the STH parasite prevalence is presented in Figure 28.

The overall prevalence of *Trichuris* was 4.99% with a range of 0% in Ndala 1, Agbarabo, Anzokudo 1 & 2, and Drati to 20% in Ndala 2. Only 7 of the 12 communities harboured this parasite.

S. mansoni was the most prolific of all 3 helminths with an overall prevalence of 57.61% and a range of 12.12% in Nzoro to 88.57% in Siloé.

Overall, Hookworm prevalence was 48.88%, with a range of 22.86% in Siloé to 69.7% in Nzoro.

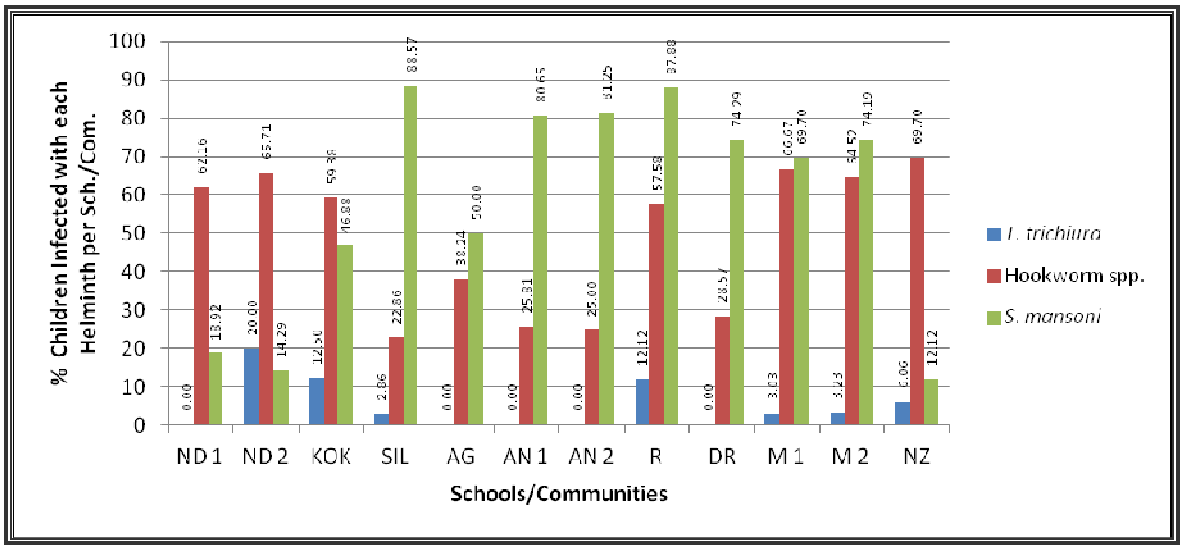

Figure 28: Overall STH prevalence rates per site

5.4.4 Intensity of STH infection

The intensity of hookworm and *Schistosoma mansoni* are shown in Figure 29 and Figure 30.

All the *Trichuris* infections fell into the category "LIGHT" (i.e. 1-999 epg), as prescribed by WHO (1995) and no children were infected with this helminth by itself.

The highest mean intensities of Hookworm epg were found in 13-14 year olds from Kokiza, Renzi and Ndala 2. In Anzokudo 1, no 13-14 year olds were infected with this helminth. In 11-12 year olds, the mean intensities of Hookworm epg ranged from a low of 150 in Agbarabo to 2203 in Siloé. In the 9-10 year olds, the range was 140 in Anzokudo 1 to 2387 in Modegi 1. All these counts fall into WHO's 'LIGHT' (i.e. 1-999 epg) infections category.

The 3 highest individual Hookworm egg counts were: 21,160 epg in a 14 year old male from Kokiza; 20,440epg in a 14 year old male from Renzi; and 14,560epg in a 12 year old male from Ndala 2. These all fall into WHO's 'HEAVY' category, i.e. ≥ 10,000 epg.

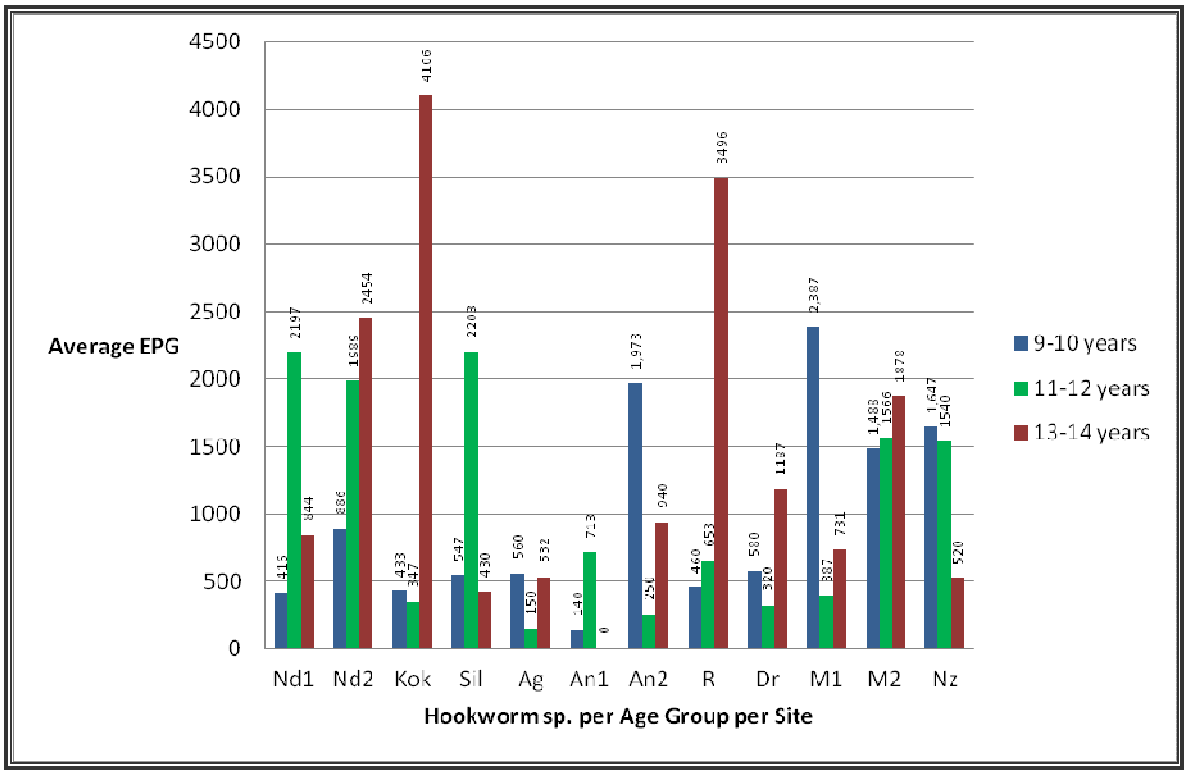

Figure 29: Mean hookworm intensities per age group per site

WHO's categories for *Schistosoma mansoni* are: LIGHT (1-100 epg), MODERATE (101-400 epg) and HEAVY (>400 epg).

The highest intensity of 5,023 *S. mansoni* epg was found in 13-14 year olds in Siloé and the next highest of 3,198 and 2,944 in 11-12 year olds in Siloé and Anzokudo 1 respectively. In 13-14 year olds, the mean epg dropped down to 60 in Anzokudo 1 and zero in Nzoro. The lowest mean in the 11-12 year olds was 73 in Kokiza. The mean epg counts in 9-10 year olds ranged from 1,324 and 1,240 in Drati and Modegi 2 respectively, down to 90 in Ndala 2.

The 3 highest individual S. mansoni egg counts were: 10,720 in a 13 year old male from Siloé; 9,740 in an 11 year old male and 7,680 in a 12 year old female from Anzokudo 1.

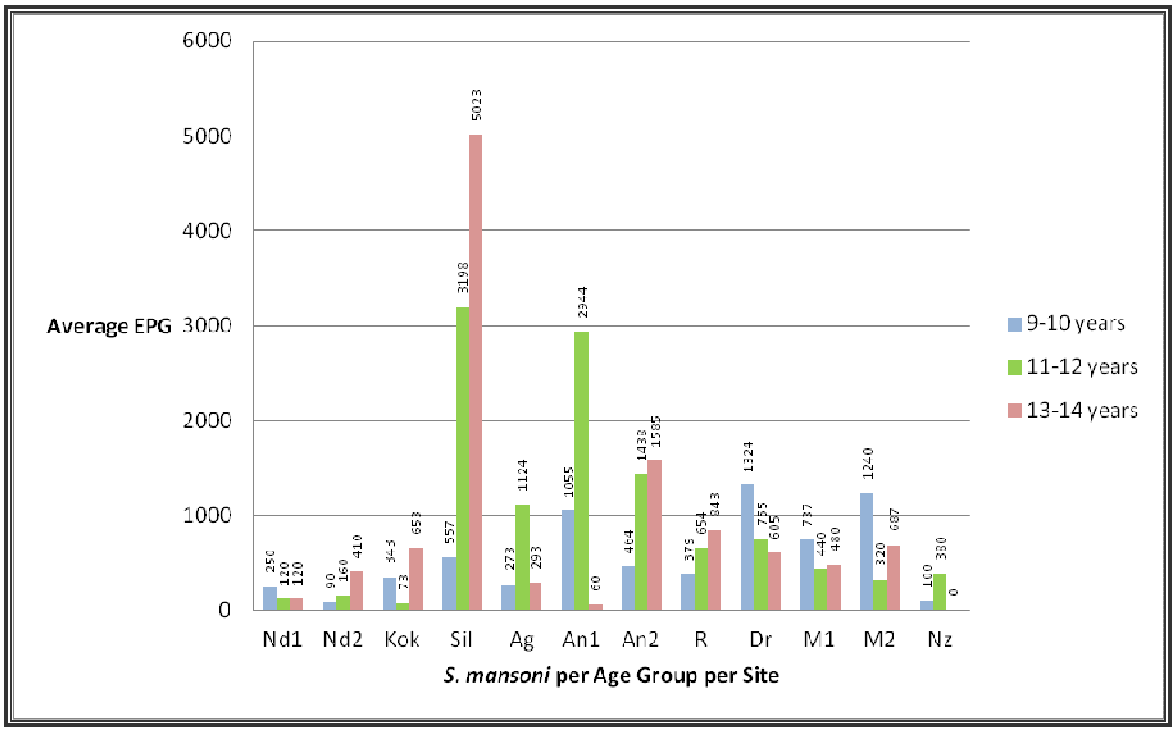

Figure 30: Mean *S. mansoni* Intensities per age group per site

5.4.5 Discussion on STHs and Schistosomiasis

It was surprising to find so few different genera of helminths in the study area with only three different human helminth species described.

It was indeed curious that no children were infected with one of the commonest of all the soil-transmitted helminths (STH), *Ascaris lumbricoides*. The reason for this could be the altitude in this region of the north eastern DRC.

An interesting find in 7 of these communities was the presence of very low numbers of an egg resembling the hookworms in shape but significantly larger. Unfortunately, the Kato-Katz method does not lend itself to accurate diagnoses of unusual parasite eggs, due to the stage where the sample is squashed, as this changes the size and shape of the eggs to a degree where they cannot be accurately measured. However, the average size of these eggs was approximately 33-40% larger than the normal hookworm eggs and judging by the morphology and average size, appear to be those of the genus, *Ternidens*. These eggs were always seen in children who had human hookworm infections, except for one case in Ndala 1. This parasite is normally found in non-human primates and is accidently picked up by humans. The low numbers of children infected (17 children or

4.24%) and the low parasitaemias (20-100 epg) support the diagnosis of a spurious parasite of interest, but of no real health consequence for the population.

The intermediate snail host for both *S. mansoni* (*Biomphalaria pfeifferi)* and *S. haematobium* (*Bulinus globosus)* must be considered in the local context as their distribution can be highly focal in nature. These snails thrive in standing or slow flowing freshwater and survive best in rivers and water reservoirs that dry out seasonally and at altitudes from approximately 250 m and 1,000 m. The total absence of *S. haematobium* was a surprise and it is recommended to undertake snail samples to determine the risk of the disease emerging. Alternatively surveillance can determine this.

The prevalence and intensity within the human population will depend on how much exposure communities have with contaminated freshwater sources. *Schistosoma* is a water based disease with disease transmission occurring from exposure to water sources that are contaminated by human urine and faecal matter. This is generally in communities that do not have access to appropriate latrines or practice indiscriminate defecation at least 50 m away from the water source. These same communities use the contaminated water to wash, bath, fish and play, thus completing the cycle of infection-contamination. The disease is thus acquired through exposure to water that is contaminated and not through washing or drinking or other insect vectors.

Children were mainly reported a low intensity of hookworm infection. These results suggest high direct exposure to soil by skin (walking and farming without footwear) as well as exposure to the faecal oral route (contaminated food and water).

The STHs affect schoolchildren by causing anaemia, poor weight gain, slow growth, poor concentration in their “learning years” resulting in poor school achievement and eventually reduced adult earning capacity. In addition, schistosomiasis cause long-term liver and renal disease which in turn cause adult morbidity and shortened life expectancy. The World Bank has concluded that the regular de-worming of school-aged children is one of the most cost-effective investments a developing country can perform. By supporting good quality dry-sanitation systems in both homes and at schools and educating communities about good hygiene and sanitation practices, then these helminths can be well managed and morbidity reduced.

5.5 Findings of the knowledge, attitude and practice survey

5.5.1 Knowledge, attitudes and practices for malaria

Malaria was recognised as a major public health concern that can influence the health as well as economic development of both the community and the project. Respondents of the KAP survey were asked about symptoms, transmission and prevention of malaria to gain an understanding of these practices so that behavioural change strategies could be developed. Respondents were not prompted for answers.

96% (n=302) were aware of malaria or its local meaning.

There was generally good knowledge of the main symptoms of malaria, with 55% mentioning 'vomiting', followed by 'feeling cold/chills' (45.7%) and 'fever/high temperature' (42.7%). 'Weakness' and 'headache' were mentioned less often at 23.2% and 20.5%, respectively. These and other less frequently reported symptoms are summarized in Table 29.

