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# "Dietary diversity of women of reproductive age and young children in rural Ghana"


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Vera Maria Högl, BSc


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# i. Dedication

To all of the helping and caring people who I crossed paths with in Ghana during this project. Guabuliga and its inhabitants taught me so much more than I could ever put into words. Your positivity both inspires me and fills me with awe.

# ii. Acknowledgement

There are so many important people whom I would like to thank, without them I would not even have dared to set off on my first steps in my academic career.
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Secondly, thanks go to my incredible team of powerful women, Nastasja, Rosa and Magdalena - having such strong individuals behind me gave me the courage to fulfill the task for this thesis.
Significant importance for this thesis certainly is also born to *Braveaurora*. Julia, Sarah, Christin, Abdul and many more who leave me stunned with their fantastic help for people in Guabuliga and will forever remain an endless inspiration for my future career.
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The field-work has been made possible through the generous scholarship of *University Vienna.*

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| | |
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| **DSW** | Department of Social Welfare |
| **FAO** | Food and Agriculture Organization |
| **FGI** | Food-group indicator |
| **IYCF** | Infant and young child feeding |
| **MMD** | Minimum Dietary Diversity |
| **MMD-W** | Minimum Dietary Diversity of women of reproductive age |
| **MAD-YC** | Minimum Acceptable Diet of young children |
| **NGO** | Non-governmental organization |
| **SSA** | Sub-Saharan Africa |
| **UN** | United Nations |
| **UNICEF** | United Nations International Children's Emergency Fund |
| **WHO** | World Health Organization |
| **WEAI** | Women's Empowerment in Agriculture Index |

# 1. Abstract

**Introduction**

Micronutrient malnutrition remains a difficult issue, especially in developing countries, mainly due to monotonous cereal-based diets. Information regarding the dietary status in Northern Ghana of women, infants and young children need to be understood to know if, and which course of interventions are needed. As Guabuliga, the research target, is an extremely remote village with high dependency on their harvest, the inhabitants are at a high risk of low dietary diversity, most notably the vulnerable groups that were examined. In comparison, the dietary diversity is easy to assess and proved itself to be a useful indicator of the probability of adequate micronutrient intake. The present study describes the minimum dietary diversity of women of reproductive age, infants, and young children. Furthermore, it was assessed to see if there are correlations between dietary diversity, wealth and household size.

**Subjects and Methodology**

This research uses a cross-sectional design for assessing the baseline data. Subjects were evaluated during the end of the rainy season in September and October. For assessing the minimum dietary diversity (MDD-W) among women of reproductive age, 75 women in the village between 14 and 49 years old were given a short interview about their food consumption during the last 24 hours, (qualitative 24-hours diet recall) their age, household size, current pregnancy, current child between the age of 6 and 23 months and wealth of the household. If the interviewed person had a child between 6 and 23 months, the same recall has been done for the child to assess the minimum dietary diversity of infants and young children (MDD-IYC). In addition, details were asked about breastfeeding (initiation and continued breastfeeding), the consumption of medicine and finally about meal frequency over the last 24 hours. The study population for the MDD-IYC and collecting details about the infant and young child feeding practices (IYCF) consisted of 24 children. For both MDDs, 21 food groups have been created, from which a food group could have been scored with 1, if a minimum of 10 grams of an item belonging to a particular food group has been consumed, otherwise would be marked as a 2. These 21 groups of foods have been aggregated for each person. This is for a total of 10 for MDD-W and a total of 7 for MDD-IYC. For gaining more information about the diet quality of infants and young children, the minimum acceptable diet (MAD-YC) has been assessed, which include

**Results**

The average age of the 75 interviewed women is 26.16 years with a regular MDD-W score of 3,48+/-0,96, which indicates a very low diversity because the value lies below 5, which is seen as sufficient. Only 10 women have reached the recommended intake of 5 or more food groups. No significant correlations have been observed between the dietary diversity and wealth, size of the household and amount of people who provide income in the household. Logistic regression analysis revealed that there is a significant positive association between age and dietary diversity (p=0,034). The younger the woman is, the poorer their diversity of foods.

Of the 24 children, all of them received breastmilk in their lives, half of them drank breastmilk within the initial 24 hours after birth, 40% continued to be breastfed up to one year, and none were introduced to solid, semi-solid or soft foods at the age of 6-8 months. 20% met the minimum dietary diversity, 30% received the minimum meal frequency and only 15% achieved the minimum acceptable diet.

The dietary pattern was based on starchy staples, plant foods and low consumption of animal source foods.

**Conclusions**

The dietary diversity of women of reproductive age is below the recommendation and put them at high risk of being underweight and having micronutrient deficiencies. Most especially, young women tended to show poor nutrient diversity, which is fatal for reproductivity. Not enough children receive breastmilk soon enough after birth, or are not breastfed long enough. Additionally, they also get introduced to solid, semi-solid or soft foods too late, don't eat often enough and display a lack of dietary diversity.

**Practical Implications**

Through this study the author contributes to motivate the NGO onsite *Braveaurora* for creating a healthier environment in Guabuliga. Moreover, guidance is offered for possible strategy tools.

# 2. Zusammenfassung


**Einleitung**

In Entwicklungsländern ist Mangelernährung nach wie vor weit verbreitet. Aufgrund von kohlenhydratbetonten und einseitigen Mahlzeiten ergibt sich ein Mangel an diversen Mikronährstoffen. Die Erhebung von Daten über die Ernährungsgewohnheiten von Frauen und Kindern in Guabuliga (Nordghana) ist der erste Schritt, um kritische Zustände aufzuzeigen um gezielte Interventionen und Maßnahmen setzen zu können. Guabuliga ist geographisch ungünstig gelegen, da nur eine schwer befahrbare Sandstraße zur nächsten Stadt mit Einkaufsmöglichkeiten führt. Dies bedeutet für die Bewohner Guabuligas eine hohe Abhängigkeit von den örtlichen Ernteerträgen. Kinder und gebärfähige Frauen sind mit ihrem erhöhten Nährstoffbedarf einem hohen Risiko für Mangelerscheinungen ausgesetzt, bedingt durch unzureichende und einseitige Kost. Die Ernährungsdiversität lässt sich durch qualitative Interviews erheben, dazu wurden zuverlässige Indikatoren durch die *Food and Agriculture Organization* entwickelt. Neben der Nahrungsmitteldiversität bei Frauen und Kindern wird auch erhoben, ob diese mit dem Alter, Einkommen, Vermögen oder der Haushaltsgröße zusammenhängt.

**Vorgehensweise**

Diese Querschnittstudie wurde am Ende der Regenzeit im September und Oktober 2017 durchgeführt und erfasste 75 Frauen zwischen 14 und 49 Jahren. Es wurde die *minimum dietary diversity of women* (MDD-W) erhoben, ein Indikator für die Vielfalt von Lebensmitteln, die innerhalb der letzten 24 Stunden verzehrt wurde. Dabei wurden neben den zugeführten Lebensmitteln das Alter, vorliegende Schwangerschaft, leibliches Kind zwischen 6 und 23 Monaten, sowie das Haushaltsvermögen abgefragt. Bei Müttern von Kindern zwischen 6 und 23 Monaten wurden zusätzliche Indikatoren über Kinderernährung eruiert, diese Informationen konnten in 24 Fällen eingeholt werden.

Für die Ermittlung der Diversität wurden 21 Lebensmittelgruppen gebildet. Bei Konsumation von mindestens 10g eines Lebensmittels der letzten 24 Stunden, wurde die zugehörige Gruppe mit 1 markiert. Wurden keine Speisen einer Lebensmittelgruppe zugeführt, wurde diese mit 2 markiert. Um die MDD für Frauen zu berechnen, wurden die 21 zu 10 Gruppen aggregiert. Für die MDD der Kinder zu 7.

**Ergebnisse**

Das Durchschnittsalter der untersuchten Frauen liegt bei 26.16 Jahren mit einem MDD-W von 3,48+/-0,96. Das deutet auf eine sehr niedrige Nahrungsmitteldiversität hin, da ein Ergebnis < 5 als nicht genügend divers gilt. 10 der untersuchten Frauen erreichten die empfohlene Mindestverzehrsmenge von 5 Lebensmittelgruppen. Es konnten keine signifikanten Zusammenhänge zwischen Vermögen, Haushaltsgrösse, Einkommen und Vielfalt der verzehrten Lebensmittel festgestellt werden. Das Ergebnise der logistischen Regression zeigte jedoch einen deutlichen Zusammenhang zwischen dem Alter und der Nahrungsmitteldiversität (p=0,023). Je jünger die Frauen, desto geringer die Diversität ihrer Ernährung. Weiters wurden Ernährungspraktiken bei 24 Kindern untersucht, wobei alle im Säuglingsalter Brustmilch erhielten, jedoch nur die Hälfte innerhalb der ersten 24 Stunden nach der Geburt, nur 40% wurden bis zum ersten Lebensjahr gestillt und die Gabe von breiiger und fester Beikost erfolgte bei allen mit ca. 8 Monaten. Nur 20% erreichten die MDD, 30% die *minimum meal frequency* und nur 15% der Kinder hatten eine *minimum acceptable diet*. Die Ernährung besteht hauptsächlich aus kohlenhydratreichen Grundnahrungsmitteln wie Mais, selbst angebauten Gemüsesorten, aber kaum tierischen Lebensmitteln.

**Fazit**

Die Nahrungsmitteldiversität für Frauen im gebärfähigen Alter in Guabuliga ist niedriger, als in Empfehlungen angegeben. Daraus ergibt sich ein erhöhtes Risiko für Untergewicht und Nährstoffmängel. Besonders einseitig zeigt sich die Ernährung junger Frauen, was naturgemäß die Chancen auf komplikationslose Schwangerschaften und gesunde Kinder reduziert. Die meisten Kinder erhalten zu spät Brustmilch, werden nicht lange genug gestillt, erhalten zu spät die erste Beikost, diese in zu geringer Menge und zu wenig divers.

**Praktischer Nutzen**

Durch diese Studie motiviert der Autor die NGO in Guabuliga *Braveaurora* ein gesünderes Umfeld für die Bewohner in Guabuliga zu schaffen. Dabei werden Daten vom jetzigen Zustand präsentiert, sowie mögliche Strategien, diesen zu verbessern.

# 3. Introduction and questions

## 3.1. Evaluation of the problem

As the global burden of health difficulties that derive from obesity is increasing in cases worldwide, up until now we have not been capable of eradicating undernutrition and nutrient deficiencies from many parts of the world. Undernutrition refers to people who have a lack of one or more nutrients. It may derive from a poor diet or a lack of an ability to effectively digest and absorb nutrients due to illnesses. [UNICEF, 2012]

Micronutrient deficiencies remain a challenge in many developing countries, especially in remote areas like Guabuliga.

Situated in the region of Northern Ghana, Guabuliga is highly vulnerable to insufficient food security due to a long, intense dry season, a lack of proper streets and infrastructure for the continuous flow of products produced outside of Guabuliga and - the biggest challenge of all - poverty.

After a vivid discussion with the local chief and the manager of the NGO *Braveaurora* it was decided that the nutritional status of women and young children who live in Guabuliga should be evaluated. The focus lies on these groups because initially, women have a higher demand for micronutrients due to pregnancy and lactation, secondly on children, whose higher nutrient demand is derived from the need for optimum growth. It is suspected that the diet onsite bears a low diversity and lacks nutrient dense foods. This is especially true in women of reproductive age, who have the tendency to consume less calories than adult males, and are in need of nutrient-dense meals. [Torheim, Arimond, 2013] The same applies to children, who mostly eat even smaller amount of foods, but which also needs to be dense in nutrients for creating the conditions for healthy growth.

To examine the nutrition quality in a defined group without anthropometric measurements and without an expert-team of nutritionists onsite means to evaluate the minimum dietary diversity of women of reproductive age (MDD-W) and the minimum acceptable diet of young children (MAD-YC), including both dietary diversity and meal frequency. The dietary diversity and minimum acceptable diet have proven their correlation with micronutrient intakes throughout several studies and strong interviewing skills with proper documentation and evaluation are needed to execute this research.

MDD-W and MAD-YC are dichotomous factors. They indicate that if certain foods have been consumed, and thus show if a diet is diverse or not. The detailed composition of the factors is stated in full in the chapter *„3.5. Methods“*.

### 3.2. Hypotheses

To identify if micronutrient intake is adequate for women of reproductive age and young children, it was decided to undertake interviews to evaluate the dietary diversity and the minimum acceptable diet. These indicators are based on the intake of certain food groups *(see chapter „3.5. Methods“).* The survey tries to answer following questions:

- Is the variety of food sufficient among women and young children?
- Which food groups are little consumed or not consumed at all?
- Which food is eaten regularly?
- What kind of impact does the size and wealth of the household have on dietary diversity in Guabuliga?
- Does breastfeeding of infants conform with the WHO-Guidelines?
- Do young children have sufficient diversity in their diet?

The necessity of this study lies in the expectation of a low level of dietary diversity, especially among women and young children. The main reasons that constitute this issue include the villages remote location, as no tarred roads lead to it and the next market town is 16.5 km away. The prevailing levels of poverty make it even harder to overcome this distance, when neither a motorbike nor a bicycle can be hired within the village as a means of transport.

Therefore, there is a high dependency on farming, which annually can cause multiple difficulties due to the long duration of the dry season combined with long periods without rainfall.

Furthermore, it will be explored if, and to what extent people consume certain food products of animal origin and whether this is subsequently connected to the wealth of the inhabited households.

# 4. Background

Before getting to the interpretation of the results of the survey, this chapter will first introduce the political, ecological and economic history of Ghana, with a special emphasis of Northern Ghana, which will lead to a better understanding of the set of circumstances that exist in the region nowadays.

## 4.1. Ghana at a glance

The country is located on the West African coast and lies within the Savannah zone. Its neighboring countries include the Ivory Coast, Burkina Faso, Benin and Togo. The area of 238,540 square kilometers makes it the 8th-largest country out of 16 total countries in the region, and to put this in context the total landmass is between that of Austria (83,879 km²) and Germany (357,376 km²).