Table 29: Knowledge of respondents on specific malaria symptoms (%)

Sentinel site	Vomiting	Feeling cold / chills	Fever / high temperature	Weakness / loss of energy	Headache	Bitter taste in the mouth	Body pain / joint pain	Fatigue	Loss of appetite	Eyes become yellow	Dizziness	Diarrhoea	Number of respondents
Salambongo	57.1	42.9	42.9	28.6	10.7	17.9	7.1	10.7	10.7	0.0	10.7	3.6	28
Gatanga	58.6	34.5	37.9	13.8	13.8	3.4	10.3	10.3	0.0	10.3	6.9	0.0	29
Kokiza	59.1	18.2	50.0	13.6	0.0	18.2	13.6	18.2	13.6	13.6	4.5	9.1	22
Gorumbwa	53.6	32.1	42.9	3.6	14.3	32.1	14.3	14.3	17.9	14.3	10.7	14.3	28
Karagba	65.5	41.8	51.7	24.1	24.1	24.1	17.2	20.7	17.2	0.0	3.4	6.9	29
Camp Chauffeur	28.6	46.4	51.7	21.4	32.1	17.9	35.7	28.6	10.7	10.7	7.1	3.6	28
Renzi	71.0	58.1	38.7	25.8	29.0	19.4	9.7	9.7	16.1	6.5	12.9	3.2	31
Durba Centre	41.8	58.6	34.5	27.6	34.5	20.7	34.5	17.2	13.8	3.4	0.0	3.4	29
Durba Toyota	46.7	70.0	33.3	33.3	26.7	20.0	13.3	13.3	10.0	0.0	3.3	3.3	30
Mazo	57.1	53.6	39.3	14.3	17.9	14.3	10.7	10.7	3.6	3.6	3.6	0.0	28
Mengu	70.0	35.0	45.0	10.0	15.0	35.0	15.0	10.0	10.0	20.0	5.0	10.0	20
Total	**55.0**	**45.7**	**42.7**	**23.2**	**20.5**	**19.9**	**16.6**	**14.9**	**11.3**	**6.9**	**6.3**	**5.0**	**302**

Table 30 provides information on the level of knowledge of modes of malaria transmission across the different SS. It was important to analyse consistent knowledge (that being

bitten by mosquitoes was the only true mode) on transmission as more than one answer was accepted. This served to detect inconsistent knowledge

Table 30: Knowledge on modes of malaria transmission (%)

Sentinel site	Consistent knowledge	Being bitten by mosquitoes	Getting cold	Being in the rain	Sugary food	Drinking dirty water	Dirty surroundings	Working in the sun	Other insects	Being bitten by flies	From another person with malaria	Beer	Do not know any	Number of respondents
Salambongo	32.1	57.1	35.7	14.3	0	3.6	7.1	3.6	0	7.1	0	0	17.9	**28**
Gatanga	31.0	58.6	27.6	20.7	13	6.9	0	3.6	0	3.4	0	0	17.2	**29**
Kokiza	0.0	50.0	40.9	31.8	0	9.1	13.6	18.2	13.6	0	0	0	9.1	**22**
Gorumbwa	7.1	57.1	42.9	21.4	14	17.9	3.6	10.7	14.3	0	3.6	3.6	14.3	**28**
Karagba	0.0	58.6	51.7	27.6	17.2	17.2	10.3	10.3	6.9	6.9	3.4	0	10.3	**29**
Camp Chauffeur	17.9	60.7	39.3	32.1	15	25.0	17.9	10.7	3.6	0	0	3.6	17.9	**28**
Renzi	9.7	58.1	35.5	16.1	6.5	16.1	9.7	9.7	16.1	0	0	3.2	12.9	**31**
Durba Centre	17.2	58.6	41.4	13.8	16.0	20.7	13.8	20.7	0	3.4	0	0	13.8	**29**
Durba Toyota	20.0	70.0	36.7	33.3	0	23.3	10	3.3	6.7	3.3	3.3	0	6.	**30**
Mazo	25.0	53.6	39.3	10.7	17	17.9	10.7	7.1	7.1	3.6	0	0	10.7	**28**
Mengu	20.0	60.0	35	30	20	40	0	10	0	5	5	0	5.0	**20**
Total	**16.5**	**58.6**	**38.7**	**22.5**	**18.0**	**17.5**	**8.9**	**9.6**	**6.3**	**3.0**	**1.3**	**1.0**	**12.6**	**302**

The level of consistent knowledge across the SS was generally poor amongst the 302 respondents, at 16.5%. This ranged from 0.0% in Kokiza and Karagba, to 32.1% and 31% in Salambongo and Gatanga respectively.

It was recognised that mosquito bites were the main mode of transmission at 58.6%. This was surprisingly poor. This was lowest in Mazo (53.6%) and highest in Durba Toyota (70%). Being in the cold and in the rain were the most common misconceptions at 38.7% and 22.5% respectively with variable results across the SS. Food with high sugar content at 18% and 'drinking dirty water' at 17.5% were the next most commonly reported misconceptions for malaria transmission.

Importantly, 12.6% of the respondents (ranging from 5% in Mengu to 17.9% in Salambongo and Champ Chauffeur) did not know any mode of malaria transmission.

The level of knowledge on potential malaria prevention methods is summarized in Table 31. Again, there was very little consistent knowledge or practice on malaria prevention methods. Among the respondents, only 40.4% reported 'sleeping under an ITN' as a means to prevent malaria transmission with 37.1% reporting to 'avoiding mosquito bites'. These findings do not correspond with the levels of knowledge for malaria transmission as described above, or the findings of the KIS survey in section 5.3.2.1, where 65% of households reported ownership of an ITN and 47.2% reported that a child had slept under an ITN the previous night. The conclusion one can draw from this is the communities do not always understand the benefits of bednets or their correct application. With the high mean malaria rates there is a concern that ITNs are not being correctly utilised and there is an opportunity for information and education programmes. This is especially relevant where 8.9% did not acknowledge any method for protecting themselves against malaria.

Other than ITN the other correct answers were not commonly answered.

Table 31: Knowledge on malaria prevention methods (%)

Sentinel site	Sleeping under an ITN	Avoid mosquito bites	Taking medicine	Avoid getting cold	Other	Keep the surroundings clean	Drink clean water	Avoid being in the sun	Avoid being in the rain	Mosquito repellents	Insecticide	Do not know any	Number of respondents
Salambongo	39.3	42.9	7.1	25.0	17.9	7.1	7.1	0.0	17.9	7.1	3.6	10.7	**28**
Gatanga	24.1	37.9	6.9	17.2	13.8	20.7	3.4	3.4	3.4	3.4	0.0	17.2	**29**
Kokiza	36.4	27.3	13.6	50.0	18.2	4.5	9.1	18.2	13.6	13.6	4.5	9.1	**22**
Gorumbwa	57.1	32.1	32.1	21.4	14.3	3.6	14.3	3.6	14.3	0.0	7.1	10.7	**28**
Karagba	41.4	34.5	20.7	44.8	17.2	6.9	10.3	13.8	20.7	3.4	3.4	17.2	**29**
Camp Chauffeur	42.9	46.4	46.4	21.4	14.3	14.3	14.3	7.1	3.6	3.6	3.6	17.9	**28**
Renzi	35.5	35.5	45.2	22.6	6.5	9.7	3.2	16.1	6.5	0.0	9.7	3.2	**31**
Durba Centre	48.3	37.9	44.8	34.5	3.4	6.9	10.3	20.7	3.4	3.4	3.4	6.9	**29**
Durba Toyota	43.3	40.0	36.7	23.3	10.0	26.7	13.3	6.7	3.3	6.7	3.3	0.0	**30**
Mazo	35.7	32.1	35.7	32.1	7.1	14.3	7.1	10.7	0.0	7.1	0.0	3.6	**28**
Mengu	40.0	40.0	45.0	30.0	15.0	15.0	20.0	0.0	5.0	0.0	0.0	0.0	**20**
Total	39.3	42.9	7.1	25.0	17.9	7.1	7.1	0.0	17.9	7.1	3.6	10.7	**28**

When asked why no mosquito prevention activities were performed, 47.5% responded that no measures were available, 26.2% stated that they cannot afford any protective measure and 21.3% that they were not aware of a method of protection.

Table 32 shows the main practices used by the 84.8% of respondents (n/N = 256/302) that reported that they protect themselves against malaria. The majority, 69.5%, reported to sleep under a mosquito net. This was most common in Mazo (85.7%) and Camp Chauffeur (82.1%). The use of nets was lowest in Kokiza (45.5%), which compared with Table 18 from the KIS survey, where Kokiza reported the lowest ownership of bednets (48.7%). In this setting a large proportion of the community reported 'to avoid getting cold' (31.8%) and 'to avoid the rain' (27.3%) as their main preventative measures. Other frequently mentioned measures across the SS were to 'avoid getting cold' (19.5%), 'taking medication' (15.6%) and 'using repellents' (12.6%).

Table 32: Protection measures taken against malaria in adults

Sentinel site	Sleeping under a mosquito net	Avoid getting cold	Taking medication	Using mosquito repellents	Avoid the rain	Drink only clean water	Closing windows / doors	Spraying insecticides	Traditional plants as repellents	Other	No. of respondents
Salambongo	60.7	14.3	7.1	17.9	3.6	0.0	3.6	3.6	0.0	10.7	**23**
Gatanga	62.1	20.7	3.4	20.7	13.8	0.0	0.0	0.0	0.0	17.2	**26**
Kokiza	45.5	31.8	13.6	22.7	27.3	4.5	0.0	0.0	9.1	9.1	**16**
Gorumbwa	71.4	25.0	21.4	17.9	14.3	21.4	17.9	3.6	0.0	7.1	**26**
Karagba	79.3	20.7	24.1	17.2	3.4	3.4	13.8	10.3	13.8	6.9	**27**
Camp Chauffeur	82.1	14.3	35.7	7.1	3.6	17.9	7.1	14.3	10.7	0.0	**24**
Renzi	74.2	19.4	19.4	9.7	9.7	12.9	6.5	0.0	3.2	3.2	**25**
Durba Centre	75.9	24.1	17.2	3.4	17.2	13.8	0.0	3.4	6.9	0.0	**27**
Durba Toyota	60.0	10.0	20.0	6.7	3.3	13.3	6.7	10.0	0.0	6.7	**24**
Mazo	85.7	14.3	3.6	14.3	10.7	7.1	3.6	3.6	0.0	3.6	**24**
Mengu	60.0	25.0	0.0	0.0	5.0	5.0	0.0	5.0	0.0	5.0	**14**
Total	**69.5**	**19.5**	**15.6**	**12.6**	**9.9**	**9.3**	**5.6**	**5.0**	**4.0**	**6.3**	**256**

5.5.2 Knowledge, attitudes and practices for sexually transmitted infections and HIV/AIDS

In the scoping HIA Sexually transmitted infections (STIs) and HIV/AIDS were recognised as existing public health concern in the area and a potential health impact from the project (Divall and Winkler, 2008). According to the most recent national level data on the DRC (2010), HIV prevalence was estimated at 4.3%. There was a predominance in rural areas (4.6%) and women had a higher risk of infection than men (UNGASS, 2010).

The World Bank has acknowledged that HIV/AIDS is one of the major problems affecting general society. Sub-Saharan Africa has over two-thirds (68%) of the global HIV/AIDS cases burden (22.4 million) and only about 30% of those infected have access to effective treatment and care. In this setting four factors play a major role in perpetuating the transmission of the virus (Listorti, 1996):

- Urban and rural transportation networks.
- Food markets with movement of people.
- Construction work crews.
- Rural-to-urban migration with the speculation of an improved livelihood though direct and indirect jobs.

The extractive industry has historically increased the spread of HIV and STIs through a variety of factors. These are well described especially in large scale mining operations and developments such as the platinum and gold mines in South Africa and the gold mining sector in the Lake Victoria Zone in Tanzania (Clift *et al.*, 2003). In-migration is also a major concern for the project zone due to the great potential of further stressing the social structures in communities.

The level of HIV/AIDS-related knowledge in the general population, social stigmatization, risk behaviour modification, access to quality services for STIs, provision and uptake of HIV counselling and testing, and access to care, including prevention and treatment of opportunistic infections and antiretroviral therapy (ART) are all essential elements to analyse.

Therefore, the level of relevant knowledge, perceptions, and behaviours at the local level are of major interest. The knowledge and attitudes indicators are composite indicators and have been created to provide an indication of the level of correct knowledge that can be

used across different countries and contexts. Although it is now accepted that knowledge in itself will not lead to change in behaviours, knowledge is an important prerequisite for behaviour change. It is essential that behaviour change communication and high risk behaviour is managed in the region and understanding existing behaviour will support interventions and the monitoring thereof.

5.5.2.1 Knowledge and awareness of HIV/AIDS transmission

In this section respondents were questioned on the awareness of HIV/AIDS and knowledge of HIV/AIDS transmission and prevention practices. These questions were based on a prompted set of possible correct and incorrect statements. Multiple answers were possible.

95.4% of the survey respondents (aged ≥15 years; n = 302) have heard of HIV/AIDS.

While elements of HIV knowledge were generally good, consistent knowledge was poor at 32.1%. This is highlighted in Table 33 and Table 35.

Table 33 shows knowledge on transmission modes of HIV/AIDS. A high proportion knew that HIV/AIDS can be transmitted when having unprotected sex (87.4%). Other common modes of transmission were less well known; 69.5% (range 31-95%) knew about the risk of contaminated blades/needles, with 53% (range 17.9-86.7%) reporting 'unsafe blood transfusions' as a potential cause. Only 31.1% of the respondents knew that HIV/AIDS can be transmitted from the mother to the child during delivery and with breastfeeding.

The most commonly reported incorrect modes of transmission included insect bites at 16.2% (range 3.4-33.3%) and sharing eating utensils with a HIV+ person at 13.9% (range 0.0-27.3%). Magic or sorcery, while only at 8.3% of reported potential causes, shows the importance of a traditional belief system in HIV transmission.

Table 33: Knowledge of HIV/AIDS transmission modes in adults (*misconceptions in italics*)

Sentinel site	Having unprotected sex	Use of a contaminated blade	Unsafe blood transfusion	From mother to child during delivery	*Insect bites*	*Sharing eating utensils with HIV+ person*	*Kissing (cheek or lips) someone who is HIV+*	*Magic/curses/scocery*	*Being coughed / sneezed on by so. who is HIV+*	*Condom use*	No. of respondents
Salambongo	71.4	57.1	17.9	3.6	*3.6*	*7.1*	*3.6*	*3.6*	*0.0*	*0.0*	**28**
Gatanga	93.1	31.0	24.1	3.4	*3.4*	*3.4*	*6.9*	*0.0*	*0.0*	*0.0*	**29**
Kokiza	68.2	50.0	18.2	4.5	*4.5*	*27.3*	*4.5*	*0.0*	*4.5*	*0.0*	**22**
Gorumbwa	89.3	75.0	53.6	3.6	*7.1*	*0.0*	*3.6*	*0.0*	*0.0*	*3.6*	**28**
Karagba	93.1	72.4	48.3	37.9	*24.1*	*20.7*	*24.1*	*10.3*	*20.7*	*13.8*	**29**
Camp Chauffeur	96.4	89.3	64.3	46.4	*17.9*	*17.9*	*14.3*	*10.7*	*14.3*	*10.7*	**28**
Renzi	87.1	61.3	58.1	45.2	*12.9*	*16.1*	*12.9*	*6.5*	*9.7*	*0.0*	**31**
Durba Centre	86.2	82.8	79.3	37.9	*17.2*	*20.7*	*6.9*	*3.4*	*6.9*	*3.4*	**29**
Durba Toyota	93.3	86.7	86.7	53.3	*33.3*	*10.0*	*13.3*	*20.0*	*10.0*	*3.3*	**30**
Mazo	85.7	67.9	53.6	50.0	*25.0*	*21.4*	*10.7*	*10.7*	*7.1*	*10.7*	**28**
Mengu	95.0	95.0	75.0	55.0	*30.0*	*10.0*	*10.0*	*30.0*	*10.0*	*15.0*	**20**
Total	**87.4**	**69.5**	**53.0**	**31.1**	***16.2***	***13.9***	***10.3***	***8.3***	***7.6***	***5.3***	**302**

There were some relevant findings in the different sampled SS. Mengu reported high levels of knowledge for the main causes of transmission, but also the highest proportion of inconsistent reasons. Magical powers and insect were mentioned in 30% of cases with use of condoms accounting for 15% of the incorrect reasons. Gatanga, Gorumbwa and Salambongo reported relatively low incorrect beliefs. Gatanga and Kokiza as the preferred host site has relatively good knowledge compared to other sites and attention will need to be given to the poor levels of knowledge in the residents of Karagba and Camp Chauffeur. These incorrect beliefs underscore the challenge is supporting behaviour change in the communities.

5.5.2.2 Knowledge and awareness of HIV/AIDS prevention

Since HIV in sub-Saharan Africa is mainly transmitted through heterosexual contact, HIV/AIDS prevention programmes focus their messages and efforts on three important aspects of sexual behaviour:

- Delaying sexual debut in young persons (**A = Abstinence**).
- Limiting the number of sexual partners or staying faithful to one partner (**B = Be faithful**).
- Use of condoms (**C = Condom**).

To monitor if these messages are effectively communicated to, and understood by, the target population, the level of knowledge on prevention methods was assessed. Table 34 outlines the responses which are to a degree linked to the transmission methods described above. Use of sterile blades (39.1%) and not having sexual intercourse with prostitutes (36.1%) were the most commonly mentioned prevention methods. Abstinence, fidelity and condom use were less commonly reported at 35.4% (range 17.2-48.4%), 32.5% (range 7.1-53.3%) and 23.5% (range 6.5-42.9%), respectively. Using condoms as an important protective measure was only mentioned by a quarter of the respondents (23.5%). This was of particular concern in Renzi (6.5%) and Mazo (7.1%) with reported knowledge of the benefits of condoms below 10%.

Of note was that the level of incorrect knowledge on preventive methods was lower than the correct knowledge of disease transmission.

Table 34: Knowledge of HIV/AIDS prevention methods (*misconceptions in italics*)

Sentinel site	Use sterile blades	Not having sexual intercourse with prostitutes	Abstinence	Fidelity	Using condoms	Avoid contaminated needles	Delay sexual debut	*Avoid mosquito / insect bites*	*Pray*	No. of respondents
Salambongo	17.9	50.0	21.4	7.1	17.9	7.1	0.0	*10.7*	*14.3*	**28**
Gatanga	6.9	27.6	34.5	27.6	13.8	6.9	13.8	*6.9*	*24.1*	**29**
Kokiza	27.3	22.7	31.8	27.3	27.3	18.2	9.1	*0.0*	*27.3*	**22**
Gorumbwa	42.9	35.7	35.7	14.3	42.9	14.3	7.1	*0.0*	*21.4*	**28**
Karagba	34.5	37.9	17.2	37.9	34.5	17.2	3.4	*6.9*	*10.3*	**29**
Camp Chauffeur	46.4	53.6	46.4	17.9	42.9	32.1	10.7	*10.7*	*0.0*	**28**
Renzi	35.5	41.9	48.4	41.9	6.5	25.8	0.0	*3.2*	*3.2*	**31**
Durba Centre	58.6	34.5	48.3	51.7	13.8	20.7	6.9	*0.0*	*6.9*	**29**
Durba Toyota	60.0	23.3	36.7	53.3	33.3	26.7	3.3	*0.0*	*0.0*	**30**
Mazo	42.9	32.1	32.1	35.7	7.1	21.4	3.6	*0.0*	*7.1*	**28**
Mengu	60.0	35.0	35.0	40.0	20.0	40.0	10.0	*5.0*	*5.0*	**20**
Total	**39.1**	**36.1**	**35.4**	**32.5**	**23.5**	**20.5**	**6.0**	***4.0***	***10.6***	**302**

5.5.2.3 Consistent knowledge on HIV/AIDS transmission and prevention

It was important that consistent knowledge on HIV/AIDS transmission and prevention was analysed. This was based on assessing consistent correct and incorrect answers for HIV transmission and prevention in the participants based on the following four conditions (MEASURE DHS, 2010):

- Rejection of the statement that HIV/AIDS can be transmitted by mosquito bites.
- Rejection of the statement that HIV/AIDS can be transmitted by using the same cup/plate as someone who is HIV+.
- Acknowledgment that HIV/AIDS can be prevented by using condoms.
- Acknowledgment that HIV/AIDS can be prevented by abstinence.

Table 35: Consistent knowledge related to HIV/AIDS transmission.

Sentinel site	Portion of participants having consistent knowledge on HIV transmission	No. of respondents
Salambongo	25.0	**28**
Gatanga	27.6	**29**
Kokiza	18.2	**22**
Gorumbwa	50.0	**28**
Karagba	34.5	**29**
Camp Chauffeur	50.0	**28**
Renzi	32.5	**31**
Durba Centre	34.5	**29**
Durba Toyota	30.0	**30**
Mazo	17.9	**28**
Mengu	30.0	**20**
Total	**32.1**	**302**

On average, 32.1% of the respondents showed consistent knowledge on HIV transmission and prevention as shown in Table 35. This low rate of consistent knowledge can result in inconsistent prevention activities as well as possible stigma and discrimination. This serves as an ideal opportunity to support intensified information, education and communication programmes that will support prevention and behaviour change.

Any difference between knowledge of HIV transmission and prevention between males and females in the study group was determined. Figure 31 shows that misconceptions were equally distributed between the genders. Other than knowledge on the use of

condoms for prevention activities, where men reported a statistically significant high level of knowledge than women (p-value: <0.001), there was no significant gender difference with regards to comprehensive knowledge on HIV/AIDS.

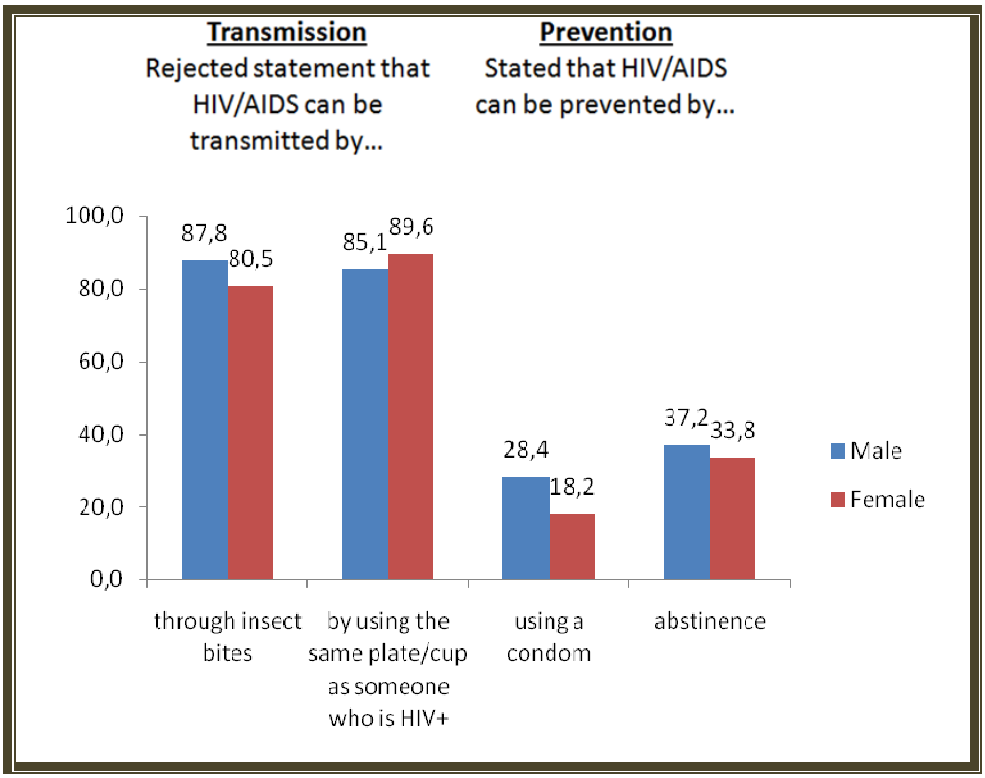

Figure 31: Gender disparities in regard to consistent knowledge on HIV/AIDS.

5.5.2.4 Attitudes and awareness of HIV/AIDS transmission

To gain a deeper understanding of the knowledge and practices in the community, respondents were asked by a series of 'Yes or No' questions on treatment and care of HIV/AIDS, as well as attitudes towards people living with HIV/AIDS (PLWHA). These are summarized in Table 36.

Slightly more than half of the surveyed individuals (54.9%) knew that HIV/AIDS cannot be cured even if diagnosed and treated early (ranges from 34.6% in Salambongo to 78.6% in Renzi). A higher proportion (71.4%) knew that there was no vaccine available against HIV/AIDS.

Data related to acceptance and attitudes towards PLWHA shows that only a minority of respondents think that they are well integrated in their community (23.6%). This was highlighted by the fact that only 43.1% of the respondents would buy fruit from someone

that was known to be HIV positive. This high level of stigma related to HIV/AIDS supports the lack of consistent knowledge and underscores the potential for discrimination in the communities.

Table 36: Knowledge and attitudes towards people living with HIV/AIDS

Sentinel site	Percentage of adults who agreed with the following statements when prompted				Number of respondents
	HIV/AIDS cannot be completely cured even if diagnosed and treated early	There is no vaccine against HIV/AIDS	Would buy a fruit from someone who is HIV+	People who are HIV+ are well integrated into the community	
Salambongo	34.6	65.4	38.5	23.1	**28**
Gatanga	65.5	69.0	31.0	13.8	**29**
Kokiza	73.7	84.2	26.3	15.8	**22**
Gorumbwa	57.7	57.7	38.5	30.8	**28**
Karagba	50.0	64.3	32.1	10.7	**29**
Camp Chauffeur	44.4	81.5	63.0	33.3	**28**
Renzi	78.6	75.0	50.0	35.7	**31**
Durba Centre	57.1	77.8	50.0	35.7	**29**
Durba Toyota	33.3	73.3	60.0	26.7	**30**
Mazo	51.8	70.4	40.7	14.8	**28**
Mengu	65.0	70.0	35.0	15.0	**20**
Total	**54.9**	**71.4**	**43.1**	**23.6**	**302**

5.5.2.5 Individual practices to reduce risk of HIV transmission

Good knowledge on prevention methods does not guarantee that this will be practiced at the individual level. It was thus important to ascertain the individual practices to reduce risk of HIV transmission. This is described in Table 37.

Faithfulness appears to be the most popular practice to avoid infection (57.9%), followed by the 'use of sterile blades' (27.5%) and abstinence (24.5%). Condom use is poorly practiced, as could be expected given the low levels of knowledge on condom use (Table 34), with only 16.2% of the participants reported using condoms as a means of safe sex. Faith plays an important role at the individual level, with 11.3% of respondents believing that praying will help them to avoid an infection.

Table 37: Individual practices to reduce HIV/AIDS transmission (*misconceptions in italics)*

Sentinel site	Faithfulness	Only use sterile blades	Not having sexual inter-course at all (abstinence)	Not having sexual inter-course with prostitutes	Avoid injection with contaminated needle	Using condoms	Retard of sexual debut	*Praying*	*Avoid mosquito / insect bites*	No. of respondents
Salambongo	60.7	7.1	7.1	17.9	0.0	10.7	10.7	*10.7*	*3.6*	**28**
Gatanga	58.6	3.4	34.5	10.3	0.0	13.8	6.9	*17.2*	*3.4*	**29**
Kokiza	45.5	22.7	31.8	22.7	4.5	18.2	4.5	*31.8*	*4.5*	**22**
Gorumbwa	53.6	17.9	25.0	17.9	17.9	28.6	3.6	*14.3*	*0.0*	**28**
Karagba	48.3	13.8	24.1	31.0	13.8	17.2	10.3	*13.8*	*0.0*	**29**
Camp	50.0	17.9	21.4	42.9	17.9	28.6	0.0	*10.7*	*7.1*	**28**
Renzi	61.3	29.0	32.3	16.1	19.4	9.7	0.0	*9.7*	*0.0*	**31**
Durba Centre	69.0	48.3	17.2	17.2	31.0	17.2	17.2	*3.4*	*0.0*	**29**
Durba Toyota	63.3	53.3	26.7	13.3	30.0	16.7	3.3	*3.3*	*0.0*	**30**
Mazo	57.1	42.9	32.1	21.4	28.6	3.6	7.1	*7.1*	*0.0*	**28**
Mengu	70.0	50.0	15.0	0.0	30.0	15.0	5.0	*5.0*	*0.0*	**20**
Total	**57.9**	**27.5**	**24.5**	**19.5**	**17.5**	**16.2**	**6.3**	***11.3***	***1.7***	**302**

5.5.2.6 Attitudes and practices for HIV/AIDS testing

HIV testing and knowledge of one's HIV status is vitally important in order to access treatment. In addition to this, knowledge of a positive status can lead to a reduction of risk taking at a personal level and with potential sexual partners to protect them from potential transmission. Studies have shown that those who have taken an HIV test, and know their result, are more likely to have a higher level of education, be in employment, have accurate HIV knowledge, and a higher perception of risk, among other factors. The link between the uptake of testing and several socio-economic indicators suggests an improvement in the general standard of living would be beneficial to testing (Peltzer *et al.*, 2009).