Accra is the capital city, situated on the coast and contains the seat of government. The population is approximately 1.594 million, which was estimated in 2010 by the United Nations (UN). The overall population in Ghana is approximately 29,164,890 million, based on the latest UN estimates. Therefore, this can be attributed to 0.38% of the global population and has, after Nigeria, the second-largest population in West Africa. Current estimates of the UN state that 46.10% inhabit rural areas. [Worldometer, 2018]

The climate is tropical, and the main seasonal change is from the wet season to the dry season. The rainy season lasts from May through to June. The Northern part of the country is mostly Savannah woodland, where the rainy season usually peaks in August and September.

Trade winds, called “Harmattan”, appear from November through April which come from the Sahara Desert. During these months the air is hot, dry and dusty. The period after Harmattan and the beginning of the rainy season are the hottest months of the year, when daytime temperatures in the north can reach over 43° Celsius. The daytime temperatures during rainy seasons are about 24° degrees Celsius in the northern parts of the country. Ghana’s farmland puts pressure on the already shrinking rain forests. One of the most important cash crops is cocoa, which grows in a diagonal belt across the rain-forests in the Ashanti and Brong-Ahafo regions, as it requires higher and more regular rainfalls and shade from trees. After gold, cocoa is the second-largest export. The indigenous palms are cultivated for their oils mainly close to the coast, and is another important cash crop. This is the same as exported coffee, citrus fruits and pineapples. Important food crops include roots and tubers like cocoyam, Asian yam and cassava – which arrived from South America during the slave trade. Maize was imported from South America and became a crucial staple food. Also, wetland rice is cultivated in areas where water stays after rainfall

and that can easily be flooded. Tropical fruits like bananas and plantain are grown and consumed throughout Ghana as well.

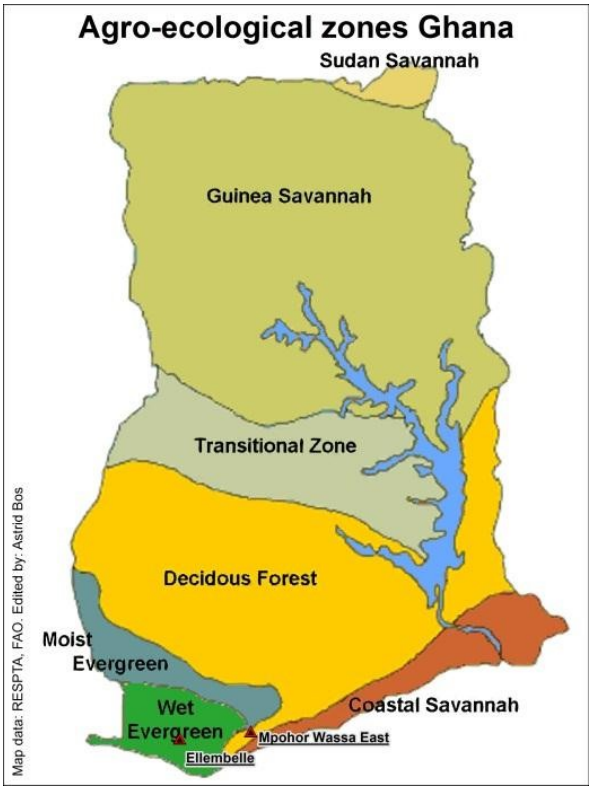


**Illustration 1**: The vegetation of Savanna [Bos, 2012]

Most of Ghana's area is Savannah woodland, where this study was carried out. High grass and semi-deciduous trees like Shea trees (*Vitellaria paradoxa*) are characteristic in this type of region. Agriculture is more unpredictable, as there is always the possibility of drought. Some of the most important animals considered for farming are goats, sheep and chicken.

The topography is dominated by dark-green hills without mountains or highlands that could influence the climate or environment. The Volta River system is the major river system that runs through the area. In 1966 the Akosombo Dam was built in order to create the world's largest artificial lake. It provides a variety of services for the region including transportation, most of the country's electricity and water for irrigation and fishing.

## 4.2. Ethnic groups in Ghana

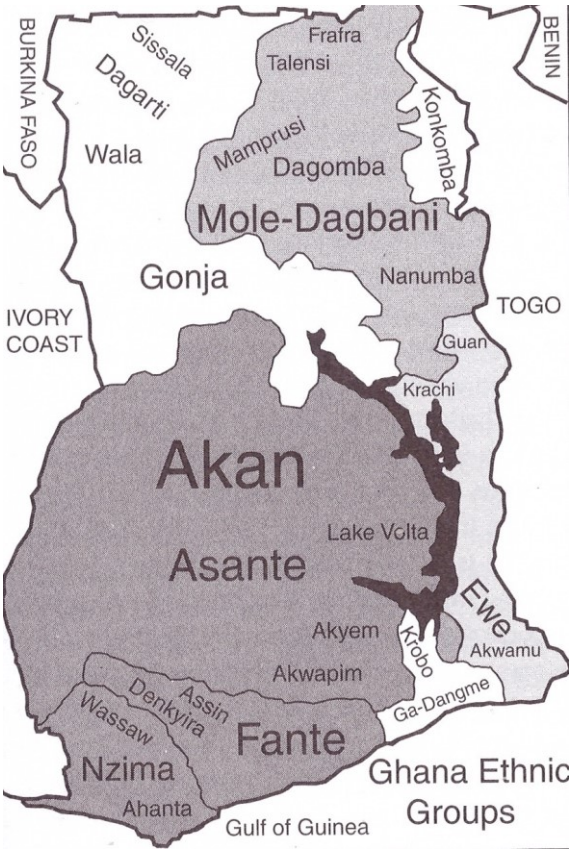


**Illustration 2**: Ethnic groups in Ghana [Gocking, 2005]

Most of the population is represented by the tribe Akans. However, Northern Ghana, where this study was held, is mostly inhabited by the Mole-Dagbani tribe, which can be subdivided into groups like Mamprusi, Nanumba, Frafra, Mossi, Talensi and Dagomba. They comprise 16% of the population and are therefore the second largest ethnic group. In contrast to the Akans, Mole-Dagbani are patrilineal and their main language is Dagbani. The religion in the north is mostly Islam, even though about 63% of the country are Christian. Approximately 21% of the religions in Ghana are traditional and indigenous. [Gocking, 2005]

The study that took place centered on the sub-tribe of Mamprusi. The formation of the tribe began during the 14th and 15th century. Before that time, they were part of the Islamic empire. In the inland regions, however, rulers of Ghana already built up independent nation-states. [Falola, 2004]

People in Guabuliga have a variety of ethnic origins but the majority are Mamprusi with a language of the same name. Originally arriving from what is today known as Togo, the

Mamprusi are part of the tribe Na Gweba, which is named after the king at that time. Polygamy is more common than monogamy, which was also observed in Guabuliga. Besides having a majority of Muslims in the population, Christianity and Traditionalism are present. Traditionalists were witnessed still practicing sacrifices and offerings to communicate with their ancestors. Traditional tales of the Mamprusi say that when Na Gweba was old his favorite son was kidnapped. He sent members of his tribe to search for his son and after night fell, the search was continued with torches, when they then found the son sleeping under a tree. This tree was accused by the king to have hidden his son from him and therefore they threw their torches on it to cast away the evil, which still can be seen nowadays in some communities, as it was also witnessed in Guabuliga at the *Bugum Chugu* („Fire Festival"). This is only celebrated by the Mamprusi and is one of the most important community celebrations of the year. Drummers and dancers in smocks, the traditional festive clothing for men, are an important part of the tradition.
The local chief and elders enjoy a high level of respect throughout their belief systems.

### 4.3. History of Ghana

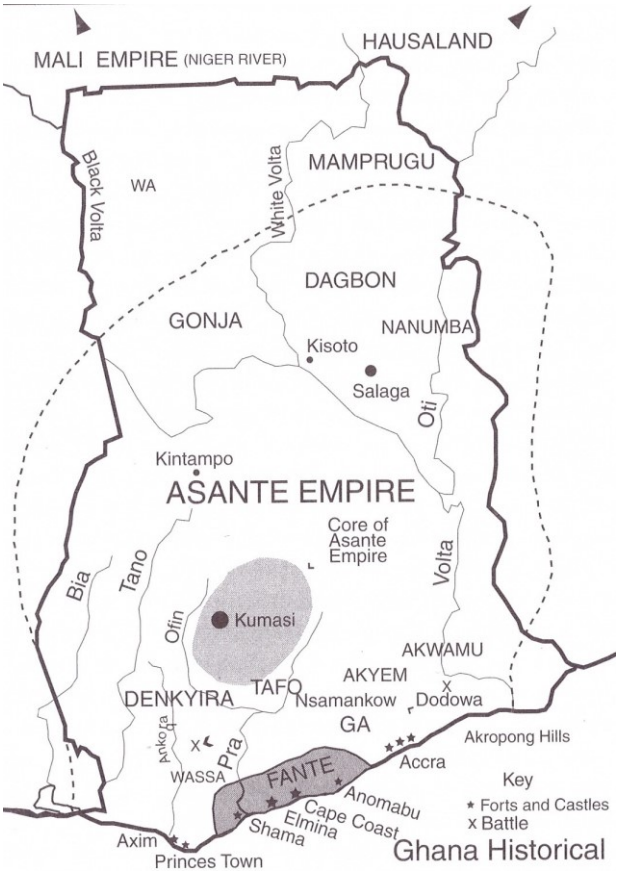


**Illustration 3**: Historical Ghana [Gocking, 2005]

**Precolonial era**

Historians set up many hypotheses of the origins of the present-day Ghanaian people. Some suggest that the Ga came from Benin, others mention Togo and Dahomey. James Anquandah, one of the earliest Ghanaian archaeologists, states that Ghana's history probably reaches back to around 50,000 B.C. Nowadays, the base of the population was built on their ancestors from the Stone Age. [Anquandah, 1982] Archeological records describe that about 10,000 A.D. (*anno domini)* the beginning of making tools, pottery, stocking animals, farming and then subsequently, village community life occurred. Iron technology that was rising between the 2nd and 4th century in the common era had an impact on the development of urbanization and state formation, as well as gold mining, which remained an important export income until today. During this time the first trading links over long-distances were established which gave rise to the first local currencies. This development created two important aspects of Ghana. One concentrated in the middle of Niger and the trans-Saharan caravan routes that linked West Africa with the Roman and Islamic north and north-east Africa. The other one looked towards the maritime coast where contacts with several European nations started.

The Mamprusi, Dagomba and Nanumba states were some of the first established states in Ghana, as in the North the iron industry was pulsating. Historians describe these people as the multi-ethnic Sudanic kingdom, which emerged in the Sahel and Savannah of West Africa during the first millennium after Christ. They exchanged gold and kola nuts for salt, cloth and grain and started taxing their transactions which led to the growth of centralization.

Initially the population in these states weren't Muslims, but they were invaded by people from the North who were at least exposed to Islam before their migration to Ghana. The Sudanic north expanded through trading and so did the influence of Islamic culture. Dagbon produced the most homogeneous Muslim society which led to a common culture and one language. Islamization was basically peaceful.

It was less peaceful when the Akan state of the Asante expanded their power through military forces. Until now Akan traditions are part of the culture in Northern Ghana. They moved along the trade routes where new states and kingdoms were established. During the second half of the 17th century the most powerful Akan states, Asante and Denkyira, emerged. The trade of gold and kola nuts was monopolized so a century later the Asante kingdom had become the dominant one. By the beginning of the 10th century Asante was effectively administered and enjoyed power all over the confederacy. [Gocking, 2005]

**The coming of Europeans**

Europeans mostly affected the coastal area and therefore will not be explained in detail, as it only indirectly affects the history of the study area.

Portuguese arrived the Ghanaian coast in 1471 and constructed castles like São Jorge da Mina (Elmina Castle) for trading until the early 17th century, initially gold from Guinea and later pepper and ivory. In exchange textiles, copper- and brass- and ironware were offered. From the beginning the Portuguese had bought African slaves that were sold in Europe.

The Dutch broke the monopoly in 1637 and dislodged the Portuguese from Elmina Castle. After five years they managed to expel the Portuguese entirely. English, Swedes, Danes, French and Brandenburgers followed and built fortifications along this Gold Coast. After trading products like gold, ivory, skins or pepper, slaves became the main trading activity by the 17th century. The long history with Europeans had effects on the culture, interior and nutrition. A wide range of crops like lemon, sugar cane, orange, banana, coconut, pineapple, yam rice, sweet potato, peanut, maize and cassava were introduced from the Mediterranean countries, Asia and America. The language also changed and English and pidgin English was used as lingua franca along the coast.

Christianity is another result bought about by the Europeans, mainly the Portuguese. During the 19th century the slave trade was abolished and missionary work for Christianity and introducing Western education began throughout West Africa. Trade economy expanded, more Western education was required and Western civilization expanded more and more.

**The road to independence and democracy**

The British expanded their power by overtaking all castles and forts along the coast. English common law, rules of evidence and methods of procedure followed. Chiefs were sometimes included in these events, however quite often excluded until the British authorities set the indirect rule where by chiefs took instructions from the British but maintained power.

The colony served military service during the First and Second World War. Takoradi and Accra got an important air-transportation system for the war effort. A large scale war against the Japanese in Burma led to increased Ghanaian production of vegetable oils, timber, rubber and minerals like tin and bauxite, which needed to be replaced. New industries were set up to save shipping space and to reduce the dependency on Great Britain. This economic stimulation led to inflation and subsequently black markets developed. New arrangements allocated import licenses benefitting large companies and made it impossible for Africa to enter the export or import business.