Table 38 describes the proportion of respondents that have ever undertaken a HIV test. This needs to be recognised with the limited HIV testing services that are available in the study area. It was reported that 20.5% of respondents have undergone a HIV/AIDS test at some point in their life. This ranged from only 3.7% uptake in Mazo to 42.3% in Salambongo. Overall, the more rural communities had lower uptakes (Mazo, Renzi, Kokiza).

Table 38: Uptake HIV/AIDS testing and reasons for not taking an HIV/AIDS test

Sentinel site	Percentage that ever did take an HIV test	Percentage that did never take an HIV test	Reasons for not taking an HIV test							No. of respondents
			Accessibility	Availability	Acceptability	Scared to test / know the result	It is not necessary for me	I do not know	Other	
Salambongo	**42.3**	**57.7**	0.0	7.1	0.0	7.1	17.9	10.7	10.7	**28**
Gatanga	**10.3**	**89.7**	6.9	17.2	0.0	6.9	37.9	0.0	20.7	**29**
Kokiza	**10.5**	**89.5**	4.5	9.1	4.5	0.0	45.5	0.0	22.7	**22**
Gorumba	**30.8**	**69.2**	3.6	3.6	3.6	10.7	28.6	3.6	17.9	**28**
KDC Karagba	**17.9**	**82.1**	10.3	3.4	3.4	13.8	44.8	3.4	10.3	**29**
KDC Chauffeur	**25.9**	**74.1**	17.9	10.7	0.0	10.7	32.1	3.6	14.3	**28**
Renzi	**7.1**	**92.9**	12.9	12.9	3.2	9.7	38.7	3.2	9.7	**31**
Durba Centre	**25.0**	**75.0**	3.4	0.0	3.4	6.9	44.8	3.4	6.9	**29**
Durba Toyota	**30.0**	**70.0**	3.3	3.3	3.3	3.3	46.7	3.3	13.3	**30**
Mazo	**3.7**	**96.3**	3.6	10.7	0.0	10.7	57.1	0.0	14.3	**28**
Mengu	**20.0**	**80.0**	15.0	0.0	10.0	5.0	50.0	0.0	10.0	**20**
Total	**20.5**	**79.5**	**7.3**	**7.3**	**2.6**	**7.9**	**40.1**	**3.0**	**13.6**	**302**

The barriers related to HIV testing are multi-factorial. The main barrier was the fact that respondents did not see the need to do so (40.1%, range 17.9-57.1%). This underscores the poor knowledge and high levels of stigma to the disease in the area and supported with the fact that 7.9% of the respondents were actually afraid of the results. The limited health care services were a concern but accessibility, availability and acceptability of HIV testing were reported by 7.3%, 7.3% and 2.6% of the respondents, respectively, showing it not to be a major determinant.

The lack of awareness of the benefit in being tested is highlighted through the lack of consistent knowledge across the communities as shown in the previous sections. This is a huge barrier to addressing HIV in the area and will need to be supported through an integrated approach to prevention and care.

Access to testing may also be limited through the limited access to anti-retroviral treatment. On an individual level it may not be that empowering to be aware of ones status and have little means to manage it.

5.5.2.7 Attitudes and practices for condom use

As discussed earlier condom use is an important method to reduce HIV transmission. Thus condom availability and use was assessed in the survey.

Table 39 outlines a variety of factors related to attitudes surrounding condom use area. Self-reported availability of condoms in the different communities revealed that only a third of all respondents (30.5%) reported that they are easily accessible. This was especially in the more rural settlements of Kokiza, Renzi, Mazo and Mengu where access to condoms was reported to be difficult. Similarly only third reported that condoms are affordable (34.8%). Again, the poorer settlements of Kokiza, Renzi, Mazo and Mengu had the highest proportion of people that perceived that condoms are not affordable.

Table 39: Self-reported availability and use of condoms

Sentinel site	Percentage of adults who agreed with the following statements when prompted				No. of respondents
	Condoms are easily accessible for me	I can afford to buy condoms	I used a condom at my last sexual inter-course	I already refused sexual intercourse because no condom was available	
Salambongo	46.4	46.4	28.6	28.6	28
Gatanga	31.0	41.4	6.9	20.7	29
Kokiza	18.2	13.6	9.1	36.7	22
Gorumbwa	35.7	39.3	25.0	35.7	28
Karagba	31.0	31.0	13.8	27.6	29
Camp Chauffeur	46.4	53.6	28.6	35.7	28
Renzi	12.9	19.4	9.7	6.5	31
Durba Centre	34.5	48.3	34.5	41.4	29
Durba Toyota	40.0	36.7	26.7	33.3	30
Mazo	14.3	14.3	0.0	10.7	28
Mengu	20.0	35.0	5.0	35.0	20
Total	**30.5**	**34.8**	**17.6**	**27.8**	**302**

Questions about personal condom use presented a similar picture. The lowest rates of condom use at the last sexual intercourse were found in Gatanga, Kokiza, Renzi, Mazo (0%) and Mengu, all with rates below 10%. Highest condom use was reported in Durba Centre (34.5%), followed by the other more urban settings Salambongo, Camp Chauffeur (both 28.6%), Durba Toyota (26.7%) and Gorumbwa (25%). Refusal of sexual intercourse because of non-availability of condoms was reported at an average rate of 27.8%. In Renzi, only 6.5% of respondents ever refused sex because there was no condom

available. This outlines the low acceptance of condoms in these communities. The more urban settings showed higher refusal rates with the highest rate was reported in Durba Centre at 41.1%.

5.5.3 Knowledge, attitudes and perceptions in relation to nutrition

Nutritional behavioural aspects were included in the KAP survey to support the baseline description and to complete the picture of clinical findings presented in part 5.3.1.3 of the report.

20.5% reported that at least one member of the household had gone to bed the previous night without having had a proper meal. The range was 0-57.1%, in Mengu and Salambongo, respectively. Generally, this was reported more commonly in peri-urban settlements compared to rural settlements, with the exception of Durba Toyota (3.3%). It was not commonly reported in the more rural villages (Mengu, Kokiza, Mazo).

The most important reasons were lack of food availability (32.8%), punishment of the child (10.3%) and 'the child did not want to eat (1.7%). The most important reason 'unavailability of food' was mostly directly linked to affordability. Of note, 55.2% were under the category 'other reasons' such as: 'no appetite', 'sickness', 'preparation time' and 'no money'.

The frequency of meat and fish consumption is presented at SS level in Table 40. This is an important indicator for protein consumption. 10.9% and 3.6% of the population reported that they never eat meat or fish, respectively. Low meat consumption was reported in Kokiza, where 31.8% hardly consume any meat. Kokiza was also the community with the highest proportion of people that never eat fish (90.9%).

Most of the respondents ate meat once (38.4%) to several times a week (34.1%). Fish is eaten several times a week by 40.7% of the participants and every day by 26.2%. Only 1.7% stated that they eat meat every day compared to 26.2% who eat fish every day. Overall, fish consumption is more common than meat consumption.

Table 40: Frequency of meat and fish consumption by sentinel site

Sentinel site	Frequency of meat consumption					Frequency of fish consumption					
	Never	Less than once a week	Once a week	Several times a week	Every day	Never	Less than once a week	Once a week	Several times a week	Every day	No. of respondents
Salambongo	0.0	3.6	42.9	46.4	7.1	7.1	7.1	10.7	35.7	39.3	**28**
Gatanga	10.3	10.3	41.4	31.0	0.0	0.0	6.9	31.0	48.3	10.3	**29**
Kokiza	31.8	18.2	40.9	9.1	0.0	9.1	4.6	45.5	27.3	13.6	**22**
Gorumbwa	10.7	10.7	39.3	0.0	0.0	0.0	0.0	14.3	53.6	32.1	**28**
Karagba	6.9	10.3	37.9	37.9	6.9	3.5	3.5	10.3	55.2	27.6	**29**
Camp Chauffeur	7.1	17.9	32.1	39.3	0.0	7.1	7.1	17.9	35.7	32.1	**28**
Renzi	12.9	32.3	35.5	16.1	0.0	0.0	22.6	16.1	32.3	25.8	**31**
Durba Centre	10.3	13.8	27.6	48.3	0.0	6.9	3.5	6.9	27.6	55.2	**29**
Durba Toyota	10.0	6.7	53.3	26.7	3.3	6.7	6.7	23.3	50.0	13.3	**30**
Mazo	10.7	17.9	32.1	39.3	0.0	0.0	10.7	32.1	39.3	17.9	**28**
Mengu	15.0	5.0	40.0	40.0	0.0	0.0	0.0	45.0	40.0	15.0	**20**
Total	**10.9**	**13.6**	**38.4**	**34.1**	**1.7**	**3.6**	**7.0**	**21.9**	**40.7**	**26.2**	**302**

33.8% of respondents consider malnutrition as a problem in their community, with various self-reported causes for malnutrition presented in Table 41. 69.3% (range 28.6-100%) considered food to be unaffordable, followed by 'poor nutritional practices' (12.9%, range 0.0-42.9%) and 'diseases' (8.9%, range 0.0-18.2%) as the main causes for malnutrition in their community. 8.9% reported other causes or did not know any.

Table 41: Self-reported causes for malnutrition by sentinel site

Sentinel site	Food not affordable	Infections / Diseases (Malaria, HIV, TB, worms)	Poor nutritional practices	Don't know	Other	No. of respondents
Salambongo	28.6	14.3	14.3	0.0	42.9	**28**
Gatanga	63.6	18.2	0.0	0.0	18.2	**29**
Kokiza	50.0	12.5	25.0	0.0	12.5	**22**
Gorumbwa	60.0	10.0	20.0	0.0	10.0	**28**
Karagba	90.9	9.1	0.0	0.0	0.0	**29**
Camp Chauffeur	92.3	0.0	7.7	0.0	0.0	**28**
Renzi	72.7	9.1	18.2	0.0	0.0	**31**
Durba Centre	88.9	11.1	0.0	0.0	0.0	**29**
Durba Toyota	42.9	0.0	42.9	0.0	14.3	**30**
Mazo	50.0	12.5	25.0	12.5	0.0	**28**
Mengu	100.0	0.0	0.0	0.0	0.0	**20**
Total	**69.3**	**8.9**	**12.9**	**1.0**	**7.9**	**302**

5.5.4 Water and sanitation practices

5.5.4.1 Water accessibility and treatment

Introduction:

The availability of and accessibility to potable water may be associated with the prevalence of water-borne diseases among household members, especially children. The important indicator of water supply is the proportion of the population with access to an adequate amount of safe drinking water located within a convenient distance from the users dwelling.

Sources of water believed to be relatively free of disease are from improved sources. WHO/UNICEF have developed the following indicators for defining improved and non-improved water sources (WHO/UNICEF, 2004):

- Improved drinking water sources
  - Household connection
  - Public standpipe
  - Borehole
  - Protected dug well
  - Protected spring
  - Rainwater collection

- Non-improved drinking water sources
  - Unprotected well
  - Unprotected spring
  - Rivers or ponds
  - Street vendor-provided water
  - Bottled water (bottled water is not considered improved due to limitations in the potential quantity, not quality, of the water)

Key findings:

The main source of drinking water in the project area was from unprotected spring water, a **non improved water source, where it was used by 76.5% of all households.** 22.5% of households get water from improved water sources (borehole, rainwater or improved spring) as described in Table 42. This was lower than compared to the findings of the MICS survey, where at a national level 45.7% improved drinking water sources (UNICEF, 2001).

While 20.2% get their drinking water from improved spring water source, there is a strong local variation. There were no improved spring water sources reported in Gatanga and Kokiza, which is of relevance as the potential host sites. In contrast, 42.9% of households get drinking water from improved springs in Gorumbwa. None of the households in Kokiza obtained drinking water from an improved source.

A minority reported that they use 'tube wells / boreholes' or 'rain water' as their primary drinking water source (1.6% and 0.7%, respectively).10.3% reporting using a borehole in Karagba.

There were interesting differences noted in Durba, where 24.1% of respondents collected water from a river water hole in Durba Centre with 3.3% in Durba Toyota. Durba Centre residents did not have a reliable improved spring (3.4%) while 26.7% Durba Toyota residents utilised such facilities.

Table 42: Sources of drinking water at household level (%)

Sentinel site	Improved spring water source	Tube-well / borehole	Rain water	Spring water	Water hole in river/dam	No. of HH
Salambongo	28.6	3.6	0.0	71.4	3.6	**28**
Gatanga	0.0	0.0	3.4	93.1	3.4	**29**
Kokiza	0.0	0.0	0.0	100.0	0.0	**22**
Gorumbwa	42.9	0.0	0.0	57.1	0.0	**28**
Karagba	31.0	10.3	0.0	65.5	0.0	**29**
Camp Chauffeur	32.1	0.0	0.0	67.6	0.0	**28**
Renzi	19.4	0.0	0.0	80.6	0.0	**31**
Durba Centre	3.4	3.4	3.4	75.9	24.1	**29**
Durba Toyota	26.7	0.0	0.0	70.0	3.3	**30**
Mazo	17.9	0.0	0.0	82.1	0.0	**28**
Mengu	15.0	0.0	0.0	85.0	0.0	**20**
Total	**20.2**	**1.6**	**0.7**	**76.5**	**3.3**	**302**
MICS	*18.1*	*3.5*	*-*	*31.6*	*16.2*	*54,976*

Amongst all respondents (n=302), 55 (18.2%) treat their water in some way to make it safer to drink. 58.2% report to let it stand and settle, 16.4% boil it, 12.7% add bleach / chlorine and 10.9% strain the water through a cloth.

5.5.4.2 Sanitation practices and services

Introduction:

Poor sanitation linked to use of unimproved water sources increases the risk of water-borne diseases and illnesses due to poor hygiene. Studies have shown that the absence of proper toilet facilities and improper disposal of faecal material increases exposure to the risk of diseases like dysentery, diarrhoea and typhoid fever. Members of households with improved sanitation facilities are less likely to contract these communicable diseases.