These difficulties led to the need for reforms. In 1944 a new Legislative Council was announced where the British colony and Ashanti got linked. Two years later the Northern Territories also received a council of chiefs. However, war propaganda made all these happenings obsolete, when they promoted creating a world where people choose their form of government. The UN, who supported this thought was formed at the time. Consequently, colonial powers were attacked and the government finally was ruled by Ghanaians. A strong national consciousness arose and new political parties like United Gold Coast Convention (UGCC) strived for independence. On the 6th of May 1957, Ghana reached independency as the first among the sub-Saharan colonies under the leadership of the first African government leader Kwame Nkrumah.
However, ambitious projects like the Akosombo dam were built which didn't show direct profit. That finally led to debts and a poor economy, which turned people against Nkrumah. Finally, the British military ended the government under Nkrumah, the National Liberation Council (NLC) was established which promoted democracy and multi-elections were legalized. Through the new civilian government in 1969, the economy dropped and led to increased prices. Another political era began1972 with The National Redemption Council, through which corruption again began to seep into the government. The Supreme Military Council was created to get rid of the current government.
The Third Republic, under Jerry John Rawlings who was inspired by socialist ideas, took over through The Provisional National Defense Council in 1981. No political parties were allowed until democracy was restored in Ghana. The economy finally recovered and in 1992 democracy reached its new start. [Gocking, 2005]

**Recent developments**

The country became one of the most stable countries in West Africa. In 1992 new elections took place where Rawlings won again, and for the first time 16 women were voted into Parliament. After one re-election of the National Democratic Congress he was accused of corruption in the late nineties.
The elections of 2000 saw John Kufour chosen as a leader, under whom the National Health Insurance and other reforms took place. In 2008 John Atta Mills was elected as the new leader who launched the oil production programme which started in 2010. After the death of Mills in July 2012, John Mahama became the head of the state and was re-elected in 2012.
In December 2016 Nana Akufo-Addo, a lawyer specializing in human rights, won the election. [BBC Africa News, 2017]

### 4.4. Chieftaincy and Politics in Northern Ghana

British policy focused primarily on the Gold Coast. Until the late 1940s, the main actions of the chiefs were to isolate the northern part from the political happenings in the south. Northern Ghana lagged in development during the colonial era. The British colony wanted to push the regions at a rapid pace by inducing political change artificially. Chiefs and people of the North responded by embracing regional particularities and resisted the domination of more advanced regions. Missions were seen to threaten the traditions and were therefore restricted in Northern Territories. This slowed down the development in the social and educational fields significantly. Only the White Fathers, who were missionaries who acted in Africa, were allowed to secure permission to open a school and a mission station in Navrongo in 1906. In this area education was more advanced than in the surrounding areas.

The British remained and continued to neglect this region. Southern politicians were encouraged to think about the profit of the colony instead of the country as a whole. Only after the Second World War, the Northern representatives participated in the Gold Coast Legislative Council and a rapid social, economic and political change, for which the North was not prepared, rushed throughout the country. The limited levels of education in the region began to bear fruit in the late 1940s. Many educated Northerners served the Native Authorities or became teachers. In 1922 a Government Training College opened in Tamale. Among these educated groups the wish was formed to end the policy of isolation for the sake of the speed of development, particularly within education. With the arrival of W.H. Ingrams in 1947 the change of pace finally arrived. After one year, however, his era ended as politicians in Accra thought his ideas were too progressive for the North.

> *„In those days, either you were near a chief, or a chief's son, or some other relation, those who were lucky to be elected. The chiefs were looking to safeguard their own interests. Those trusted by the chiefs were elected. In 1956, there was some change, but not very much; very few of those elected were not close to the chiefs."*
> (W.A. Amoro, Member of Parliament, 1954-66)

The Northern Territories Council (NCT) was founded by the colonial authorities which consisted of minor chiefs from the district. The first meeting in Tamale in 1946 was more a ceremonial affair and did not contribute to the political development of the region. But later it took the shape of a miniature parliament. For the British the NCT was a training school where future representatives might learn rules procedure and how to debate. Most of the chiefs in the NCT were illiterate and they had their own interpreter, who often had better comprehension and crafted speech. The meetings are described as arduous and much was lost through the translations. But by 1948 progress moved towards a representative system of government. By then the Committee on Constitutional Reform included five

Northerners, which symbolized the end of policy isolation. The chiefs and their educated advisors became the official political leaders of the North and were also recognized by the colonial administrators.

### 4.5. Farming systems

*„For the foreseeable future, dealing with poverty and hunger in much of the world means confronting the problems that small farmers and their families face in their daily struggle for survival.“ [Dixon et al, 2001]*

Farming obviously creates nutritious foods but also indirectly provides effective strategies against poverty and strengthens economic growth. It is the challenge for developing countries to identify the agricultural opportunities and needs.

The region of sub-Sahara Africa is relatively rich in natural resources. However, levels of hunger and poverty are higher than in other developing countries and are rising at an alarming rate. A big factor that lends to this issue is that policy and economic environments are not supportive and do not create the necessary support for agricultural production.

Dixon et al identified 15 farming systems in the sub-Saharan Africa, which are summarized in Table 1.

| Farming system | Land Area (%SSA) | Agric. Population (%SSA) | Principal Livelihoods |
|---|---|---|---|
| Irrigated | 1 | 2 | Rice, cotton, vegetables, rainfed crops, cattle, poultry |
| Tree Crop | 33 | 6 | Cocoa, coffee, oil palm, rubber, yams, maize, off-farm work |
| Forest Based | 11 | 7 | Cassava, maize, beans, cocoyams |
| Rice-Tree Crop | 1 | 2 | Rice, banana, coffee, maize, cassava, legumes, livestock, off-farm work |
| Highland Perennial | 1 | 8 | Banana, plantain, enset, coffee, cassava, sweet potato, beans, cereals, livestock, poultry, off-farm work |
| Highland Temperate Mixed | 2 | 7 | Wheat barley, tef, peas, lentils, broad-beans, rape, potatoes, sheep, goats, livestock, poultry, off-farm work |

| Farming system | Land Area (%SSA) | Agric. Population (%SSA) | Principal Livelihoods |
|---|---|---|---|
| Root Crop | 11 | 11 | Yams, cassava, legumes, off-farm work |
| Cereal-Root Crop Mixed | 13 | 15 | Maize, sorghum, millet, cassava, yams, legumes, cattle |
| Maize Mixed | 10 | 15 | Maize, tobacco, cotton, cattle, goats, poultry, off-farm work |
| Large Commercial and Smallholder | 5 | 4 | Maize, pulses, sunflower, cattle, sheep, goats, remittances |
| Agro-Pastoral Millet/Sorghum | 8 | 8 | Sorghum, pearl millet, pulses. sesame, cattle, sheep, goats, poultry, off-farm work |
| Pastoral | 14 | 7 | Cattle, camels, sheep, goats, remittances |
| Sparse (Arid) | 17 | 1 | Irrigated maize, vegetables, date palms, cattle, off-farm work |
| Coastal Artisanal Fishing | 2 | 3 | Marine fish, coconuts, cashew, banana, yams, fruit, goats, poultry, off-farm work |
| Urban Based | 2 | 3 | Fruit, vegetables, dairy, cattle, goats, poultry, off-farm work |

**Table 1:** Farming systems in the Sub-Saharan Africa [Dixon et al, 2001]

Many farming systems, especially maize, are currently in crisis because seeds, fertilizer and agro-chemicals are short in supply or too expensive. Drought and market volatility are the main sources of vulnerability. [Dixon et al, 2001]

In Guabuliga it was observed that there is a high prevalence of the cereal-root crop mix, which is perfectly adjusted to the local conditions like low altitude, extreme temperatures, low density of population, plentiful cultivatable land and low standard of transportation and infrastructure of communications. The major crop cultivated close to the village is maize. Other major crops grown in and around Guabuliga are soybeans, cowpeas, tomatoes, groundnuts and rice. Also, oil palm is a major crop with potential for expansion.

FAO supports several strategies to increase agricultural production in order to reduce hunger and poverty:

- A sustainable resource management fights against degradation of the land, supports healthy soil and soil fertility and tries to improve the crop yield through higher productivity of resources. The knowledge of farmers about agriculture must be enhanced, as well as a proper information system for documenting and sharing success.
- Improved access to resources by farmers in poverty would create a viable base for small family farms.
- Higher competitiveness among small farms will motivate to exploit opportunities on the market. Improved technology for linking production with niche markets are necessary.
- Less vulnerable farm households through risk management. Insurances and improved crops which are for example resistant against drought are crucial. [Dixon et al, 2001]

### 4.6. Dietary diversity in Northern Ghana

The condition of agriculture in the region directly effects the patterns of the daily diet. Dietary diversity is defined in this study as how many different groups of food were consumed over a certain period of time, which, for the purposes of this study is 24 hours.

A baseline study of the *Feed the Future Initiative* from USAID in 2012 examined the progress regarding nutrition and food security in defined areas of Ghana. 45 administrative districts were covered, which lie above Latitude 8°N in four regions: Northern, Brong Ahafo, Upper East and Upper West. MDD-W has been assessed in 4,322 women, all were of reproductive age, from 15 to 49 years old. The average of the MDD-W for this sample is 4.0 ± 1.6 and 40.5% had 3 or less food groups the previous day. Differences between rural and urban residents were statistically significant, whereas the MDD-W in rural areas was 3.8 ± 1.5 and urban residents reached 4.6 ± 1.5 on average. This means that inhabitants of rural areas are more vulnerable to inadequate micro- and macronutrient intakes than urban women. [Zereyesus et al, 2014] Especially when the village is as remote as Guabuliga.

A further study regarding the dietary diversity of pregnant women and their infants has been assessed in Tamale Teaching Hospital, which is situated in Northern Ghana. Women who were in late pregnancy had a minimum dietary diversity, which was set from minimum 8 or more food groups in seven days, was 85%, with a mean of 9.1+/- 1.4 food groups. There was a significant correlation between the diet and birth weight, as the weight in the higher diversified group was 197.0 g higher. [Saaka, 2012] The dietary diversity in Guabuliga is expected to be lower as it is rural and remote, unlike Tamale, which is the rapidly growing capital of Northern Ghana.

Another interesting study in Northern Ghana examined if foods are channeled to certain members of the household, such as the child of the head of the household or of the first wife in polygynous families. For this purpose, the data of 464 children between the ages of

9 and 36 months who lived in an extended household in rural Northern Ghana was assessed. One significant outcome of this study ascertains that if the mother was monogamous, the child was more likely to be taller than those born from second wives. If the child was from the head of the household, the height is associated with a higher level of household dietary diversity. This study revealed that intra-household inequalities exist, and gender differences have an impact on the child's diversity and statue. These factors should be considered during interventions.

More than half of the household income is spent on food, compared to Austrian private households which currently spend 10.30%, and Germans 10.21% of their household income on food and beverages. [UNdata, 2017] Furthermore, 16 to 17 different social statuses that people belong to, live in one compound together, sharing limited resources with each other. Those children from parents of a higher social status may receive more nutrient-dense foods, such as those derived from animal sources. [Leroy et al, 2008]

Another Ghanaian study assessed the impact of non-farm work on food security among rural households in Northern Ghana. Promoting rural non-farm enterprises is a strategy for poverty reduction by the Ghanaian government. [International Monetary Fund, 2012] Enterprises could be centered on commerce, transport services, firewood gathering or repair services. Also, agro-processing of products like shea nuts, rice, groundnuts and soap manufacturing or trading of food are other such examples. This work is mostly done by women. Extra income can start a cycle for sustaining each other's growth - agricultural and rural off-farm enterprises. And indeed, the study revealed that non-farm work has a statistically significant positive impact on the income of the household, and therefore influences the level of food security. Non-farm work is crucial to ensure food security and to fight poverty in rural, developing areas. Females contribute more often in off-farm work, but males earned higher incomes and therefore contribute more to food security status. [Owusu et al, 2011]

Large progress in moving towards non-farm incomes is already ongoing in Guabuliga through training centers of the NGO *Braveaurora*, where women especially are trained in skills such as weaving, Shea butter and soap processing, or baking that all can lead to an extra source of income for the household. A tough issue is mobilization and motivation of the society, which surely needs improvement. Current movements can be seen on their homepage: *http://www.braveaurora.org* and even more updated content on the blogspot: *http://braveaurora.blogspot.co.at*.

To empower women is a key driver to ensure food security, and is a major aspect of the Millennium Development Goals while having a direct link to infant and young child feeding practices (IYCF).

### 4.7. Infant and Young Child Feeding Practices in Northern Ghana

Women with greater status in society usually have better access to information, health services and control over household services. Therefore, they can provide their children with higher quality care. Interventions that focus on improving the status of women, and reducing gender based inequalities are expected to improve the well-being of both women and children. Women play the main role in childcare and food preparation in many areas, which in Guabuliga is definitely the case. [Smith et al, 2003]

4,410 households in Ghana have been examined in 2015 for the Index of Women's Empowerment in Agriculture (WEAI) and are linked to IYCF practices and nutrition outcomes in the woman and children. In this sample a dietary diversity score of 2.62 was reached, and only 31% reached at least 4 out of 7 food groups. Only 15% achieved the minimum acceptable diet, which concludes that there is not a sufficient level of dietary diversity and meal frequency. Interestingly, the correlation for empowerment measures and IYCF practices are only found in girls, meanwhile there were no significant associations for boys. Girls are 9% more likely to be exclusively breastfed where the mother is more involved in production decisions. This essentially means the female has more input in decisions regarding agricultural activities. However, no significant associations could have been found between WEAI, number of credit decisions, gender parity gap and the practices for exclusive breast-feeding in neither boys nor girls.

An evidence based culture- and context-sensitive policy is crucial for improved nutrition and health. Empowerment of women and the ability to examine the correlation with maternal and child nutrition is a step forward in closing nutritional gaps. [Malapit, Quisumbing, 2015]

*Feed the Future Intervention* also did assessments regarding two aspects of the IYCF practices: Exclusive breastfeeding and minimum acceptable diet. 60.5% of 377 infants were exclusively breastfed in the defined areas (Northern, Brong Ahafo, Upper East and Upper West districts of Ghana), whereas the Northern region showed the highest prevalence of exclusive breastfeeding with 67% overall.

From a total of 946 children only 9.0% aged 6-11 months and 19.0% aged 18-23 months reached the minimum acceptable diet (see Table 10 for criteria). The Northern region had the lowest overall prevalence with 13.9%. Furthermore 49.6% aged 6-23 months met the minimum meal frequency. [Zereyesus et al, 2014]

## 4.8. Life expectancy rates and death rates

Births are not officially registered in Guabuliga. Furthermore, obstetrics is not provided by clinics on-site. As a result, most women deliver their child at home or - if financially possible and if time allows - at the hospital in Walewale, which is located 16.5 km away (see illustration 5). However, due to the poor condition of the roads, traveling there takes about 45 minutes.

Since there is no documentation in Guabuliga, statistical data of Ghana was used to frame life expectancies.