WHO/UNICEF have developed definitions and a set of indicators for evaluating human excreta disposal. The following definitions and indicators are widely used to monitor the progress towards supporting the provision of sanitation services (WHO/UNICEF, 2004):

- **Improved sanitation facilities**[2]
  - Flush or pour – flush to piped sewer system, or septic tank or pit latrine
  - Ventilated improved pit latrine
  - Pit latrine with slab
  - Composting toilet

- **Non-improved sanitation facilities**
  - Flush or pour – flush to elsewhere
  - Pit latrine without slab or open pit
  - Bucket
  - No facilities or bush or field

Key Findings:

The different types of latrines used by the communities are presented in Table 43. In the surveyed communities 74.8% reported to having a toilet facility / latrine within their compound (ranges from 61.3% in Renzi to 95% in Mengu). Out of those who did not have a latrine within their compound, 93.5% reported sharing a latrine. 6.5% reported that they have no access to a latrine.

Two different types of latrines were found in the project region: Open and closed pit latrines. The different types of latrines used by the communities are presented in Table 43. Closed pit latrines were more predominant (59.5%) compared to open pit latrines

[2] Only facilities which are not shared or are not public are considered improved.

(40.5%). These were considered improved facilities and thus **59.5% of households use improved sanitation facilities.** The more rural settings again have limited services in comparison to the peri-urban ones with Kokiza, Mazo, Gatanga and Mengu all reporting less than 40% closed latrines in their community. When sharing was considered in those with improved facilities it was determined that the overall coverage of improved sanitation facilities was 42.4%.

Table 43: Types of sanitation facilities (%)

Sentinel site	Open pit latrine	Closed pit latrine	No. of respondents
Salambongo	28.6	71.4	**28**
Gatanga	62.1	37.9	**29**
Kokiza	85.7	14.3	**22**
Gorumbwa	35.7	64.3	**28**
Karagba	22.2	77.8	**29**
Camp Chauffeur	25.9	74.1	**28**
Renzi	26.7	73.3	**31**
Durba Centre	27.6	72.4	**29**
Durba Toyota	10.3	89.7	**30**
Mazo	78.6	21.4	**28**
Mengu	60.0	40.0	**20**
Total	**40.5**	**59.5**	**302**
MICS 2001	*35.2*	*37.5*	*54,976 p.*

Most children (73.1%) use a toilet facility if it is available, with ranges from 63.3% in Renzi to 89.7% in Gatanga.

Personal hygiene is another important factor in sanitation. Possession and use of soap was assessed and found to be similar in all the surveyed communities. 75.5% of respondents do possess soap of some description. The majority uses soap for bathing (89%) and washing clothes (82.9%). 56.1% reported to wash dishes with soap, while only 21.5% wash their hands with soap.

5.5.5 Traditional medicine

A specific questionnaire was used to conduct interviews in the SS where traditional healers (TH) could be identified. However, this was only possible in 3 of the 11 SS. A total of 6 interviews were conducted (5 males, 1 female). Three were from Gatanga, two from Durba Centre and one from Kokiza.

Three were purely herbalists, one purely a soothsayer and two functioned both as herbalists and soothsayers. Four of them had been practicing for more than seven years, one for five years and the other for 2 years. Only three of them had received patients in the 10 days preceding the survey and all in all cases it was for fever in a child under 5 years.

Five of the traditional healers said they had referred patients to health units in the course of their practice and three of them admitted they had referred patients to a health facility in the month preceding the survey.

Four reported they had an association of traditional healers in the locality. This was in line with the ministerial decree No. 250 on the Organization of the Exercise of the Profession of Practitioner of TM as discussed in the rapid HIA.

This underscores that TM is not widely practiced in the area despite the clear underlying tone that witchcraft or magic can play a part in many disease processes, such as HIV as described above. This is supported by the fact that only 0.2% of the surveyed community in the KIS study axis attended TH. This was only reported from Camp Chauffeur.

5.5.5.1 Conditions treated and types of treatment used

80% of the symptoms that traditional healers reported as being able to treat were recognized medical conditions such as fever, diabetes, coma, paralysis, respiratory infections, cancer, bone fractures, convulsions, haemorrhoids and diarrhoeal diseases. The remaining 20% consisted of various psychiatric conditions, demonic influences, curses or bad luck.

Of the 57 products cited as treatment for the various health conditions reported (either alone or in various combinations), 39 (70%) were plant products (leaves, roots, flowers,

seeds, fruits, barks, herb powder, herb tea and extracts) while 18 (30%) were other methods (scarifications, incantations, salt, sugar, leopard "grease" and even dust).

5.5.5.2 Factors associated with referral of patients to health units

Traditional healers were asked the question whether they had ever referred patients to a health facility. The most important variables associated with referral of patients to health facilities was the type of community (represented by the SS), the number of children under 5 years, and the presence of an association of traditional healers. It was found that only the SS variable was statistically significant ($p = 0.032$).

5.5.5.3 Qualitative component of the survey among traditional healers

The questionnaire also had open-ended questions that sought to inform:

- The kinds of conditions that traditional healers have ever referred to health facilities.
- The kinds of conditions for which they would never refer patients to health facilities.
- Suggestions on how the health system could be improved at a local level and how traditional healers could contribute to this improvement.

Most conditions or symptoms for which traditional healers referred patients to health facilities were recognized medical and surgical conditions such as diarrhoea, meningitis, high fever, hernia, and various kinds of pain. Of the 13 responses on whether TH would refer patients to a health unit, 7 were classified under recognized medical and surgical conditions, while 6 fell into the class of sorcery or witchcraft.

Suggestions on how the health of the community could be improved, included responses in 28% who cited infrastructure support (construction of health facilities, schools and roads), while 24% suggested collaboration with modern medicine. 18 of the 25 suggestions required action to originate from the health workers or authorities, while only 5 of the responses required action from the TH themselves. Only two of these suggestions were seen as a mutual responsibility. These are described in Table 44.

Table 44: How to improve community health according to traditional healers

Theme	No. of responses
Infrastructure	**7**
Collaboration	**6**
Training of traditional healers	**3**
Better care for patients	**3**
Sale of medicinal plant preparations	**1**
Creation of an association of traditional healers	**1**
Improve status of traditional healers	**2**
Carry out research	**1**
Improve drinking water quality	**1**

In conclusion, TH generally recognized the need for a better collaboration with modern health care professionals and consistent with this was the fact that most of them had referred patients to health facilities in the course of their practice. By soliciting better collaboration local health authorities and the desire to see health facilities constructed and medicines supplied to their health facilities, TH portrayed a positive attitude towards modern medicine. Their willingness to be trained and for research to be carried out on medicinal plants further illustrates this positive attitude. Unfortunately, most of them considered their role in the improvement of health care delivery in the community as rather passive.

Hence, TM clearly plays an important part in the area and traditional healers should be considered as key partners in health in the community. However, the practice needs to be better regulated in order to protect the people who make use of their services. Health education on health seeking behaviours should also be promoted.

5.5.6 Maternal and child health

The health and well-being of women, newborns and children are closely inter-linked and should be managed in a unified and integrated manner. Maternal and child health is regarded as a crucial indicator to measure the health status and development of a population. Thus indicators that support essential health and reproductive services for women from adolescence, through pregnancy, delivery and beyond; as well as proper health services for newborns to ensure their survival through childhood, young adulthood and beyond are important to analyze.

Access to antenatal care and delivery care are used as indicators for maternal health. Breastfeeding practices and childhood vaccination are used as indicators for child health.

5.5.6.1 Access to antenatal care

91.1% of mothers reported that they attended some form of antenatal care (ANC) during their last pregnancy. This is above the rate of 74.8% which was found in the DHS for the Orientale Province (CNSEE, 2008). Attendance was reported 100% in Gorumbwa and Durba Centre. Durba Toyota and Karagba also had high attendance rates (97.3% and 97.1%, respectively). Renzi was the lowest at 71%. These findings correlate to the accessibility of health care services from the different SS.

Table 45: Access to antenatal care

Sentinel site	Attended ANC	Did not attend ANC	Number of mothers
Salambongo	89.5	10.5	38
Gatanga	84.8	15.2	46
Kokiza	85.7	14.3	21
Gorumbwa	100.0	0.0	42
Karagba	97.1	2.9	34
Camp Chauffeur	94.4	5.6	36
Renzi	71.0	29.0	31
Durba Centre	100.0	0.0	36
Durba Toyota	97.3	2.7	37
Mazo	83.9	16.1	31
Mengu	93.1	6.9	29
Total	**91.1**	**8.9**	**381**
DHS DRC 2007	*85.3*	*14.7*	*5,473*
MICS 2001	*72.6*	*27.4*	*2,666*

5.5.6.2 Place of delivery and assistance

A key element of maternal and child health services is the provision of safe delivery care. The proportion of deliveries in a health care setting, as well as the supervision of the delivery by a trained health provider, are both important determinants to good maternal and foetal outcomes.

Table 46: Place of delivery

Sentinel site	Health facility	At home	Outside the household	No. of births
Salambongo	81.8	18.2	0.0	**11**
Gatanga	80.0	20.0	0.0	**15**
Kokiza	66.7	33.3	0.0	**6**
Gorumbwa	100.0	0.0	0.0	**12**
Karagba	100.0	0.0	0.0	**10**
Camp Chauffeur	91.7	8.3	0.0	**12**
Renzi	50.0	50.0	0.0	**10**
Durba Centre	92.3	7.7	0.0	**13**
Durba Toyota	91.7	0.0	8.3	**12**
Mazo	87.5	12.5	0.0	**8**
Mengu	60.0	30.0	10.0	**10**
Total	**83.2**	**15.1**	**1.7**	**119**
DHS DRC	*70.1*	*27.8*	-	*8,999*
DHS Orientale Province	*65.9*	*31.3*	-	*1,019*

83.2% of women across all SS reported that they delivered their last child in a health facility, which was significantly lower than the reported ANC attendance. It is however above the national and regional average found in the DHS 2007 (70.1% and 65.9%, respectively) (CNSEE, 2008). In Gorumbwa and Karagba the high reported ANC attendance was mirrored by the delivery care. The rural villages Kokiza, Renzi and Mengu had the highest proportion of women that delivered at home which was likely to be associated with access to health care facilities.

In addition to the place of delivery, the type of assistance during delivery is an important determinant influencing the birth outcome and the health of the mother and infant. A skilled birth attendant can reduce the likelihood of complications during and after delivery. This was important in this setting with the limited health care services.

Table 47 shows the distribution, per SS, of births that were attended by a skilled health provider compared to other providers.

Table 47: Delivery assistance

Sentinel site	Skilled health personnel				Traditional Birth Attendant	Family member/ Relative/ other	Nobody	No. of births
	Doctor	Nurse	Midwife	Total				
Salambongo	30.0	70.0	0.0	**100.0**	0.0	0.0	0.0	**11**
Gatanga	0.0	80.0	6.7	**86.7**	0.0	13.3	0.0	**15**
Kokiza	16.7	50.0	0.0	**66.7**	0.0	16.7	16.6	**6**
Gorumbwa	16.7	83.3	0.0	**100.0**	0.0	0.0	0.0	**12**
Karagba	10.0	90.0	0.0	**100.0**	0.0	0.0	0.0	**10**
Camp Chauffeur	0.0	100.0	0.0	**100.0**	0.0	0.0	0.0	**12**
Renzi	0.0	81.8	18.2	**100.0**	0.0	0.0	0.0	**11**
Durba Centre	7.7	92.3	0.0	**100.0**	0.0	0.0	0.0	**13**
Durba Toyota	9.1	90.1	0.0	**100.0**	0.0	0.0	0.0	**11**
Mazo	0.0	87.5	12.5	**100.0**	0.0	0.0	0.0	**8**
Mengu	0.0	70.0	0.0	**70.0**	0.0	20.0	10.0	**10**
Total	**7.6**	**83.1**	**3.4**	**94.1**	**0.0**	**4.2**	**1.7**	**119**
DHS DRC 2007	*5.2*	*27.6*	*31.6*	*74.0*	*21.8*	*0.4*	*2.7*	*8,999*
DHS DRC in Orientale Province	*2.8*	*25.7*	*34.7*	*68.4*	*29.1*	*0.0*	*1.0*	*1,019*
MICS 2001in Orientale Province	*0.8*	*18.7*	*39.6*	*59.1*	*19.8*	*13.7*	*6.3*	*317*

The majority of women (94.1%) delivered their last child with the assistance of a skilled health personnel, i.e. doctor, nurse or mid-wife. With the exception of the women in Gatanga, Kokiza and Mengu, all mothers that delivered at a health facility were assisted by skilled health personnel. In Kokiza and Mengu at total of 1.7% of the deliveries took place without any assistance. In other cases, family members/relatives were present at birth. None of the births were assisted by a doctor in Gatanga, Camp Chauffeur, Renzi, Mazo and Mengu.

Due to limited access to health services, lack of skilled health personnel and/or traditional or cultural factors delivery care is often provided by unskilled aids. This can include nurse assistants (matrons), family members, relatives, traditional birth attendants (generally untrained) or others. 4.2% were supported by these potentially untrained personnel and 1.7% delivered without any assistance.

Compared with national and regional averages, the proportion of skilled delivery care provided was higher in the project area. It was surprising that there were no reported traditional birth attendants from the respondents and there is a concern that confusion over the status of the person providing assistance may have introduced a bias.

5.5.6.3 Breast feeding practices

Breast feeding is very important during early childhood. It not only supports the basic nutritional needs of the child but it also boosts their immunity through transfer of antibodies from mother to child. It also encourages maternal bonding and provides a natural form of contraception which promotes child spacing. The WHO recommends that breastfeeding should be provided exclusively for the first six months of life and then supported by supplemental food up until the during at a minimum of 2 years of age (WHO, 2002).

86.7% of the mothers (n = 104) reported that they breastfed their youngest child, compared to the national average of 95.3%). **Only 7.7%** reported to have exclusively breastfed for at least 6 months, which is a very low rate. 11.5% breastfed between 4-6 months and the majority (80.8%) reported to have breastfed the last child for less than 4 months. These are extremely low rates.

5.5.6.4 Vaccination coverage

81.7% (n = 98) of mothers reported that their youngest child has received some form of vaccination. Values above 80% were reported in all the SS with the exception of Salambongo at only 54.5%.

The specifics of the type of vaccinations were not questioned due to significant recall bias concerns. Instead mothers were questioned on whether they had a vaccination/growth chart for the child. On average 46.9% (n = 46) reported to have a vaccination card, but considerable differences between the SS could be observed. In Renzi none of the mothers reported to possessing a vaccination card, while in Salambongo 83.3% of mothers reported that they did possess these cards. In total 2.0% did not know what the purpose of the card was and the balance acknowledged that they did not have a card.