Table 2 shows the mortality rates among children under age 5 and children aged 5-14 [UN IGME, 2017]:

| | **1990** | **2016** |
|---|---|---|
| **Under-five mortality rate (U5MR) with 90% uncertainty interval** (deaths per 1,000 live births) | 127 (120-134) | 59 (45-77) |
| **Number of under-five deaths with 90% uncertainty interval** (thousands)* | 70 (66-74) | 51 (39-66) |
| **Sex-specific under 5 mortality rate** (deaths per 1000 live births) | 135 (m), 119 (f) | 64 (m), 53 (f) |
| **Infant mortality rate** (deaths per 1,000 live births) | 80 | 41 |
| **Number of infant deaths** (thousands)* | 44 | 36 |
| **Neonatal mortality rate** (deaths per 1,000 live births) | 42 | 27 |
| **Number of neonatal deaths** (thousands)* | 24 | 24 |
| **Probability of dying among children aged 5–14** (deaths per 1000 children aged 5) | 29 | 13 |
| **Number of deaths among children aged 5–14** (thousands)* | 12 | 9 |

* Numbers of deaths are rounded to thousands. A zero indicates that the number of deaths is below 500. Unrounded numbers of deaths are available for download on

**Table 2:** Estimates of mortality in Ghana among children under age 5 and children aged 5–14

## 4.9. Food taboos in Ghana

Taboos regarding foods, which could mean avoiding certain food items, serve many different purposes, most of which the roots run deep in human history. Often it is not possible to explain them in a rational manner as some items are strictly taboo in specific societies whereas in others they are consumed normally. According to anthropologists, there may

be over 300 different reasons for certain food restrictions that are considered taboos among certain cultures. Among them are special myths or histories of certain items, such as a dirty perception of an item. They are meant to signify unwritten social rules.
All factions of human society have certain taboos regarding their nutrition, especially in religious communities declaring certain types of food as “common”, which naturally leads to restrictions in the intake of certain nutrients and increases the risk of deficiencies, especially in vulnerable groups like women of reproductive age or children that live in developing areas. When the taboo is part of a religious system it is usually of the belief that it protects against evil, and to consume it would be blasphemous. Another reason may be due to ecological backgrounds, for instance in preventing the loss of resources. As an example, the Inuit of North West America and Nootka Indians hunt whales for food. For a third tribe that lives in this area, whales are a taboo, which makes ecological sense. [Freuchen, 1961] An additional aspect is empathy, which is also a powerful reason that causes certain groups to avoid eating various kinds of meat. For example, in many societies, pets enjoy a higher level of protection than animals without a closer relation. Meyer-Rochow mentions in his work these pets protected from consumption are considered as „honorary humans“. And apart from a few tribes in very remote parts of the world, the consumption of human meat is nearly universally a taboo.
Furthermore, certain rules pertaining to nutritional habits can strengthen the cohesion, create bonding and identification in groups or individuals. [Meyer-Rochow, 2009]
A study among 200 adults in Accra, the capital of Ghana, was conducted to investigate if education or ethnic group has any influence on the belief in food taboos. Whereas education showed a significant correlation, belonging to an ethnic group did not influence the belief significantly.
Most taboos that involve food pertain to a specific animal origin. Many of them are not permanent but temporal for a certain period of life, for instance during pregnancy to ensure safe delivery, which is an oft mentioned period where certain foods are prohibited. These periods often differ from tribe to tribe, and if one taboo is temporal to one tribe, it may be permanent to another.
The most mentioned food associated with taboos at 64% was meat that derives from dogs, and the least mentioned one was green leafy vegetables with only 1%. Other frequent taboos were snails, pigs, cats, bush rats, eggs and yams. The most mentioned reasons are: 94% cultural, 92% religious, 80% health, 50% magical reasons, 33% special events and 10% for sympathy, ethics and compassion.
Nearly all foods which are restricted from certain societies are rich in protein, vitamins and minerals and can therefore influence the nutritional status of individuals. This is especially

true in vulnerable groups like pregnant or lactating women and children. Ironically, these groups abstained more often from some foods than others. [Gadegbeku et al, 2013]
Guabuliga is a village rich in its diversity of various tribes, which makes it a difficult task observing specific taboos. One major taboo are eggs, even though guinea fowls are held by many households. A major reason that was mentioned for this was the belief it would turn one into a bad person, especially children. The term “bad“ was not able to be specified.
Most of the inhabitants in the village are Muslim, which explains the other main taboo: pork. This aligns to religious reasoning, the roots of which lie far back in history. As a utilitarian reason, it can be stated that it competes with humans for water and food, and it also tends to hoard a multitude of sickness-causing parasites. It is said that soldiers who fought in North Africa during the second World War and who ate pork suffered from toxic ulcera. As soon as they stopped eating meat, the ulcera vanished. [Meyer-Rochow, 2009]
Food taboos do exist in Northern Ghana and contribute to nutritional patterns. Further studies on them will be important for understanding and improving the nutritional status of the inhabitants in the region.

# 5. Subjects and methods

After the introduction of basic knowledge and understanding some of the historical aspects of Ghana, this chapter leads into a thorough look at detailed information on the study area and the methods that have been used for the assessment, including descriptions of the relevant indicators.

## 5.1. NGO on-site: *Braveaurora*

The association was founded 2009 in Linz, Upper-Austria by four young social workers. To simplify the communication and administration processes, a year later the NGO *Braveaurora Ghana* was founded in Accra, the capital city of Ghana. Since then, donations started rising, so more projects could be realized and more people in Guabuliga received employment through the NGO. Since 2017, *Braveaurora* employs ten workers and became the second biggest taskmaster.
The NGO regularly welcomes volunteers who are living in the village for about 6 months at a time. Through these volunteers new inputs are regularly introduced and established projects can be kept alive.
The main reason the association started was that the founders experienced firsthand the horrible state of many orphanages during their initial stay in Ghana. After investigating further, it appeared that many orphanages were built up only for lucrative volunteer business.

Volunteers pay an exceeding monthly fee for their work, and are additionally often charged with donations. In many instances neither the fees nor the donation are received by children, but by clever businessmen. Most of the children still have family, but very often poverty or a disability that has been incurred force their parents to put them in an „orphanage“. Initiated by the *Department of Social Welfare* (DSW) in Ghana, orphanages below certain acceptable standards started closing. And it is in this situation where *Braveaurora* offers help and support throughout the whole Northern Region, where most of those institutions were closed. Families are tracked down to give support to be able to care for the child's reintegration in their home, with regular monitoring and detailed assessments.

No assessments about nutrition or feeding practices have ever been made in this village. This study aims to provide the knowledge of typical dietary patterns and the diversity of their diets.

## 5.2. Study area


**Illustration 4:** Location of Guabuliga, (left: Africa, right: Ghana) [Google maps, 2017]

The study was carried out in Guabuliga, located in West Africa (Ghana), a remote village which cannot be reached by typical transport routes, from the only route is via rough sandy roads. The closest important national transit-route leads to Walewale. It is the capital of the West Mamprusi District and the most important market town for Guabuliga, which lies 16.5 km away. This is one of the reasons that highlights the high risk of food insecurity in this district, especially during the harsh dry season, which lasts from November through to April. The rainy season from May to October brings fertility and harvest to the region. The type of vegetation found in the area is Guinea savannah woodland which as mentioned above, is distinguished by tall grass and trees that are resistant to drought

such as Mango (*Mangifera indica*), Neem (*Azadirachta indica*) or Moringa (*Moringa oleifera*).

It is an area inhabited by 2,408 people, living in 253 households. The main occupations for the entire families are in agriculture, mostly with the crop maize (*Zea mays*). During rainy seasons many crops are cultivated, such as tomatoes (*Solanum lycopersicum*), tobacco (*Nicotianum tabacum*) and okra (*Abelmoschus osculentus*). Animal stocks in the area mostly consist of cattle, goats, donkeys, guinea fowls, chicken and sheep. The religion, which also may influence nutritional patterns, is predominantly Muslim (79,5%*[1]) besides a smaller percentage of Christians and Traditionalists. [Mustapha, Nyarko, 2014]

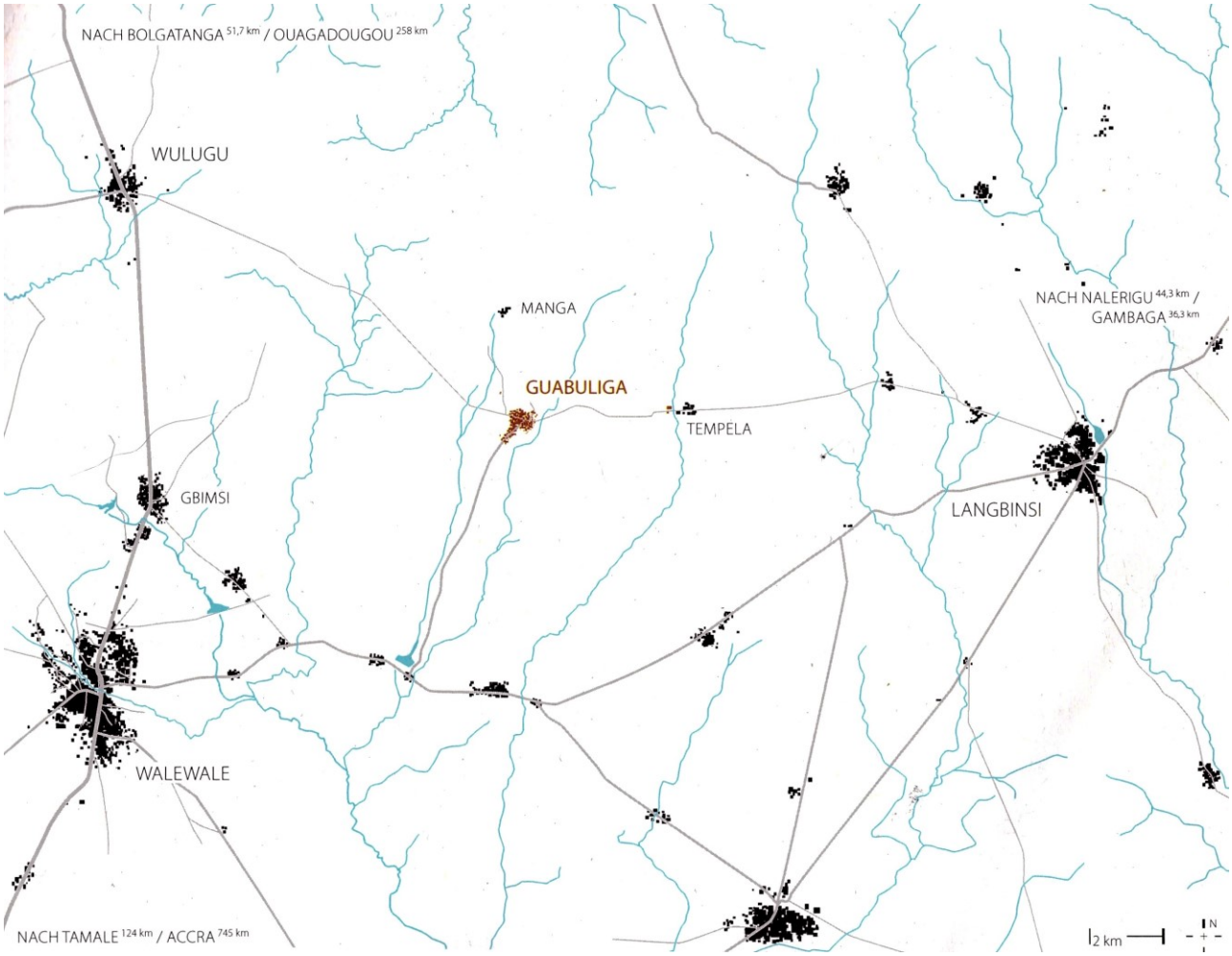


**Illustration 5:** Detailed surroundings of Guabuliga [Car C, 2016]

[1] Percentage refers to West-Mamprusi District, as there is no data available for Guabuliga

### 5.3. Sampling of women

For the cross-sectional study 69 women between the ages of 15 and 49 years old were interviewed during my stay in September and October 2017. This time of the year is the end of the rainy season in which fertility and harvest are still at a high level. If MDD-W and MAD-YC are too low during this time of the year, action and interventions need to be conducted instantly, as the dry season offers even less variety on the plate.

No convenience sampling was used. All interviews were held throughout daytime every day during the week, including Sundays. No feast- or celebration days such as Ramadan were included, as typical diet differs during feasts.

The main methodology used was to walk with a translator from compound to compound, asking for women in the age bracket between 15 and 49, and starting the interviews right away. Without exception, the will for cooperation was high. Some women were interviewed directly at the training center of *Braveaurora* and some were interviewed at the local secondary school.

### 5.4. Methods

The interviews that were undertaken were respecting of the guidelines of *„Indicators for assessing infant and young child feeding practices“.*[WHO,2010].

The main interest focused on the quality or diversity of the diet, and less on the quantity, so it was decided that no anthropometric measures will be taken.

One obstacle arose while assessing the date of births, as no birth certificates existed and birthdays don’t have the same value as they have in western society. After the first interviews were conducted, the realization occurred that it would be too difficult to assess the exact birthday, so the approximate age was asked. If the age was still unknown, attempts were made to find out through important local celebrations and events. If the age at the event was known, the years that have passed can be added. Based on this information, the age could be estimated, which was shown to be effective with good results. The same procedure was conducted for the age of the child. Using the aforementioned method, the age of all women and children were assessed and none of the ages were solely estimated.

Some difficulties also appeared when the number of people in the households were assessed. Guabuliga contains traditional round mud-huts, where up to 7 houses are linked together and result in one compound. People were answering with over 40 people living together, so it was decided to determine the size of the nuclear family, that is, the initial family living together under one roof. Even then, the amount of people living in the small houses was surprisingly high.