5.5.7 Social determinants and quality of life

5.5.7.1 Substance abuse

Substance misuse such as alcohol, tobacco and drugs is not only an important health determinant but also closely linked to mental health (Prince *et al.*, 2007). It is further associated to crime, prostitution and domestic violence.

Alcohol

Figure 32 shows the frequency with which the surveyed population (n = 302) consumed alcohol. Out of the total surveyed population, 47.4% reported that they drink regularly. While 7.7% of respondents reported to drink alcohol every day, the majority (33.6%) reported drinking less than once per week.

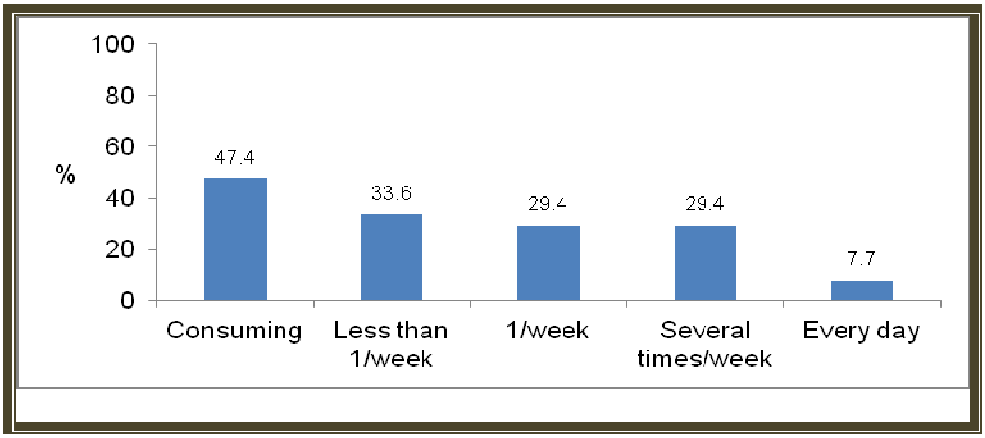

Figure 32: Frequency of alcohol consumption

Alcohol consumption per SS is presented in Table 48.

Table 48: Alcohol consumption by SS

Sentinel site	% that drinks alcohol	No. of respondents
Salambongo	35.7	**28**
Gatanga	62.1	**29**
Kokiza	77.3	**22**
Gorumbwa	42.9	**28**
Karagba	41.4	**29**
Camp Chauffeur	39.3	**28**
Renzi	48.4	**31**
Durba Centre	37.9	**29**
Durba Toyota	43.3	**30**
Mazo	57.1	**28**
Mengu	40.0	**20**
Total	**47.4**	**302**

Cigarettes

Figure 33 shows the frequency of cigarette use. 27.5% of the sampled population reported that they smoked. Amongst the smokers, the majority (36.1%) smokes 1-5 cigarettes per day. However, 60.2% of those that do smoke consume more than 6 cigarettes per day with 6% of the population consuming more than 40 per day.

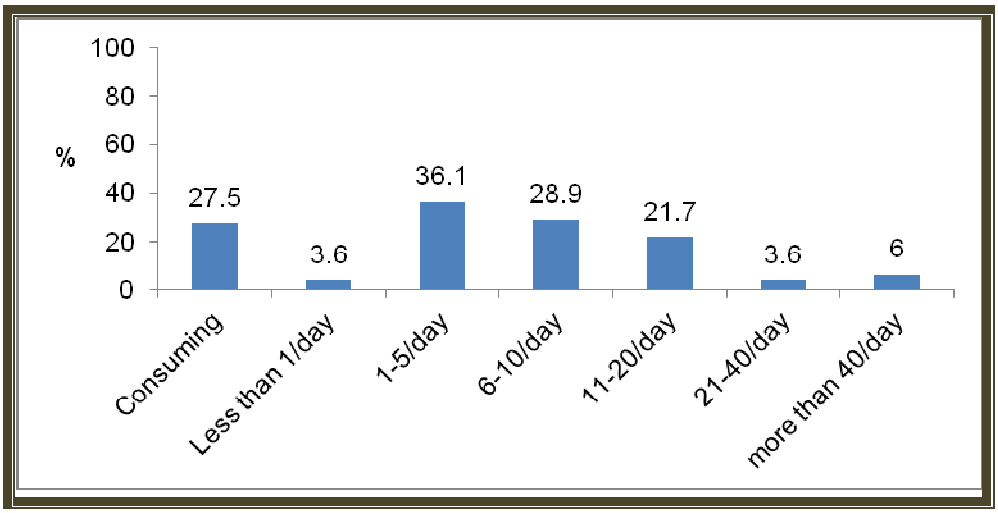

Figure 33: Frequency of cigarette consumption

Cigarette consumption per SS is presented in Table 49.

Table 49: Tobacco consumption by SS

Sentinel site	% that smokes	No. of respondents
Salambongo	32.1	**28**
Gatanga	27.6	**29**
Kokiza	40.9	**22**
Gorumbwa	21.4	**28**
Karagba	31.0	**29**
Camp Chauffeur	21.4	**28**
Renzi	25.8	**31**
Durba Centre	17.2	**29**
Durba Toyota	20.0	**30**
Mazo	35.7	**28**
Mengu	35.0	**20**
Total	**27.5**	**302**

Drugs / prostitution / domestic violence

Social problems that can have health impacts were analysed. These included drug abuse, prostitution and domestic violence as reported in Table 50.

Table 50: Social challenges in communities

Sex	% who consider the following a problem			No. of respondents
	Drug abuse	Prostitution	Domestic violence	
Men	73.3	62.6	40.0	147
Women	71.9	68.4	55.0	152
Total	**72.6**	**65.5**	**47.6**	**299**

Overall, 72.6% of respondents reported that they considered drug abuse as being a problem in their community. 65.5% considered that prostitution was a problem in their community. This is broken down into the separate sentinel sites in Table 51.

Table 51: Community perceptions of prostitution

	Men		Women	
Sentinel site	Prostitution as a problem in their community	No. of respondents	Prostitution as a problem in their community	No. of respondents
Salambongo	61.5	13	71.4	14
Gatanga	57.1	14	78.6	14
Kokiza	25.0	12	10.0	10
Gorumbwa	100.0	12	81.3	16
Karagba	76.9	13	60.0	15
Camp Chauffeur	85.7	14	92.9	14
Renzi	75.0	16	80.0	15
Durba Centre	57.1	14	100.0	15
Durba Toyota	75.0	16	64.3	14
Mazo	15.4	13	26.7	15
Mengu	50.0	10	70.0	10
TOTAL	**62.6**	**147**	**68.4**	**152**

It is important to note that women reported this in a higher proportion than men in most communities. The areas of concern were Gorumbwa, Camp Chauffeur, Durba, and

Karagba as peri-urban settings. In the rural settings Renzi reported a high proportion and Kokiza as the potential host site the lowest.

Table 52: Community perceptions of domestic violence

Sentinel site	Men		Women	
	Consider domestic violence as a problem in their community	No. of respondents	Consider domestic violence as a problem in their community	No. of respondents
Salambongo	58.3	13	61.5	14
Gatanga	53.8	14	78.6	14
Kokiza	8.3	12	10.0	10
Gorumbwa	50.0	12	37.5	16
Karagba	30.8	13	50.0	15
Camp Chauffeur	57.1	14	71.4	14
Renzi	37.5	16	73.3	15
Durba Centre	57.1	14	86.7	15
Durba Toyota	37.5	16	42.9	14
Mazo	30.8	13	28.6	15
Mengu	10.0	10	50.0	10
TOTAL	**40.0**	**147**	**55.0**	**152**

47.6% of all respondents considered domestic violence as a problem in their community. This was more accentuated in women (55%) than in men (40%) as shown in Table 52. The perception of domestic violence as a problem was low in Kokiza (9.1%), Mazo (29.6%) and Mengu (30%), but relatively high in Durba Centre (72.4%) and Gatanga (66.7%). Durba Centre and Gatanga this was also reported as high in the female respondent group at 86.7% and 78.6%, respectively.

Out of 150 women interviewed, 32.7% (n = 49) reported that they have suffered from domestic violence from their partner or husband. 11.3% were given slaps in the face, 12% were beaten and 9.3% were beaten until they bled.

5.5.7.2 Mental health

Among all the respondents (n = 302), 13.3% reported to having a family member who suffers from a mental illness. Only 17.9% of the respondents think that people with mental illnesses are well integrated in the community. This highlights the high levels of stigma associated with these conditions.

5.5.7.3 Perceived level of noise and air pollution

To assess different environmental health determinants at baseline the participants were asked questions related to perceived noise and air pollution in their community. Data is presented in Table 53 and Table 54. These questions had the intention to obtain the current baseline so to allow future comparison.

Noise pollution

The proportion of respondents that reported a perception of noise pollution within their environment is described in Table 53. 52% of all respondents reported that noise pollution occurred in their environment with 86.5% reporting that it was disturbing in nature. The range was from 7.1% in Mazo to 79.3% in Durba Centre.

Table 53: Community perceptions of noise pollution

	Is noise pollution present?			**Perception of noise pollution** (only those that reported noise pollution)		
Sentinel site	Yes	No	Number of respondents	Disturbing	Not disturbing	Number of respondents
Salambongo	57.1	42.9	28	93.7	6.3	16
Gatanga	41.4	58.6	29	75.0	25.0	12
Kokiza	31.8	68.2	22	71.4	28.6	7
Gorumbwa	75.0	25.0	28	90.5	9.5	21
Karagba	62.1	37.9	29	83.3	16.7	18
Camp Chauffeur	64.3	35.7	28	88.9	11.1	18
Renzi	51.6	48.4	31	66.7	33.3	15
Durba Centre	79.3	20.7	29	90.9	9.1	22
Durba Toyota	60.0	40.0	30	94.4	5.6	18
Mazo	7.1	92.9	28	100.0	0.0	2
Mengu	30.0	70.0	20	100.0	0.0	6
Total	**52.0**	**48.0**	**302**	**86.5**	**13.5**	**155**

Air pollution

The proportion of respondents that reported a perception of air pollution within their environment is described in Table 54. 55% of all respondents perceived that air pollution

occurs in their environment, with 89.8% reporting it as disturbing in nature. This ranged from 25% in Mazo to 86.2% Durba Centre.

Table 54: Perception of air pollution

Sentinel site	Is air pollution present?			Perception of air pollution (only those that reported air pollution)		
	Yes	No	Number of respondents	Disturbing	Not disturbing	Number of respondents
Salambongo	57.1	42.9	28	81.3	18.7	16
Gatanga	37.9	62.1	29	72.7	27.3	11
Kokiza	27.3	72.7	22	66.7	33.3	6
Gorumbwa	64.3	35.7	28	94.4	5.6	18
Karagba	58.6	41.4	29	94.1	5.9	17
Camp Chauffeur	75.0	25.0	28	90.5	9.5	21
Renzi	58.1	41.9	31	88.9	11.1	18
Durba Centre	86.2	13.8	29	100.0	0.0	25
Durba Toyota	60.0	40.0	30	100.0	0.0	18
Mazo	25.0	75.0	28	71.4	28.6	7
Mengu	45.0	55.0	20	88.9	11.1	9
Total	**55.0**	**45.0**	**302**	**89.8**	**10.2**	**166**

5.5.7.4 Quality of life

To assess quality of life, respondents were asked questions such as whether they were looking forward to something special, whether they felt sad or depressed, or whether they had troubles sleeping in the week preceding the survey as described in Table 55.

Table 55: Self reported quality of life.

Gender	Frequency of the below criteria on quality of life					Number of respondents
	Never	Once	Several times	All the time	Doesn't know	
Looking forward to something special						
Men	47.3	18.9	28.4	4.7	0.7	148
Women	48.7	20.8	22.7	6.5	1.3	154
Total	**48.0**	**19.9**	**25.5**	**5.6**	**1.0**	**302**
Feeling sad or depressed						
Men	28.4	22.3	40.5	8.1	0.7	148
Women	24.7	29.2	37.0	7.8	0.7	154
Total	**26.5**	**25.8**	**38.7**	**8.0**	**0.7**	**302**
Having trouble sleeping						
Men	45.3	14.2	36.5	4.1	0.0	148
Women	33.1	23.4	36.4	7.1	0.0	154
Total	**39.1**	**18.9**	**36.4**	**5.6**	**0.0**	**302**

The vast majority of respondents reported to never looking forward to a special occasion in the week preceding the survey with only 19.9% reporting at least one event. 25.5% reported that they had several events that they had looked forward to. Women were less inclined than men to perceive this (22.7% compared to 28.5%, respectively).

Fewer men reported ever feeling sad or depressed (71.6%) or having trouble sleeping (54.7%), compared to women with 75.3% and 66.9%, respectively. 38.7% of those surveyed reported feeling sad or depressed several times a week with 8% feeling depressed all the time. 36.4% reported having trouble sleeping several times a week and 5.6% reported to having trouble sleeping all the time.

5.5.8 Educational level

Education is a key determinant of the lifestyle and status that an individual enjoys in society. Education is important as it helps individuals to make informed decisions that impact their health and wellbeing. Studies have consistently shown that educational attainment has a strong effect on health behaviours and attitudes. Education in women is a key determinant to child health as they are the gatekeepers for health in the family unit (Armar-Klemesu *et al.*, 2000).

Table 56 describes the ratio of school enrolment across the SS. 3.6% of the population do not have any formal education. This rate was especially high in Mengu, where one quarter of respondents had never attended school. Smaller proportions were found in Gatanga (6.9%), Karagba (6.9%), Mazo (3.6%) and Durba Centre (3.5%). In the other SS the respondents reported that they have attended some formal education in their life.

Across all the SS it was reported that 16.2% completed primary school education. This was lowest in Renzi and Mengu (below 10%) and highest in Kokiza (31.8%). The overall proportion that finished secondary school was markedly lower at only 2.0%. Only 1 person (0.3%) reported to have a university degree/diploma.

Table 56: Educational attainment of the adult household population

Sentinel site	No education	Attended primary school	Finished primary school	Attended secondary school	Finished secondary school	University	No. of people
Salambongo	0.0	35.7	21.4	39.3	3.6	0.0	**28**
Gatanga	6.9	55.2	10.3	27.6	0.0	0.0	**29**
Kokiza	0.0	54.6	31.8	13.6	0.0	0.0	**22**
Gorumbwa	0.0	28.6	21.4	50.0	0.0	0.0	**28**
Karagba	6.9	24.1	27.6	41.4	0.0	0.0	**29**
Camp Chauffeur	0.0	42.9	10.7	42.8	3.6	0.0	**28**
Renzi	0.0	48.4	6.5	41.9	3.2	0.0	**31**
Durba Centre	3.5	31.0	17.2	48.3	0.0	0.0	**29**
Durba Toyota	0.0	30.0	16.7	46.7	6.7	0.0	**30**
Mazo	3.6	46.4	10.7	32.1	3.6	3.6	**28**
Mengu	25.0	50.0	5.0	20.0	0.0	0.0	**20**
Total	**3.6**	**40.1**	**16.2**	**37.8**	**2.0**	**0.3**	**302**
MICS DRC 2000		*51.4*					

In spite of the poor educational attainment in the area it was important to analyse gender equality in terms of school attainment as shown in Figure 34. A significant gender difference was found between the female and the male population (p-value <0.001). 7.1% of women reported that they received no education, while this was not reported in men. In the girls that did receive education there was little difference until secondary school, where gender disparities at the secondary and graduate level were significant with ratios of women: men at 1:1.6 and 1:5.7, respectively. Not only do fewer girls attend secondary school, but a higher percentage does also not finish this level.

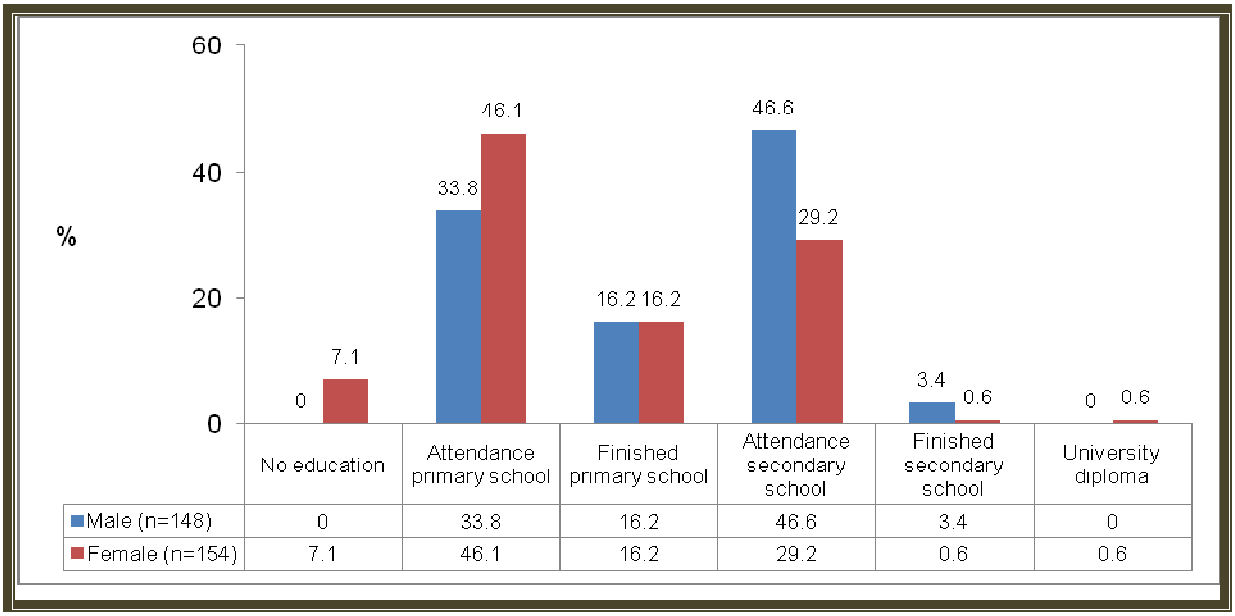

Figure 34: Educational level and gender disparities.

5.6 Findings of Heavy Metal Survey

5.6.1 Mercury

Mercury is a naturally occurring metal that mainly occurs in cinnabar ore. It occurs or is converted in three main forms each with a different toxicological profile:

- Elemental Mercury: This is the form called quicksilver due to its fluid form at room temperature and also includes any other compounds that can change to mercury vapor. Examples of these include: batteries, dental fillings, calibration instruments, electrical apparatus, thermometers, paints and use in photography.
- Inorganic mercury salts: mercurous mercury is usually combined to form salts that dissociate slowly in water. Examples of these include disinfectants, paints and dyes, explosives, tattooing material, perfumes. In the occupational setting it includes chemical laboratory workers and tannery workers.
- Organic mercury: These are divided into long chain or short chain alkyl compounds which in the latter include methyl and ethyl mercury. Examples of these can include paper manufacturing, insecticides, bactericides, fungicides and germicides

The pattern and severity of mercury exposure and the resultant toxicity is dependent on the form of mercury and the route of exposure due to the differing forms and their related toxicology. In general chronic exposure to any form will lead to toxicity.

The largest exposure to mercury as a result of human activities is mainly as a result of mining and ore smelting and degradation of mercury containing products. It is also released as a result of burning fossil fuels.

The general population is exposed to mercury mainly from food such as fish. This occurs through activities mentioned above and also through normal environmental processes from the earth's crust with mercury deposited in the environment and the majority of this ultimately finding its way to the oceans. Significant amounts of mercury then lead to bioaccumulation in fish that are then consumed by humans [Sullivan J, Krieger G. (2001)].

While the proposed mining activity will not involve the use of mercury in the extraction process there is likely to be enough naturally occurring mercury in the atmosphere and soil to warrant determination of baseline levels of mercury exposure in the community.

This was considered especially important as none of these results were available prior to the BHS. If there is an assay lab on site that uses mercury this exposure if any will be limited to the workers in this area and not the general community so this risk cannot be considered significant.

Probably the most important consideration is the fact that there are several large scale artisanal and small scale mining operations in the area. These artisanal miners or "orpailleurs" use mercury in the extraction process and could potentially be exposed to high levels of vapor during the final extraction process. This vapor if used in a large scale could then be precipitated with rainfall and contaminate soil and farming grounds and even water bodies. Mercury is also used in the field after the washing process and there is a real risk that local water ways can also be polluted with mercury. While it was reported from only a small number of water samples that mercury did not occur in the surface or ground water these were not available in the sample areas prior to the BHS. Neither were any sediment samples which would indicate past mercury exposure of pollution.

When one considers urinary mercury levels is it very important to evaluate health effects on target organs which may guide appropriate organ assessment tests for assessing toxicity. Table 57 below shows some of these effects [Robert P, Terry C. (1997)].

Table 57: Urinary mercury levels and toxic effects

Target organ toxic effects of mercury	
Urinary mercury level	**Effect**
0-510ug/L	Short term memory loss
5-1000ug/L	Increased tremor frequency and reaction time Impaired hand eye co-ordination
20-450ug/L	Increased motor and sensory nerve latency
>56ug/L	Disturbance in verbal intelligence and memory
300-1400ug/L	Nephrotic syndrome, hypercholesterolemia

5.6.1.1 Reporting

Urine samples were collected from children above 5 and adults to examine for mercury exposure to determine a baseline exposure in the community. While this has been found to be a reliable test for the identification of elevated mercury levels it is more appropriate for the assessment of elemental or inorganic mercury exposure. Organic mercury is only minimally excreted by the urine and since hair sampling was not possible this form will be difficult to evaluate. It was also not considered necessary to sample for organic mercury for the survey.

Urine was thus chosen as the biological sample of choice as it is a more appropriate marker for elemental (metallic) and inorganic mercury exposure. The main excretion pathway for both forms of this metal is via urine and feces.

In total 283 samples were collected from 5 different communities based on likelihood of exposure and the methodology described in 2.3.3. Table 58 shows the location of the different sampling points and sample sizes across the communities.

Table 58: Sample sizes of heavy metal samples acrorss communities

Area	No of samples		
	Male	Female	Total
Salambongo	21	23	44
Gatanga	36	43	79
Gorumbwa	30	45	75
Camp Chauffeur	22	33	55
Kokiza	15	15	30
Total	**124**	**159**	**283**

The reference range of below **20µg/L** was used as the normal level in the general population. The biological exposure indices (BEI) are generally used as a reference for samples in groups with more than 6 months occupational exposure or a chronic exposure. This is the time thought to obtain steady state mercury levels. This measurement is thus of less value in the setting of community sampling but is reported for completeness. The BEI reference range is considered as less than **35 µg/g creatinine**.

Overall Data Summary:

Low levels of mercury were found throughout the communities sampled as reported below.

Of the samples taken during the survey the mean mercury value was 7.71µg/L or 6.86µg/gCr and the median was 2 µg/L or 1.7 µg/gCr.

The range of results was from 0-191.7µg/L or 0-327.4 µg/gCr .There were 28 samples above the 20 ug/L reference point in all the groups sampled. When corrected for creatinine, there were only 9 samples above the chronic exposure level of 35 µg/gCr level, of which 3 were from Salambongo and 3 were from Gorumbwa. Of these 9 outliers only 1 was female. The ages of the males ranged from 20 to 44 years of age.

This shows that there is no meaningful exposure to mercury. This coupled with the very narrow overall 95% confidence interval (5.6 µg/L -9.8 µg/L) meant that reporting on any variance across the range would not show any meaningful results.

The distribution of the mercury results is shown in Table 59 and graphically in Figure 35.

Table 59: Distribution of mercury (µg/L) results across groups

Mercury in Urine (µg/L) analysed in sampled groups							
Group	**Community**	**Mean**	**Median**	**Sample Size**	**Standard Deviation**	**95% Confidence Interval**	**Range**
1	Salambongo	12.2	3.2	44	34.2	2.1-22.3	0-191.7
2	Gatanga	2.3	0.0	79	4.6	1.3-3.3	0-29.9
3	Gorumbwa	12.3	3.8	75	18.4	8.1-16.5	0-93.1
4	Chauffeur	7.0	3.2	55	8.1	4.8-9.1	0-32.6
5	Kokiza	5.3	0.4	30	13.1	0.6-10	0-70.2
	Overall	7.7	2.0	283	17.9	5.6-9.8	0-191.7

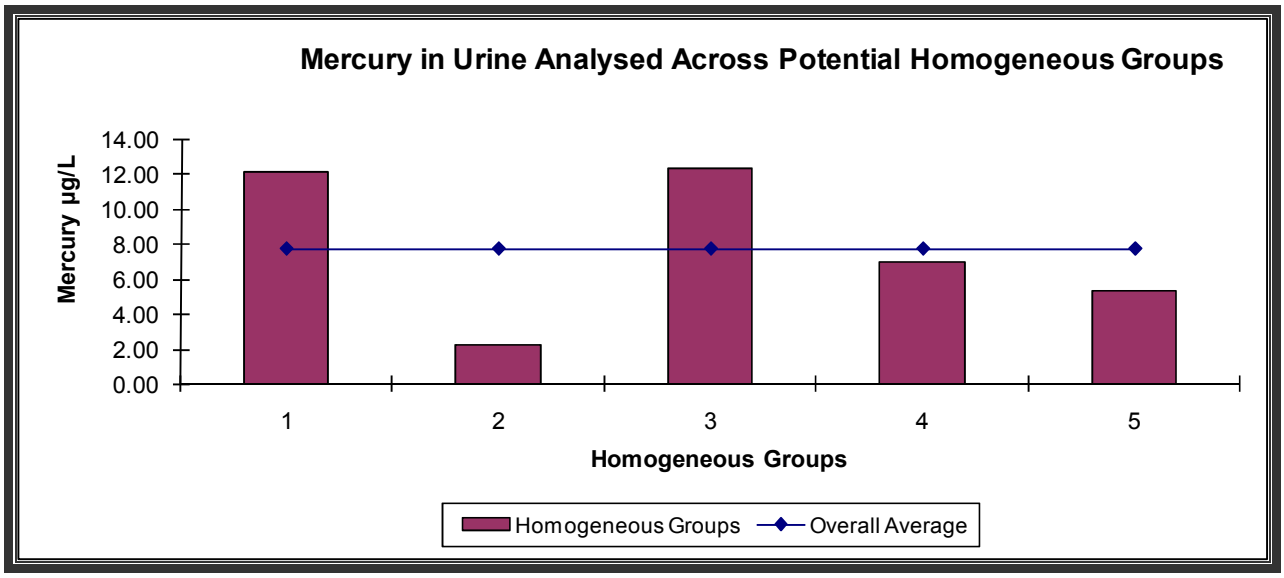

Figure 35: Mean Mercury (µg/L) distribution in groups

Analysis of the outliers indicated that most of them occurred in Salambongo and Gorumbwa, and it is noted that these communities have higher mean mercury levels.

Mercury data corrected for creatinine is analysed in Table 60.

Table 60: Distribution of Mercury (µg/gCr) results across potential homogenous goups

Mercury in Urine (µg/L) analysed in sampled groups							
Group	**Community**	**Mean**	**Median**	**Sample Size**	**Standard Deviation**	**95% Confidence Interval**	**Range**
1	Salambongo	7.6	1.7	44	13.7	3.5-11.6	0-63.8
2	Gatanga	3.1	0.0	79	6.7	1.6-4.6	0-42.3
3	Gorumbwa	11.5	3.8	75	38.5	2.7-20.2	0-327.4
4	Chauffeur	6.7	3.9	55	10.8	3.8-9.6	0-70.8
5	Kokiza	4.6	0.3	30	10.2	0.9-8.2	0-50.5
	Overall	6.9	1.7	283	21.75	4.3-9.4	0-327.4

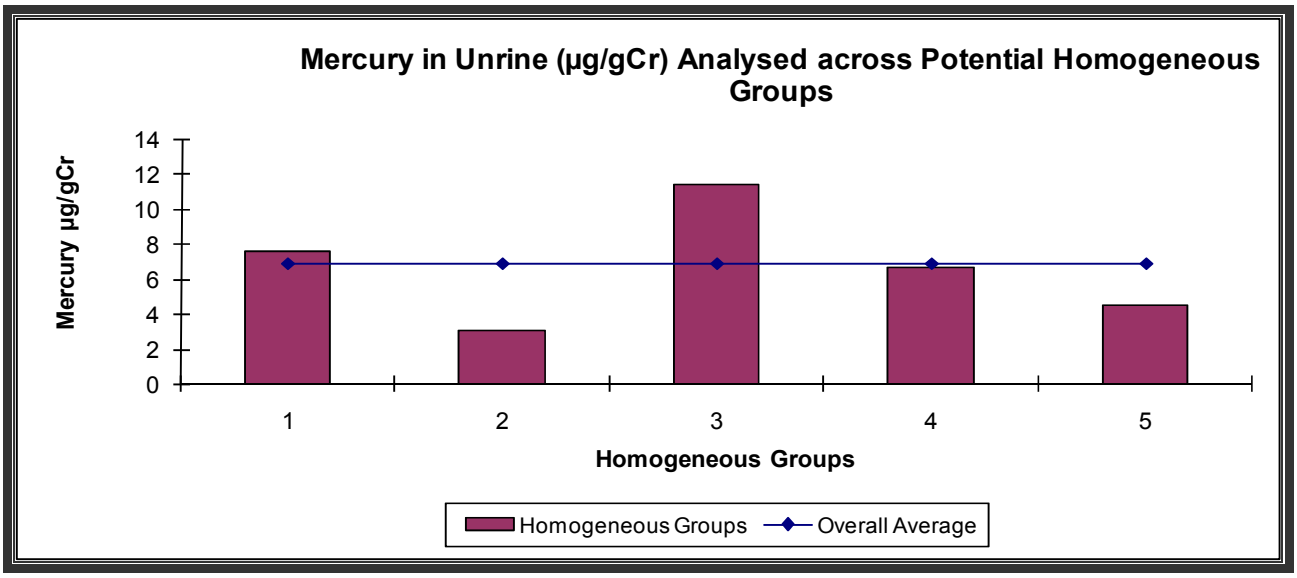

Figure 36: Mean Mercury (µg/gCr) analyzed across potential homogeneous groups

Once again, when corrected for creatinine, the mean mercury in Salambongo and Gorumbwa was slightly higher than in the other communities, and as mentioned before, these communities contained the majority of the samples above the normal reference ranges.