For assessing the household wealth of the interviewed woman, an index was created, inspired by a recent paper of Chakona and Shackleton. [Chakona, Shakleton, 2017] Ten specific possessions of value in the households were determined: Car or truck, bicycle, television, cattle or goats or donkeys, radio, motorbike, fridge, cellphone, chicken or guinea fowl, and electricity. Furthermore, it was asked if, and if yes, how many people in the household have jobs with a regular cash incomes. Finally, it was assessed if farmers were present in the household.
After this was determined, information was gathered about their pregnancy and age of the youngest child, if they had children.
Then the 24h recall began to measure the dietary diversity, which can be defined by the minimum dietary diversity for women of reproductive age [FAO, 2010]. It contained questions about food that was consumed during daytime. To avoid bias, the questions were kept neutral. For instance, the questions were not what was consumed for breakfast/lunch/dinner, but if there was any food that was consumed during the morning/daytime/night, to spare any feeling of embarrassment if there was no food. Mixed dishes needed to be described precisely, which became a challenge in some interviews, as many women cook for the whole compound, which consists of many people. Substances used to enhance flavor but which are also nutritious substances, such as ground dried fish could have been easily over or underreported. Additionally, all meals and snacks in between have been asked to be accounted for and all food groups which have not been mentioned were asked a second time to try and ensure that no food has been forgotten. Information about the process of regularly eaten meals like Tuo Zaafi, Banku and Porridge was collected before the main data collection, to provide understanding on eating behaviors and for recognizing where ingredients could be forgotten. Every food that had been consumed the day before was coded into the 21 food groups and then transferred in the ten aggregated food groups. The sum of all food groups consumed created the MDD-W. These 21 food groups included: Food made from grains (A), white roots and tubers (B), pulses like beans, peas, lentils (C), nuts and seeds (D), milk and milk products (E), organ meat (F), meat and poultry (G), fish and seafood (H), eggs (I), dark green leafy vegetables (J), vitamin A-rich vegetables, roots and tubers (K), vitamin A-rich fruits (L), other vegetables (M), other fruits (N), red palm nut products (O), other oils and fats (P), savory and fried snacks (Q), sweets (R), sugar-sweetened beverages (S), condiments and seasonings (T) and finally other beverages, drinks and food (U).
If a food group was consumed during the last 24 hours, it was marked with „1“. Multiple scores are ignored, so a food group can only be selected with „1“ for yes and „2“ for no. The maximum attainable score was 21, whereas the aggregated MDD-W reached 10 and MDD-IYC, which is needed for assessing the MAD-YC and follows the same scheme,

reached a maximum of 7. The minimum intake of reaching a “yes” score was considered 10g, which is similar in volume to about one tablespoon, which made it easy to assess during the interviews. Also, nutrient dense spices such as ground fish or chili that was included needed to be consumed with a minimum of 10g for eligible scoring in a food group. High sources of vitamin A are considered as foods, which serve an equivalent to 60 retinol activity (RAE) per 100g.

The consumption of red palm nut products is widespread in West Africa. To find out if people in Guabuliga use it, it was included as an additional food group.

The most common used oil *Frytol*, has very high levels of vitamin A. It’s made from palm nuts and is fortified with 750 mcg RAE per a serving of 100g. Nearly all prepared dishes, especially the daily eaten stews contain the oil. It is the only available oil in the surrounding areas, so every score of *other oils and fats (P)* was counted as the *Frytol*.

All the 21 food groups cover all varieties of relevant micronutrients. The quality of the diet can be reflected by the dietary diversity, which correlates to the intake of micronutrients. FAO [FAO and FHI 360, 2016] highly recommends not to put the food group of fats and oils in the MDD-W, because it does not contribute to micronutrient adequacy. Yet *Frytol* contains high levels of vitamin A and contributes, like all fats and oils, to better absorption of fat-soluble vitamins.

This study sticks to the official recommendations and an additional separate indicator which includes fats and oils was created, as it can improve the diet tremendously.

After finishing the questionnaire, the data was transferred, cleaned and checked for missing information before they were put in *Numbers* (*Excel*-version of *MacBook*). The statistical analysis through Statistical Package for Social Science (SPSS) Version 22 has been done at the *Department of Nutritional Sciences* in Vienna.

Scientific papers have been taken from online-sources such as *Pubmed* or *Scopus*.

The calculations for the values of the IYCF indicators have been done under the instructions of WHO [WHO, 2010]

### 5.5. Classification of dietary diversity and FGIs

The scores of all food groups were put into the aggregated food-group indicator (FGI) and finally summed up to the indicator MDD-W or MDD-IYC. If less than five food groups were consumed, it was deemed as nutrition with poor dietary diversity and thus as food insecure or at high risk for micronutrient deficiencies. If five or more food groups were achieved, the diet was said to reflect good dietary diversity and food security.

As recommended by the FAO [FAO and FHI 360, 2016], from the 21 food groups FGI-10 for MDD-W and FGI-7 for MDD-IYC was formed. FGI-10 contains 10 food groups: „Starchy staples“ (A „foods made from grains“ plus B „white roots and tubers“), „pulses“,

„nuts and seeds“, „milk and milk products“, „meat“ (F „organ meat“, G „meat and poultry“, H „fish and seafood“), „eggs“, „dark green leafy vegetables“, „vitamin A-rich vegetables and fruits“ (K „vitamin A-rich vegetables, roots and tubers, L „vitamin A-rich fruits“), „other vegetables“ and „other fruits“. FGI-7 for MDD-IYC is expressed by following 7 food groups: „Starchy staples“ (A „foods made from grains“, B „white roots and tubers“), „pulses and nuts“ (C „pulses“, D „nuts and seeds“), „milk and milk products“, „meat“ (F „organ meat“, G „meat and poultry“, H „fish and seafood“), „eggs“, „vitamin A-rich fruits and vegetables“ (J „dark green leafy vegetables“, K „vitamin A-rich vegetables, roots and tubers“, L „vitamin A-rich fruits“) and „other fruits and vegetables“ (M „other fruits“, N „other vegetables).

| **FGI-10 (MDD-W)** | **FGI-7 (MDD-IYC)** |
|---|---|
| Starchy staples (A,B) | Starchy staples (A,B) |
| Pulses (C) | Pulses and nuts (C,D) |
| Nuts and seeds (D) | Milk and Milk products (E) |
| Milk and milk products (E) | Meat (F,G,H) |
| Meat (F,G,H) | Eggs (I) |
| Eggs (I) | Vitamin A-rich fruits and vegetables (J,K,L) |
| Dark green leafy vegetables (J) | Other fruits and vegetables (M,N) |
| Vitamin A-rich fruits and vegetables (K,L) | |
| Other vegetables (M) | |
| Other fruits (N) | |

**Table 3:** Description of food-group indicators

## 5.6. Definitions of the IYCF- indicators

The calculations for the values of the IYCF indicators have been done under the instructions of WHO [WHO, 2010]. A short description for each indicator is stated below:

- **Early initiation of breastfeeding**

This number indicates how many children who were born within the last 24 months have been receiving breastmilk during the first hour after birth.

- **Exclusive breastfeeding under 6 months**

After first identifying infants with ages from zero to five months, it is assessed how many of them exclusively received breastmilk. This is defined as solely the intake of breastmilk

being fed to the infant. As soon as other food, drinks or water is fed, except vitamins, minerals and medicines, it is not considered as exclusive breastfeeding.

- **Continued breastfeeding at 1 year**

Indicates how many children within the age of 12 to 15 months have been receiving breastmilk the day before. Next to exclusive breastfeeding, the continuation of giving breastmilk builds the base for a healthy child and maternal development.

- **Introduction of solid, semi-solid or soft foods**

Infants between the age of 6 and 8 months are identified if solid, semi-solid or soft foods have been consumed the previous day. The importance of timely introduction is repeatedly recommended by WHO to cover the nutritional needs of the growing child. Furthermore, the significance of adequacy is pointed out, meaning that adapting the frequency, consistency and amount of which the child needs. Hazards like contamination with pathogens need to be minimized. [WHO, 2018]

- **Minimum dietary diversity**

This MDD for young children follows the same principles as the MDD-W. The age range of the children assessed for this indicator is 6 to 23 months. They are put in proportion with the children who received food from 4 or more different food groups. Contrary to MDD-W, which include 10 food groups (FGI-10), only 7 food groups (FGI-7) are included to form the minimum dietary diversity for children, which are depicted in Table 2 under the chapter *3.6. Classification of dietary diversity and FGIs*. If a child scores 4 or more food groups, the diet is considered to have a sufficient level of diversity.
This indicator aims to reflect the quality of complementary food; therefore, breastmilk is not included.

- **Minimum meal frequency**

The definition of this indicator separates between breastfed and non-breastfed children. However, in both cases children between the age of 6 and 23 months are evaluated if they received solid, semi-solid, or soft foods the minimum number of times or more the day before the assessment.
To complete the indicator for non-breastfed children it is additionally asked if at least two milk feedings were given.
To determine if the frequency is sufficient or not depends on age. For breastfed children between the age of 6 and 8 months, the minimum required feedings per day is 2 but 3

feedings per day are required for children aged between 9 and 23 months. The amount is fixed at 4 times per day for all non-breastfed children and does not depend on the age.

| | Breastfed | Non-breastfed |
|---|---|---|
| 6-8 months | 2 | 4 |
| 9-23 months | 3 | 4 |

**Table 4:** Minimum number of times of feeding complementary foods, adapted from [WHO, 2010]

- **Minimum acceptable diet**

This multidimensional indicator includes how many children between 6 and 23 months received at least the minimum dietary diversity (see above) and the minimum meal frequency the day before assessment (see above). Furthermore, there is a distinct difference between breastfed and non-breastfed children. Both indicators are calculated before, and only if both components score positively will a minimum acceptable diet be deemed as present.

However, for non-breastfed children, the components in their dietary diversity change slightly. The food group score does not include 7 but 6 food groups, as dairy products are excluded. Furthermore, a minimum number of milk feeds need to be received because they are considered as a required and separate element for non-breastfed children. Through this method, double-counting of dairy products is avoided.

| Dimension | Criteria |
|---|---|
| Minimum Dietary Diversity | **Breastfed**: 4 or more groups out of 7 food groups<br>**Non-breastfed**: 4 or more groups out of 6 food groups |
| Minimum Meal Frequency (solid, semi-solid, soft foods) | **Breastfed, aged 6-8 months**: 2 or more feedings<br>**Breastfed, aged 9-23 months**: 3 or more feedings<br>**Non-breastfed, aged 6-23 months**: 4 or more feedings |
| Milk feedings | **Non-breastfed, aged 6-23 months**: at least 2 milk feedings |

**Table 5**: Criteria for reaching the minimum acceptable diet, adapted from [WHO, 2010]

- **Children ever breastfed**

This indicator represents the proportion of children within the age group up to 24 months and if they have ever been breastfed.

- **Continued breastfeeding at 2 years**

Here it is indicated how many children receive breastmilk within the age of 20 to 23 months. Especially in remote areas like Guabuliga, breastmilk is a significant nutritional contribution and energy source in children's diets. A large-scale analysis of 241 regions of sub-Saharan Africa has shown that continued breastfeeding up to 2 years correlates to a decrease of 24% in the odds of child mortality. [Akachi et al, 2017]

# 6. Results

The average MDD-W of the 75 women examined in the assessment was calculated to be 3,48+/-0,96. A score below 5 is recognized as insufficient and therefore the diversity of the diet is low. 10 women (7.5%) have reached the recommended intake of 5 or more food groups. The diversity does not seem to correlate significantly with the size of the household, number of people with income, farmers living in the household or wealth. The only significant correlation that could be observed was between the dietary diversity and age. The older a woman gets, the more diverse the diet becomes.

The MAD-YC, which by definition differs between breastfed and non-breastfed children (see criteria in Table 5) is basically zero (~ 0,1) for breastfed children. The MAD-YC for non-breastfed children could not have been determined because the evaluation did not include the frequency of milk feeds. For non-breastfed children however, the diet was insufficient. Breastfeeding enjoys a high importance as 100% of the children assessed had been breastfed. But only 29% have been put to the breast immediately after birth, which increases the risk of neonatal mortality. Less than the half (40%) of children between 12 and 15 months received breastmilk. Introduction of solid, semi-solid or soft foods often happens too late, as none of the children between 6 and 8 months received any food other than breastmilk. 0.2 is the score of MDD-YC, whereas more than three quarters did not receive ≥ 4 food groups the previous day. This is especially true with respect to foods from animal sources which where scarcely consumed.

A different definition between breastfed and non-breastfed children also exists for the minimum meal frequency (see criteria in Table 4). In both cases it resulted in 0.3, which means that not even a third received enough meals the previous day. 50% of the children assessed received breastmilk until the age of 2 years, however the study size was low for this indicator.

## 6.1. Characteristics of the sample

The numbers in Table 6 are presented as means +/- standard deviation, including the minimum and maximum. The mean ages of the women examined range from 15 to 47.

**Descriptive Statistics**

| | N | Mini-mum | Maxi-mum | Mean | Std. Devia-tion |
|---|---|---|---|---|---|
| Age_y | 75 | 15 | 47 | 26,16 | 9,569 |
| Householdsize | 75 | 2 | 15 | 8,04 | 2,719 |
| Income_#people | 75 | 0 | 5 | ,93 | 1,070 |
| Wealth | 75 | 0 | 10 | 4,05 | 2,259 |
| Valid N (listwise) | 75 | | | | |

**Table 6:** Characteristics of the women

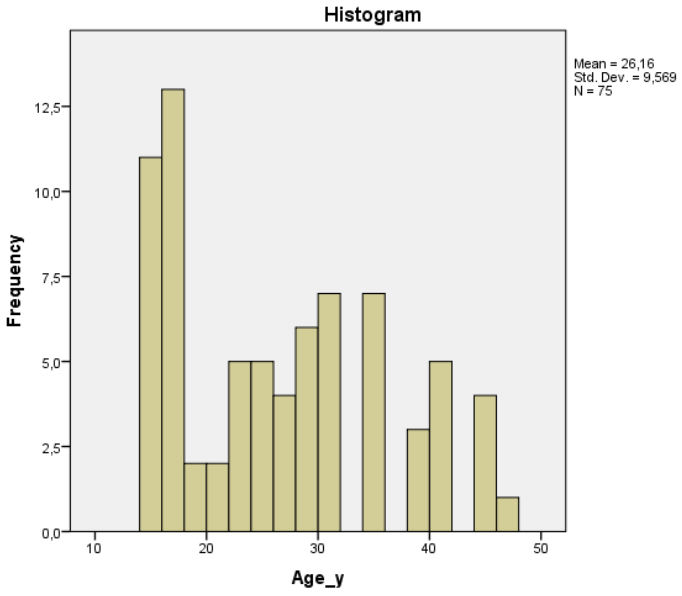


**Table 7:** Distribution of the age among women

The peak during young age (Table 7) was due to a large part of the sample having been drawn from secondary school, as the translator used in this study was a teacher and this was simply the availability at the time. However, one week after the interviews the sample was taken from other areas, as taking a big sample from one secondary school will not lead to representative outcomes.

The mean size of the household was 8 persons. The household sizes may be underreported, as in most homes a large number of children live in the compound, and in many interviews, it seemed as though respondents were solely guessing the amount of people in their household. Repeated questioning and asking for all the names of all children living under the same roof were used to assess correct numbers of the household size.
The index of wealth is a reliable source that was used, as the items were listed exactly and there was little to no chance to give false answers. The mean wealth index is 4, whereas the range reached from 0 as the lowest through to 10 as the highest.
Of the infants and young children, the mean age was 14.8 +/- 5.5 months (mean +/- std. deviation) totaling 14 females and 10 males.

### 6.1.1. Consumption patterns

The daily nutrition is dominated by starchy staples, mostly consisting of maize and rice. As depicted in Table 8, all the questionnaires contained an item of the food group A (Foods made from grains) or B (White roots or tubers). The other majority is covered by M (other vegetables), J (dark green leafy vegetables), C (pulses) and D (nuts and seeds) because of the soups with which the maize or rice dishes are served.

| Food group | Summary of food group intakes by women |
|---|---|
| Starchy staples (A,B) | 100 % |
| Other vegetables (M) | 68,0 % |
| Dark green leafy vegetables (J) | 66,67 % |
| Pulses (C) | 48,0 % |
| Nuts and seeds (D) | 40 % |
| Meat (F,G,H) | 20 % |
| Milk and milk products (E) | 2,67 % |
| Vitamin A-rich fruits and vegetables (K,L) | 2,67 % |
| Eggs (I) | 1,33 % |
| Other fruits (N) | 0 % |

**Table 8:** Summary of food group intakes by women in percentage

Table 9 shows the percentages of each of the food groups by the various scores of dietary diversities in women, which ranged from 2 to 5. Only one person scored 6 food groups, creating percentages for n=1 which is not representative, and therefore is not shown in the following table.

| MDD-W | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Starchy staples: | | | | |
| Foods made from grains (A) | 100 | 100 | 100 | 100 |
| White roots and tubers (B) | 15,38 | 12,50 | 7,14 | 22,22 |
| Pulses (C) | 7,69 | 45,83 | 64,29 | 55,56 |
| Nuts and seeds (D) | 7,69 | 25,0 | 53,57 | 77,78 |
| Milk and milk products (E) | 0,0 | 0,0 | 3,57 | 11,11 |
| Meat: | | | | |
| Organ meat (F) | 0,0 | 0,0 | 0,0 | 0,0 |
| Meat and poultry (G) | 0,0 | 0,0 | 3,57 | 0,0 |
| Fish and seafood (H) | 0,0 | 4,17 | 21,43 | 66,67 |
| Eggs (I) | 0,0 | 0,0 | 0,0 | 11,11 |
| Dark green leafy vegetables (J) | 53,85 | 66,67 | 75,0 | 55,56 |
| Vitamin A-rich fruits and vegetables: | | | | |
| Vitamin A-rich vegetables, roots and tubers (K) | 0,0 | 0,0 | 0,0 | 22,22 |
| Vitamin A-rich fruits (L) | 0,0 | 0,0 | 0,0 | 0,0 |
| Other vegetables (M) | 30,77 | 62,5 | 78,57 | 100 |
| Other fruits (N) | 0,0 | 0,0 | 0,0 | 0,0 |

**Table 9:** Percent consumption of the food groups by MDD-W

### 6.1.2. Precise description of the food groups

**Foods made from grains**

Maize and rice are the main sources of food in Guabuliga. These staple foods contain low nutrient density and low bioavailability of micronutrients. Furthermore, they contain anti-nutrients such as phytic acid (or phytate = salt form). Its anti-nutritional behavior derives from its capability of creating chelates with ions like calcium, magnesium, zinc or iron. Most significantly the high affinity to iron is problematic because food from animal sources with high iron-availability are particularly scarce in Guabuliga.

**Illustration 6:** Ingredients of Banku with okra stew [Dietiker, 2013]

Science is currently making progress in researching gene regulation to enhance phytases, which can hydrolyze phytic acid. [Vashishth et al, 2017] Any progresses in this research field should be paid particular attention, as iron deficiency takes high importance in “hidden hunger” – the hunger caused by micronutrient deficiency – which in many cases leads to reduced growth, lower activity of the immune system and anemia. Special concern needs to be paid to the risk of anemia in Guabuliga, as the stable transmission of malaria is additionally contributing to the occurrence of it. Moreover, intestinal worms and HIV-infected mothers can cause anemia in the antenatal fetus. [Murgia et al 2012] Both risk factors are highly probable to be present in Guabuliga.

**Illustration 7:** Ingredients of Tuo Zaafi and Alefu leaves [Dietiker, 2013]

Maize accounts for a high percentage of the daily energy intake. Nearly all women who did the 24-hour diet recalls, mentioned that they eat Tuo Zaafi, popularly called TZ, twice or often even three times a day. TZ is a maize-based dish, whereas maize is boiled in water and salted until the desired creamy consistence is reached. It is accompanied by a soup that often contains okra fruits, okra, alefu or baobab leaves, either dried or fresh, or ground nuts.

Moreover, Banku is a dish also regularly eaten, which is accompanied by the same soups. For Banku, maize powder is mixed with water and left aside for a couple of days for the fermentation process to take place. The end result is compressed into balls and subsequently cooked. Fermentation reveals many advantages. Firstly, it is a suitable method for extending shelf-life as occurring metabolites like lactic, acetic or propionic acids inhibit the growth of a variety of pathogenic microorganisms that could spoil the food. [Caplice, Fitzgerald 1999] A study in 1991 showed that fermented maize could inhibit strains of *Shigella flexneri* and enterotoxigenic *Escherichia coli* (ETEC). This knowledge is crucial especially for producing less contaminated foods in unhygienic conditions. [Mensah et al, 1991] The nutritional benefit of cheap and available crops can be altered through the fermentation. Cereals show, after fermentation through a lower pH level a decrease of the previously described phytate [Coulibaly et al, 2011] so iron, zinc, magnesium, calcium and proteins have increased bioavailability. Another possible health impact of cereal fermentation is the ability of probiotic bacteria to influence gut microbiotica and furthermore indirectly modulate the immune system through altered production of antigens and enhancement of the mucosal barrier functions. [Ciorba, 2012]

This food group provides most of the energy intake.

**White roots and tubers**

Yams are the sole food item (*Dioscorea rotundata*) to have been mentioned in the food group B. Potatoes were only available at a very high price in Walewale, whereas yams were slightly cheaper. Traditionally the root is cut in pieces and subsequently fried in oil, served with groundnut powder or topped with a spoon of frying oil. Rarely, it would be consumed by way of boiling the peeled yam and serving it with stews rich in oil, tomato paste, onions and vegetables like cabbage or leaves - if available.

**Illustration 8:** Ingredients of Yam with cabbage stew [Dietiker, 2013]

Plantains (*Musa paradisiaca*) are being planted by a local farmer, however the acceptance of this in the diet by the inhabitants of Guabuliga is still low.

**Pulses (beans, peas, lentils)**

Half of the women (see Table 8) scored this food group. This was mainly by eating *Tubaani,* where a flour of cowpeas (*Vigna unguiculata*) is mixed with water and smashed until a creamy mixture appears, followed by cooking it in water. Tofu made from soybeans (*Glycine max*) is another rather new food, that is regularly available in front of school. In households or food stands however, it was not observed. Surely improvements could be made in promoting the consumption of soybeans, as the health benefits range from reduction of coronary hearth diseases [Messina, 2010] to simply adding protein and higher dietary diversity to the plate. Furthermore, benefits like improved endothelial function can be drawn from soy based foods. Nutrition in Guabuliga is mainly plant-based, and for that reason the consumption of pulses- should be enhanced for a higher protein-intake.

**Nuts and seeds**

Nuts more so than seeds play large role in traditional dishes. Groundnuts are produced and processed locally for their own use. They are mainly eaten either dried and roasted, or as a form of soup, whereas the nuts get ground with water to a creamy, liquid state, which is then added to the traditional stew.

**Illustration 9:** Groundnut harvest in Guabuliga © Vera Högl, 2017

The stew is made from oils, tinned tomatoes, onions and other condiments. On one hand groundnuts show nutritional benefits like reduced mortality, specifically coronary-heart-disease mortality starting from the consumption of about approximately 3 servings of 12 grams per day. [Chen et al, 2017] On the other hand, it can play a major role in keeping the soil fertile by proper intercropping. A recent study in Northern Ghana revealed that maize-legume intercropping is a favorable possibility under marginal conditions, when the fertility of land is already poor because of its high ability to fix nitrogen. To intercrop within rows (planting groundnuts between maize) resulted in a more productive yield than those of the sole maize crops. [Kermah et al, 2017] This knowledge should be passed on to the farmers on-site.

**Milk and milk products**

Cattle is held on a small-scale by one tribe in Guabuliga, therefore it is rare that fresh milk is sold in the streets. However, it is presumed that not enough milk is produced for covering the nutritional needs of the village. Another product that is widespread but rarely consumed due to its high price is tinned milk from *Nestle (ideal)* and *Carnation*. Small amounts are occasionally added to black tea or porridge. Yet not enough is consumed to score the food group E in the survey, as in nearly all cases the person consumed less than a spoonful per meal.

**Organ meat**

Organ meat did not occur in any diet recall or field observation.

**Meat and poultry**

The consumption of meat and poultry is extremely low, due to the high costs and/or no availability. Cattle are only owned by a small tribe in the village, and there is no indication how often animals are butchered and sold in the village. Wild pigs are rarely seen due to the high percentage of Muslims in the village, to whom pork is a meaningful taboo. If meat is consumed it is mostly from chicken in small quantities, it is boiled in the soup to go with TZ, banku or other starchy meals. If a woman reported that the soup was prepared with chicken, only rarely were parts of the chicken eaten in a relevant quantity. It is probable that meat pieces are eaten mainly by the men or children in the household.

**Fish and seafood**

No seafood has been reported or was observed being eaten. Dried fish however is added to a high percentage of meals. Small-sized fish are crushed, often with other condiments like chili or salt and added to the soups. In each interview it was important to find out how many spoons of powder was used

**Illustration 10:** Crushing dried fish in Guabuliga © Vera Högl, 2017

for which amount of soup and how many people ate from it. Often, they were added in such high quantity that the diet was enriched in its diversity (see Table 9) and could be a significant contribution in reducing malnutrition due to the presence of proteins and micro-nutrients. Most notably the iron content is high, and this can be an important factor in avoiding anemia. [Abbey et al, 2017]

**Eggs**

Guinea fowl and chickens are domesticated animals in this area, therefore eggs are consumed by those who hold them, but were never seen for sale to other families. A strong belief still maintains its roots, that when eggs are consumed at a young age people lose their good spirit and turn into evil minds. This saying has been justified by asking many families, though no reason could have been investigated. Pointing out the benefits of eating eggs may help create diverse nutrition.

**Dark green leafy vegetables**

The third most frequently eaten food group is dark green leafy vegetables, dominated by okra leaves (*Abelmoschus esculentus*) and baobab (*Adansonia digitata*), which are either dried or fresh.

**Illustration 11:** Ingredients ready to be sold: dried leaves, pepper, salt and oil © Vera Högl, 2017

All TZ and banku dishes are served with a soup which often contains them as a main ingredient. Cocoyam (*Colocasia esculenta*) grows well and is cultivated by single farmers, though acceptance is still low, and should be enhanced. The same goes for moringa (*Moringa oleifera*), which is well known as „herbal medicine“ and taken when sickness occurs, but it is not seen as food for healthy people. This food group is essential to health due to its high content of β-carotene, iron, zinc and calcium. [Amagloh et al, 2017] However, they also contain anti-nutritious phytates and polyphenols and furthermore they are mostly eaten with maize-based dishes that may limit the bio accessibility of certain minerals and proteins. [Vashishth et al, 2017] This matter has been examined recently in Ghana: Cocoyam showed exceedingly high levels of calcium compared to other examined leaves, which were baobab, cocoyam, corchorus (*Corchorus olitorius*), kenaf (*Hibiscus cannabinus*), moringa, leaves of each orange fleshed sweet potatoes, purple fleshed sweet potatoes and white fleshed sweet potatoes. Baobab, with a high presence of polyphenols showed the lowest accessibility of iron. Moringa contained the highest number of

β-carotene and ascorbic acid, which can enhance iron absorption and they showed a rather low content of polyphenols, which both led to the highest ferritin absorption. (See Table 10) The leaves of sweet potatoes (*Ipomoea batatas*) and those of cocoyam have very similar iron bio accessibility but sweet potato-leaves contain much more β-carotene, and because of this reason promotion should be focused on the potato-leaves. [Amagloh et al, 2017]

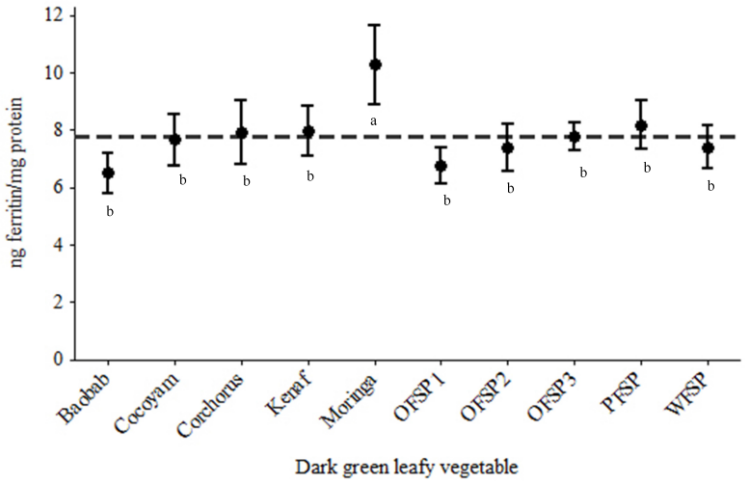


**Table 10:** In Vitro Iron Bioaccessibility Using Caco-2 Cells [Amagloh et al, 2017]

**Vitamin A-rich vegetables, roots and tubers**

Only a very small percentage of women could score this food group. Sweet potatoes are not available in the surroundings of Guabuliga, neither are carrots as they are not common as crops. The acceptance of pumpkin is high, as they let it grow on some roofs of their traditional huts where it offers shade and helps promote cooler temperatures. In the season of the harvest, the score in this food-group will probably be higher. Research in Northern Ghana this year has already proven that the dietary diversity is affected by seasonality. [Abizari et al, 2017]

**Vitamin A-rich fruits**

No item was consumed which fits this food group. The major reason is anew the high dependency on seasonality and harvest. Vitamin A-rich fruits like Shea fruits and mangoes are only available in the first period of the rainy season. [Abizari et al, 2017]

**Other vegetables**

Due to the high availability of fresh tomatoes during evaluation, the score of this food group was high. Even if women had the MDD of 2, a third (30.77%, see Table 9) of these women had an intake of ‚other vegetables ‘, whereas all the women scored this food

group if their DD was 5. Tomatoes are an essential ingredient in most of the stews and soups that are served with starchy staples. Tinned tomatoes are sold in big quantities at a low price when fresh tomatoes are out of season, so consumption of items fitting this group is very likely to be high. Boiled okra was often eaten very often alongside TZ.