The overall mercury however was not above reference range and thus there is no significant community exposure to mercury

5.6.2 Arsenic

Arsenic is classified as a metalloid as it can exhibit both metallic and non metallic properties. It generally is classified into the inorganic and organic arsenic compounds.
The forms usually encountered in occupational exposure are generally in the form of inorganic compounds. Arsenic encountered in seafood is generally in the form of organic arsenic but may also occur in the inorganic form (10%).

Arsenic occurs naturally in mineralized zones (such as gold deposits) and arsenic enriched surface environments can be created from oxidation and wastes from mining activities. These in turn can affect the health of the community if not managed properly. This includes both atmospheric and water-borne transmission forms. This will be the biggest source of potential arsenic exposure in the community.

Other sources could be the burning of fossil fuels, house and garden pesticides, dyes and paints and glass.

The route of absorption through arsenic exposure is generally through inhalation and ingestion. The major route for elimination is via the kidneys with lesser amounts in the hair and feces. The half life of arsenic compounds in the body is relatively short at 4-5 days so any exposure during the sampling would have been either recent or ongoing.

The most toxic effects of arsenic are due to the inorganic form as the organic form is relatively non toxic. Arsenobetaine, an organic form of arsenic is generally the form of arsenic encountered in seafood.

5.6.2.1 Reporting

A total of 283 samples were analyzed for the presence of arsenic in urine. These samples were taken in conjunction with the collection for the mercury samples in the community members above 5 years of age with the distribution as per Table 58.

The samples were measured for total arsenic in urine with includes both inorganic and organic forms. Urine is considered a useful means to assess exposure. Normal total urinary arsenic values are <50 µg arsenic per liter (ug/L) in the absence of consumption of seafood in the past 48 hours. An average of < 100 ug/L in non exposed humans is still considered acceptable but numerous studies have indicated that above average urinary levels (>100ug/L) are indicators of recent arsenic ingestion. Values in excess of 300ug/L were considered abnormal.

The normal reference range for arsenic corrected to creatinine clearance, for non industrial exposed specimens, is below 30ug/g creatinine.

Overall Data Summary

The mean arsenic level was 18.6µg/L or 17.31µg/gCr and the median was 11.2 µg/L or 9.4 µg/gCr which is well below the reference ranges described above.

The results ranged from 0.4-219.3 µg/L. Mean arsenic concentrations were below the reference ranges in all communities and there were only 5 samples above 100 µg/L and none above 300µg/L. There was also quite a narrow confidence interval (15.7-21.4 µg/L)

across the groups showing that there was not a marked variance in the groups and that the background exposure to arsenic in the community was fairly uniform.

The distribution of results of arsenic (µg/L) testing is shown in Table 61 and Figure 37.

Table 61: Distribution of arsenic (µg/L) results

Arsenic in Urine (µg/L) analysed in sampled groups							
Group	**Community**	**Mean**	**Median**	**Sample Size**	**Standard Deviation**	**95% Confidence Interval**	**Range**
1	Salambongo	29.3	19.5	44	36.3	18.6-40.0	1.6-219.3
2	Gatanga	6.2	4.1	79	8.6	4.4-8.1	0.4-70.5
3	Gorumbwa	17.2	12.6	75	16.7	13.4-21	0.7-119.6
4	Chauffeur	30.4	20.4	55	32.0	21.9-38.9	1.9-190
5	Kokiza	17.0	13.2	30	12.7	12.4-21.5	1.1-46
	Overall	18.6	11.2	283	24.4	15.7-21.4	0.4-219.3

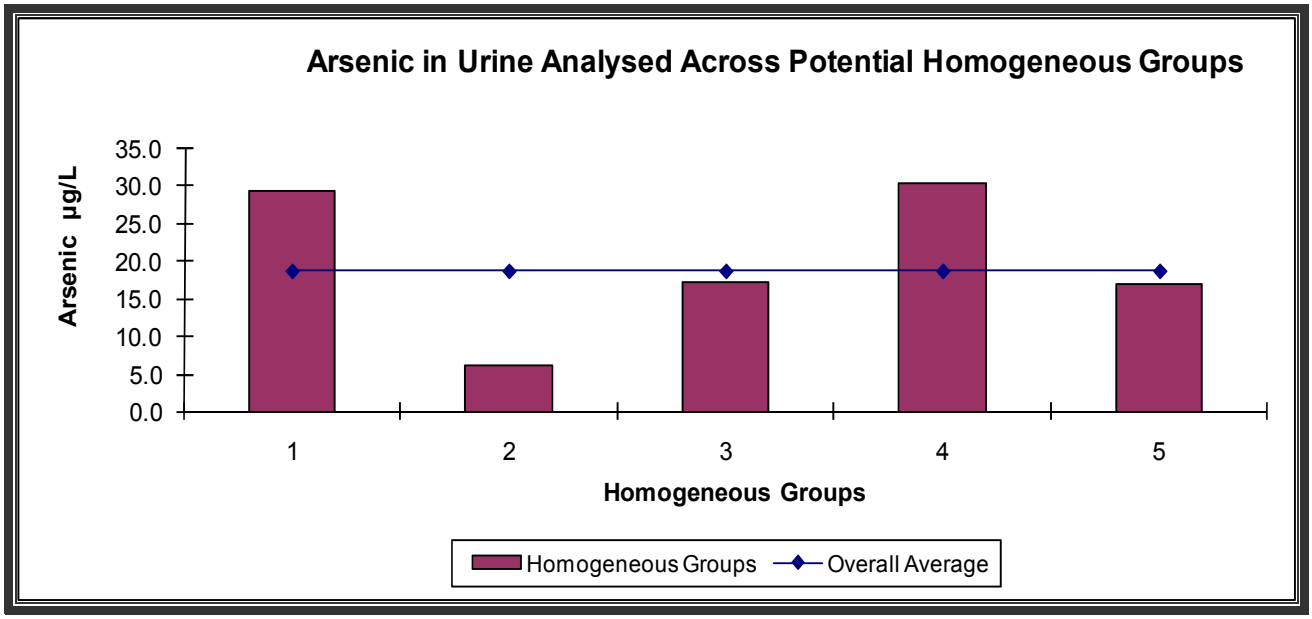

Figure 37: Arsenic (µg/L) distribution in groups

It was unnecessary to further evaluate different groups by age or gender as there were only 5 samples above 100 µg/L and none above 300µg/L.

Arsenic data corrected for creatinine is analysed in Table 62.

Table 62: Arsenic in Urine (µg/gCr) analyzed in potential homogeneous groups

Arsenic in Urine (µg/gCr) analysed in sampled groups							
Group	**Community**	**Mean**	**Median**	**Sample Size**	**Standard Deviation**	**95% Confidence Interval**	**Range**
1	Salambongo	20.0	14.0	44	19.4	14.2-25.7	3.6-107.7
2	Gatanga	6.3	4.1	79	5.3	5.1-7.5	1.2-30.0
3	Gorumbwa	12.4	8.6	75	13.4	9.4-15.5	2.0-88.5
4	Chauffeur	39.9	16.7	55	136.1	4.0-75.9	4.1-1017.7
5	Kokiza	13.0	11.3	30	7.5	10.3-15.7	3.0-36.6
	Overall	17.3	9.4	283	61.7	10.1-24.5	1.2-1017.7

Although the range is very wide, the 95% confidence interval is relatively narrow and the mean is very low, indicating that the high values in the range are as a result of a few outliers.

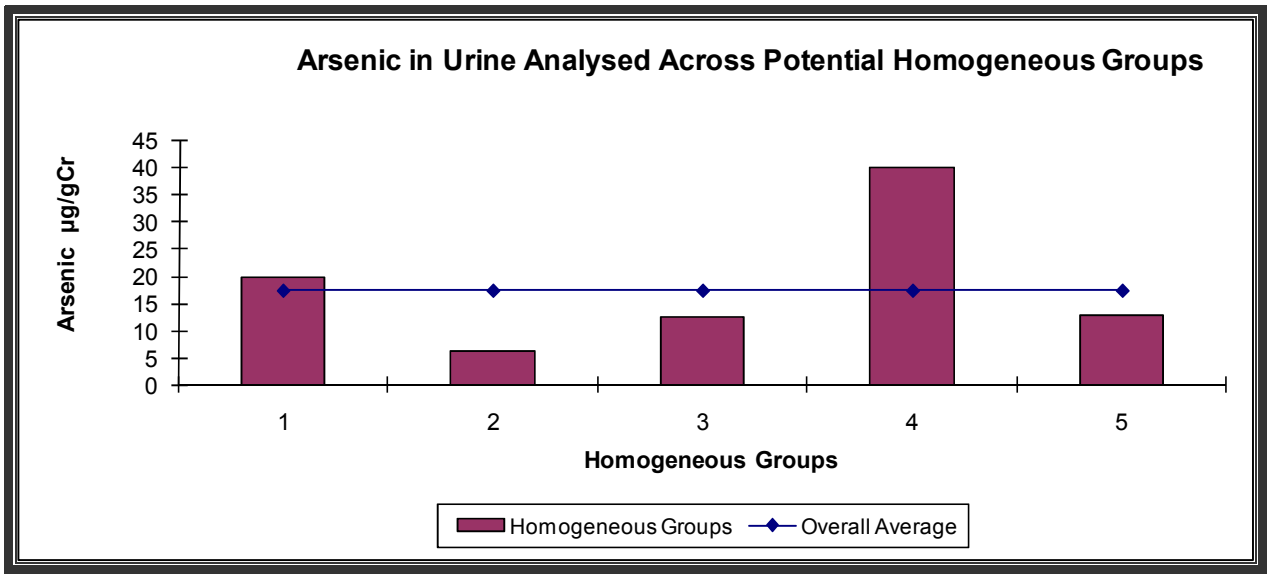

Figure 38: Arsenic in Urine (µg/gCr) analyzed across potential homogenous groups

6 Conclusions

As identified in the rapid HIA the BHS had the objective of producing an accurate and robust health baseline that represents the 2010 health conditions of the community surrounding the project. This reflects the existing health conditions and health status of members of the community, prior to the commencement of industrial scale mining of the area.

The key findings and health impacts which were identified at the rapid HIA (Divall and Winkler, 2008) are now better understood following this exercise and there is adequate evidence update the rapid HIA into a comprehensive HIA. Further information is available to assist the Kibali Gold Project to develop a community health management plans. Table 63 outlines the different levels of HIA and defines the requirements for a comprehensive HIA.

Table 63: Levels of Health Impact Assessments

Level of HIA	Characteristics
Desktop/Scoping HIA	• Provides a broad overview of possible health impacts. • Analysis of existing and accessible data. • **No new project specific survey data collection.**
Rapid Appraisal HIA	• Provides more detailed information of possible health impacts. • Analysis of existing data. • Stakeholder and key informant analysis. • **No new project specific survey data collection.**
Comprehensive HIA	• Provides a comprehensive assessment of potential health impacts. • Robust definition of impacts. • **New project specific survey data collection.** • Participatory approaches involving stakeholders and key informants.

The BHS has also provided indicators that can serve as tools for monitoring and evaluation in the short to medium term. These indicators can be used to monitor both impact mitigation and voluntary contributions to social investment. The methodology has been designed so that selected indicators can be measured at all or at selected sentinel sites and indicators can be added or removed as the surveillance process matures and the health conditions evolve in the area.

The findings of the BHS can also support the identification and classification of health risks that can assist in the planning for workplace health strategies. By using the information in the BHS an overarching strategic health plan can be developed for the project. By utilising the information from the BHS and the HIA information and assessments the Safety, Health and Communities Department integrate activities and share common metrics and resources to measure the effectiveness of health programs. The HIV/AIDS, malaria programs and medical surveillance programs are prime examples of this integration.

As an extension on the rapid HIA the key findings of the BHS and the updated project and community risk factors are presented in the executive summary in Table 1.

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8 Annexes

8.1 Annex 1: Ordre de Mission

REPUBLIQUE DEMOCRATIQUE DU CONGO

MINISTERE DE LA SANTE
PROVINCE ORIENTALE
DISTRICT SANITAIRE DU HAUT UELE
EST

ORDRE DE MISSION N° 721 /047/ BDS/HU-E/WAT/2010

Monsieur: Mirko WINKLER
Matricule:

Grade:

Fonction : PROGRAM MANAGER
Au Service de : NEW FIELDS

Est désigné pour effectuer une mission dans la zone de santé de WATSA

Pays : R.D.C.

Durée de la mission : 14 JOURS

Départ le: 30/07/2010

Mode de transport:

Il est accompagné de :
OBJET DE LA MISSION: ENQUETE SUR L'ETAT ZERO DE LA SANTE DANS LA ZONE DE SANTE DE WATSA: DU 30/07/2010 AU 12/08/2010.
Mentions spéciales: Les autorités Civiles et Militaires sont priées d'apporter leur assistance au porteur du présent en cas de nécessité.

NB: Référence : Autorisation n°345/T.WTSA/063/J038/2010.

Fait à Watsa, le 15 / 07/2010
LE MEDECIN CHEF DE DISTRICT

Dr KULIDRI AMAYO
Médecin Général