**Other fruits**

Obviously, no fruit has been eaten by any interviewed woman. One of the highest appreciated fruits in the village is mango, however, it is eaten only during the short period of its season in which it is available. Another fruit that seemed to be usual was the fruit of the cashews, but the trees were very rare. Bananas and plantain are grown by a local farmer on a small scale for providing Guabuliga, however the acceptance level for these two items is bizarrely low.

**Red palm nut products**

Nearly no products of red palm nuts have been found in Guabuliga, even though it is known by many women. If it was consumed, it was again part of the daily soup that was eaten. Investigations into reasons of low consumption should be carried out as the chance of a high level of consumption is given if availability and price are reasonable.

**Other oils and fats**

As with other animal products, there is no consumption of animal fat, butter, cream or mayonnaise. The fat in their nutrition derives mostly from the aforementioned vegetable oil *Frytol*, which is fortified with vitamin A (750 µg RAE). About 20% of this is known to be lost during heating process [Dach, 2000], which could be even higher in the case of typical cooking traditions in Guabuliga, because stews traditionally tend to be boiled for very long periods of time. Food fortification is one of the main strategies to combat vitamin-A deficiency. Oil, especially palm oil is widely available in Ghana and offers a good nutritional matrix. Fortification of palm oil is a proper intervention strategy for increasing vitamin A-intake. Therefore, it was investigated that mildly oxidized palm oil fortified with retinyl palmitate with a peroxide value of < 2 meq O2/kg did not indicate significant loss during 57 days storage, whereas high oxidized palm oil with the peroxide value of > 5 meq O2/kg induced high declines retinyl palmitate. Another advantage of palm oil fortification is that the oil is rich in oleic acid and palmitic acid. Both compounds don't oxidate as easy as linoleic and linolenic acid in soybean oils. It is also very rich in polyunsaturated fatty acids. Only approximately four tablespoons are needed per day to meet the recommendations of 2% energy of linoleic acid. [Pignitter et al, 2016]

**Savory and fried snack**

None of the women consumed fried snacks. The only item that could be identified during observations on-site was fried yams, which was sold for very little money in front of the school. However, children rarely have money to buy foods so these fried yams are mostly eaten by male teachers, who were not included as part of the survey.

**Sweets**

Sweetened foods are not common in Guabuliga. During the assessment, it was very rarely mentioned that biscuits have been eaten the day prior, but it can be concluded that sweets need no further intervention and attention.

**Sugar-sweetened beverages**

Black tea from the popular brand *Lipton* is often consumed with sugar and tinned milk. The assumption of a prevalence of higher iron deficiency and resulting anemia from the formation of insoluble complexes has meanwhile proven to be negative. Many studies concerning the correlation between the consumption of black tea and iron status (ferritin concentrations) have been carried out in western countries, which showed that tea-drinkers did not have significantly lower ferritin concentrations in their system. [Ehm, Pga, 2002] The THUSA-study (Transition and Health during Urbanization of South Africans) in South Africa yielded the same results, and highlighted that consumption of black tea does not explain iron deficiency or iron deficiency anemia. [Hogenkamp et al, 2008]
All the results from the study came from examining healthy subjects. Outcomes may differ in people with an already high preposition of iron deficiency.

**Condiments and seasonings**

When foods have been used in small amounts to flavor a dish they have been added to this food group. Everything that exceeded the set quantity of a tablespoon has been categorized in the appropriate food group. Fish powder was frequently mentioned as an ingredient used as a condiment. Women were required to describe exactly how much powder was used and how many people ate from the meal. In many cases the quantity of fish was not sufficient to adequately contribute to nutrient intake.

**Other beverages and foods**

Items which were recorded in this group were all covered by *Lipton* with tinned milk.

### 6.1.3. Determinants of dietary diversity

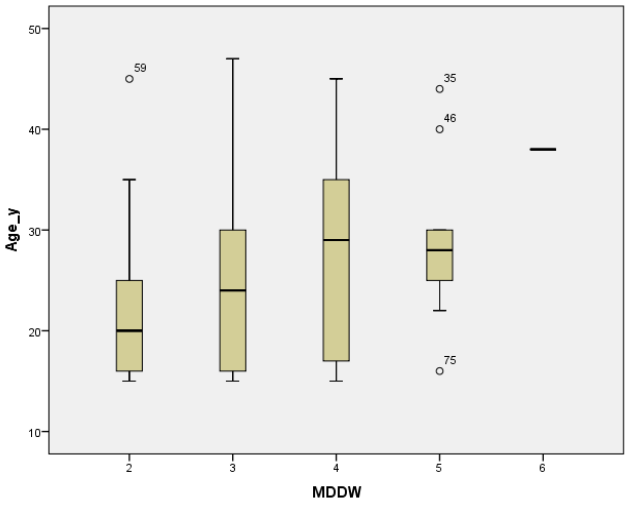


**Table 11:** Boxplot for MDD-W and age

Table 11: The diversity seems to be dependent on age, as the means of ages rise, the higher the level of diversity is. If this is the case, this will be statistically tested in chapter 4.4.

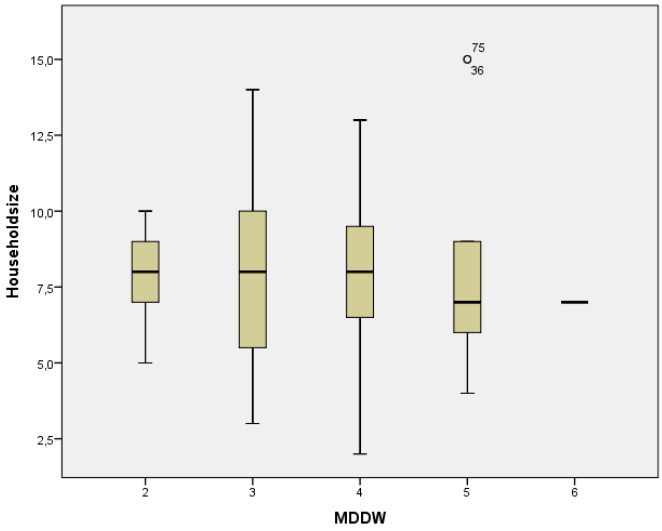


**Table 12:** Boxplot for MDD-W and householdsize

Table 12: As is visible from the box-plot above, there is no significant correlation between the amount of people who live in the same household and the diversity of nutrition. The trend for higher diversity is trending downwards the bigger the household is. Significance however is not present. [Annex 3]

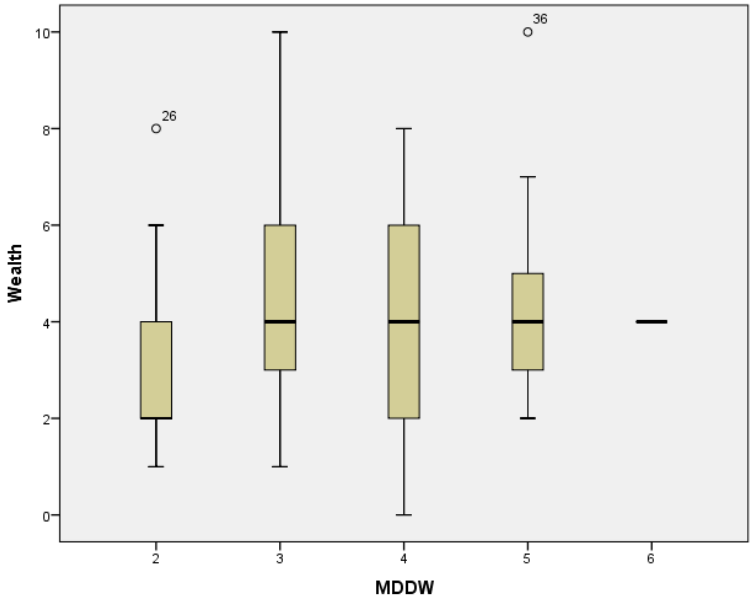


**Table 13:** Boxplot for MDD-W and wealth

Table 13: An association could not be identified between the index of wealth and the MDD-W. Especially if the diversity is 3 or more, the mean of the wealth-indices is on a similar level. The lowest assessed dietary diversity-category of 2 also shows a very low index. However, a MDD-W of 2 does not show a significantly lower index of wealth than the other diversity scores. [Annex 4]

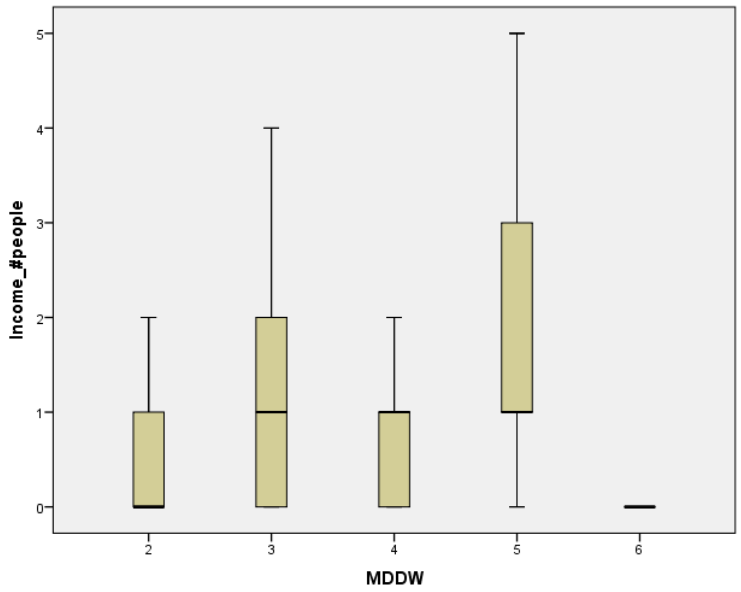


**Table 14:** Boxplot for MDD-W and the number of people in the household with an income

Table 14: No associations could be found between the dietary diversity of women and the amount of people who hold a job with cash income in the household. Access to jobs is highly limited in the village. Most families live without income and obtain their foods from their own farms and trade items among families. Occasionally when there is an overstock of food which would spoil if left for a period of time, it is sometimes on sold to markets in Walewale.

From these statistical is presumed that no significant correlations are present, but there is an association between age and minimum dietary diversity among women. Considering age is a variable metric, Pearson correlation was used. MDD however is an ordinal variable which favors the Spearman correlation. It is a key metric and if an ordinal variable is present, the Spearman method should be the preferred method used. The Spearman correlation shows that there is a significant positive correlation present between MDD-W and age. The older a person is, the higher the score of the minimum dietary diversity. [Annex 5]

Table 15: Boxplots only tend to highlight trends. Shifting the MDD-W from an ordinal to a metric variable allows the ability to create a rank order correlation. The line shows a significant trend upwards (p=0,034) [Appendix 4] whereas the equation displays Age(years)=17,69+2,43*MDD-W. If dietary diversity is rises up one rank, 2.43 years of life can be added to the total life expectancy.

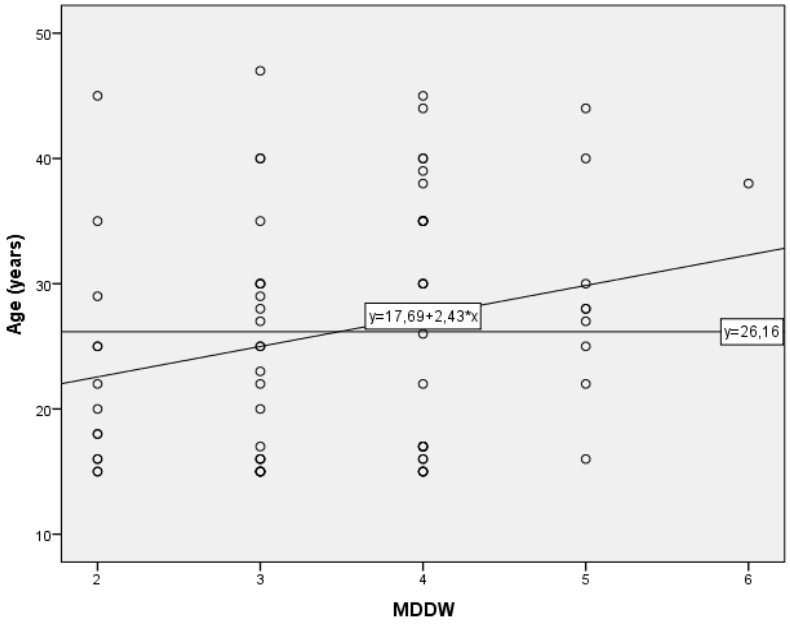


**Table 15:** Rank order correlation between MDD-W and age

The dietary diversity of a total of 17 children could be examined, and in 8 out of 17 they displayed the same level of dietary diversity as their caregiver. This is approximately half of the respondents at 47%.

## 6.2. Indicator values of IYC

In total, the data of 24 children could be obtained via their caretakers. Details on breastfeeding habits have been recorded (see Annex 2), like time of initiation or whether exclusive breastfeeding was practiced. The exact birthdays of the respondents have been widely unknown, as births have not been documented in the village so there is no reliable source of documentation. For this reason, the age of the children was asked directly in months, which led to biases however this was the only chance to collect this data as fast as possible.

Based on the instructions of the WHO [WHO, 2010] the calculations of the following indicators have been done without SPSS, but nevertheless the rules of their document were strictly followed.

One positive remark is that 100% of surveyed mothers answered to having ever breastfed their children. 71% of respondents put their child to the breast within the time period of the 24-hours diet recall.

**Early initiation of breastfeeding: 0,29**

7 children (~29%) were put to the breast immediately. A large randomized, double-blind, placebo-controlled study in remote villages of central Ghana observed the correlations between the initiation of breastfeeding and the mortality of newborn children. Sub-Saharan Africa is still enduring a high neonatal mortality rate, which may be avoided with an earlier timing of initiated breastmilk. The study results show, that if a newborn receives breastmilk later than the first day, the risk of neonatal mortality was 2.4 times higher. Exclusively breastfed infants showed the lowest risk, compared to the partially breastfed group, which indicates that not only timing, but also type of feeding has an impact on a child's survival. [Edmond et al, 2006]

Similar findings have been made within the recently conducted systematic review and meta-analysis: If initiation of breastfeeding starts after the first hour of life, the risk of neonatal mortality rises by 33%. If the infant receives breastmilk later than 24 hours after birth, the risk increases by 2.19 times the average rate. [Smith et al, 2017]

In this study population nearly a third of the children were initiated early. The promotion of early initiation is highly recommended, principally in the remote areas of Ghana.

**Exclusive breastfeeding under 6 months:**

There were no infants between 0 and 5 months available, so this indicator remains unknown and should be targeted on future interventions.

**Continued breastfeeding at 1 year: 0,4**

Only 5 children at the age of 12 months were present, which does not lead to a valid indicator in this study. 2 out of the 5 children were breastfed the day before. Continuing breastfeeding is probably not promoted well, and therefore should be a focus of future interventions.

**Introduction of solid, semi-solid or soft foods: 0**

There were not enough infants between the age of 6-8 months to achieve representative data. From the four children who were assessed, none of them received solid, semi-solid or soft foods, but were exclusively fed breastmilk. The recommendation of WHO and UNICEF says that safe, adequate and properly fed food should be introduced at the age of 6 months, as the need for optimal growth of the child exceeds the sources of nutrients available from breastmilk. The actual advice for the early stages are „2–3 meals per day for infants 6–8 months of age and 3–4 meals per day for infants 9–23 months of age, with

1–2 additional snacks as required“[2]. [WHO Fact sheet, 2017] The statement is supported by a solid base of multiple studies and it recently has been proven that earlier introduction had no significant effect on weight or morbidity. [Smith, Becker, 2017]
Even if a child receives breastmilk after the age of 6 months, the chances of seeing stunted growth is high if no complementary food is given. The first two years of life are regarded as the „critical window“, in which the most important, life-determining growth and development of a child occurs. Inappropriate feeding after the age of 6 months has been identified as one major cause of malnutrition and as the cause of about 50% of deaths in developing countries of children under 5 years of age. [Ezzati et al, 2002]
An Australian study that analyzed the data of 833 Ghanaian children found the outcome of the prevalence of proper introduction of complementary foods between the ages of 6-8 months was 72.6%. Household poverty is mentioned as one of the main reasons of this late introduction. Furthermore, the introduction of solid, semi-solid or soft foods was significantly lower if the mothers were illiterate (adjusted OR = 3,55), which again highlights the importance of empowerment of women and the detrimental consequences that can arise when this factor is overlooked. From this study, only 14.1% of the data had been obtained from the Northern Region, and 62% came from rural settings. [Issaka et al, 2014] In Guabuliga, where 100% percent of the data derives from poorer rural areas, the outcomes switch to even lower numbers.

**Minimum dietary diversity: <u>0,2</u>**

Dietary diversity is used as a proxy for measuring the range of micronutrients consumed. In the data set of Guabuliga the level of diversity is extremely low, as not even a quarter of the population met the recommendation of ≥ 4 food groups consumed the previous day. All of them had a starchy staple, which was predominantly *Tuo Zaafi* (a dish made out of boiled maize in water) the previous day except for one child (16 months). The second most consumed food group is „dark green leafy vegetable“, and like *Tuo Zaafi* it is accompanied with a stew or soup, which regularly contains fresh or dried okra (*Abelmoschus esculentus*) or baobab (*Adansonia digitata*) leaves. Only 3 out of 24 infants and children scored a food group that was derived from animal sources (dairy products, flesh foods, eggs).
These patterns naturally reflect eating habits of their caretakers, of which the analysis of their dietary diversity has shown similar outcomes. Observations in another study showed that the earlier an infant is fed lumpy solids, the more likely it is to eat the same food as the rest of the family later. If they were introduced to solid foods at the age of 10 months

[2] WHO: *Fact sheet on infant and young child feeding*, July 2017, online source accessed on 16th Nov 2017

or later, more difficulties in feeding occurred and reluctances to certain foods formed more often. If infants received solid food from the age of 6 months, the chance to accept a higher level of dietary diversity is higher than when it is introduced at the age of 10 months or later. [Northstone et al, 2001]

**Minimum meal frequency: <u>0,3</u> for breastfed children**

**<u>0,3</u> for non-breastfed children**

An additional indicator has been created in *numbers* to evaluate „who received solid, semi-solid or soft foods the minimum number of times or more during the previous day".

Overall, not even a third of the infants and young children reach the requirements of the minimum meal frequency, which is an alarming result that should without question be addressed during future interventions.

**Minimum acceptable diet**

For calculating the MDD for non-breastfed children, an indicator with 6 food groups was created, which excludes dairy products. However, no changes needed to be made, as only one child consumed dairy. This child had a MDD of 5, and after adjustment of the food groups it drops to 4, which still shows sufficient dietary diversity.
Criteria for reaching the minimum acceptable diet:

| Dimension | Criteria |
|---|---|
| Minimum Dietary Diversity | **Breastfed**: 4 or more groups out of 7 food groups<br>**Non-breastfed**: 4 or more groups out of 6 food groups |
| Minimum Meal Frequency<br>(solid, semi-solid, soft foods) | **Breastfed, aged 6-8 months**: 2 or more feedings<br>**Breastfed, aged 9-23 months**: 3 or more feedings<br>**Non-breastfed, aged 6-23 months**: 4 or more feedings |

**Table 16**: Criteria for reaching the minimum acceptable diet, adapted from [WHO, 2010]

In the present sample, the indicator is ~ **<u>0,1</u>** for breastfed children.

The indicator for breastfeeding is practically zero and despite the small sample size shows us that there is absolutely no acceptable diet for infants, when applied to the reliable recommendations of WHO. Unfortunately, the indicator for non-breastfed children could not be determined because the questionnaire did not evaluate how often milk feeds were served. This missing data should be assessed during future assessments.

**Children ever breastfed**

The importance of breastfeeding was evidently clear to the caregivers that were interviewed. As a result, **100%** (24/24) of the children have ever been breastfed, which is a bright outcome and the base for the healthy evolution of the child.
Observations on-site also presented evidence that breastfeeding in public, such as on public transport, at restaurants or social gatherings are well established, which meets the WHO-suggestions.

**Continued breastfeeding at 2 years = 0,25**

Regrettably not enough data is available from this present dataset. From the total of 24 children, only 6 children were of the age of 20-23 months, which does not allow representative conclusions to be drawn. Obviously continued breastfeeding does not seem to happen generally and there should be another focus in future education concerning lower morbidity, mortality, alongside fewer dental complications and higher IQ. [Victoria et al, 2016]

# 7. Limitations

The most significant limitation in this study was the small population size for evaluating the infant and young child feeding practices. Women in Guabuliga were cooperative in giving details about their practices after the interview for themselves. The participation to solely answer questions about their children when interviewed for MDD-W was sufficient, but for the IYCF-Indicators it was rather low.

Furthermore, it was not possible to gain information of the exact birthdays, neither from women nor from the children as there is little to no official birth registry in the village. Only a few people knew their exact date of birth, and nearly none knew the birthdate of their child so the ages had to be based on estimations from both sides. This could create biases for the outputs of IYCF practices because the gaps of some indicators were only a few months.

Another limitation is the use of the 24-hour recall window. People tend to over- or underreport, both subconsciously and consciously. This widely known phenomenon produces errors on the information about food and nutrient intakes, and it is not clear to what extent foods and nutrients are affected.

However not only errors in reporting may reflect differences between the actual diets and the dataset. Seasonal changes have a huge influence on traditional eating habits, especially in remote areas where basically no import of foods take place. People in Guabuliga are mostly dependent on farming, which changes their eating behaviors tremendously through different seasons. A study that was conducted in various areas of Northern Ghana, close to Guabuliga, revealed that dietary diversity is significantly higher during the rainy season than during the dry season. The highest prevalent differences were in the consumption of vitamin A-rich fruits and vegetables, and vitamin A-rich deep yellow, orange and red vegetables. [Abizari et al, 2017]

# 8. Discussion

Overall, the staple diet of women and young children in Guabuliga is centered around maize, rice, oil and vegetables. Using the 10 specified food groups, women had a mean MDD-W of 3.5 and young children 2.8 using 7 total food groups. If 5 out of 10 food groups (MDD-W) have been consumed, a sufficient level of diversity would be deemed to have been reached. 7.5% of the 75 assessed women had a sufficient diversity according to this definition.

For infants and young children an acceptable diverse diet is reached if 4 out of 7 food groups have been achieved. In both the cases the nutritional behaviors observed could not meet these recommendations. These findings align with the results of the *Feed the Future Initiativ*e. In 4 regions (Northern, Brong-Ahafo, Upper East, Upper West region) the MDD-W of 4.0 ± 1.6 was assessed. When only investigating rural communities, an indicator of 3.8 ± 1.5 was reached. The low diversity in Guabuliga may result from its remoteness.

IYCF practices are poor in Guabuliga. The initiation of breastfeeding is often too late and the dietary diversity of the infant is extremely low as they mostly receive watery maize dishes that are not suitable in meeting the nutritional requirements of infants. The minimum meal frequency is also not sufficient and continued breastfeeding up to two years does not happen on a regular basis which exacerbates the problem and risk of malnutrition. 47% of children showed the same level of dietary diversity as their caregiver. If women receive a diet rich in diversity, it is very likely that the diet of the child will also be more diverse automatically.

Big progress towards non-farm incomes is already ongoing in Guabuliga through training centers of the NGO *Braveaurora*, where women tend to be a key focus and are trained in skills such as weaving, Shea butter and soap processing or baking that all can lead to a supplementary income of the household. A tough quest is the mobilization and motivation of the society, which surely needs improvement. Current projects being executed by *Braveaurora* can be seen on their homepage: *http://www.braveaurora.org* and even more information is updated on their blogspot, including a few articles that have been uploaded during the field-stay of this study: *http://braveaurora.blogspot.co.at*.

## 8.1. Interventions

### 8.1.1. Training interventions

**Nutrition education**

An intervention in rural areas of Malawi raised knowledge among civilians concerning diet diversification in young children and the hygienic practices during food preparation and feeding infants. The short-term effect of the exposure to the educational program was, that the standard of health was enhanced among children because caregivers were motivated to apply the knowledge they received about IYCF practices. Long-term effects have not been collected. [Chiutsi-Phiri, 2017]

Even if food resources are sufficient to practice proper IYCF, it is necessary that knowledge and awareness in nutrition are present. Nutrition education programmes bear great potential to improve IYCF practices.

As *Braveaurora* hosts volunteers throughout the year, dedicated people with an educational background regarding nutrition that teach pupils in schools or women in the community should be considered. Most volunteers stay for half a year, and the follow-up can be done at the end of the stay after 6 months for short-effects, and long-term effects evaluated through the next group of volunteers. The methodology should be discussed before data sampling is carried out and the implementation of nutrition education with nutrition experts in the origin country of the volunteer and Tamale (*University of Development Studies, UDS, Faculty Allied Health Sciences*).

Additionally, the data assessed from this study can be used as a baseline for various indicators.

**Policy environment**

To shift behavior, policies based on recent scientific findings contribute to success for long-term results. Over a period of 4 years, the policy environment targeting nutrition and IYCF practices in Vietnam, Bangladesh and Ethiopia have been examined, and different improvements have been scored in each country. In all countries the priorities have been focused on the reduction of stunting of growth and exclusive breastfeeding. Key actors besides the government were civil societies and also development partners and the private sector. The policies are well-recognized among legislation and implementation processes. However, the commitment to fund further implementations still challenges potential impacts of improved policies.

Policies can catalyze changes in nutritional behavior and improve IYCF practices on a national level. The obstacles of financing and the commitment of multiple systems need to be managed to achieve change. [Harris et al, 2017]
The existing collaboration between *Braveaurora* and *UNICEF* can be used to spread key messages from policies regarding health and nutrition among civilians. It could also be considered that the person who will be responsible for the nutrition education gets in touch with workers from *UNICEF* onsite to explore possibilities.

### 8.1.2. Health interventions

**Deworming**
This particular issue leads to infection that can result in a vicious cycle with regard to malnutrition. A study in the Philippines revealed that the level of children infected with *Schistosoma japonicum* and hookworm was significantly higher for those who did not reach the recommended nutrient and energy intakes.
Most of the children who did not have a sufficient intake of energy, iron, thiamine and riboflavine were infected with *Trichuris trichiura*. There was a significant correlation between infections of parasitic worms and the poor intake of energy, thiamine and riboflavin. Especially in the case of hookworm infection it was found out to be a major predictor of stunting.
Insufficient intakes of different micronutrients like vitamin A, vitamin B12, vitamin C, β-carotene, riboflavin, selenium, zinc, and iron may lead to a reduced immune response and therefore make the body vulnerable to infections. Once an infection is present it may lead to a reduced level of absorption of nutrients and to impaired digestion through damage in the intestinal mucosa.
In tropical and subtropical areas where levels of poverty are high, and hygiene and sanitation is poor the prevalence of infections with intestinal parasitic worms is high. [Papier et al, 2014] In rural areas like Guabuliga the variety of foods was low which may lead to deficiencies and a high susceptibility to infection. These intestinal parasites remain as one of the heaviest burdens in developing countries, mostly with school-aged children.
The connection between these infections and *Anorexia* has already been proven in several studies during the 1980's. A review in 1984 showed that when rats, mice, pigs, sheep and domestic fowl were infected with 12 species of helminth and protozoan parasites, 10 of the species experienced reduced food intake and as a result reduced weight gain.

These findings motivated scientists to do research for the sake of human health. Primary school children in Kenya and Indonesia who were infected with either *Schistosoma haematobium*, hookworm, *Trichuris trichiura* or *Ascaris lumbricoides* were treated for their infections. 3 weeks to 4 months after treatment they showed a significantly improved appetite and consumed more food. Compared to placebo groups, the infection-treated children also gained more weight and improved in more anthropometric measures like physical fitness. It is recommended to treat school-age children against the intestinal worm infections, as they show a high prevalence and the infection with *Ascaris lumbricoides* for example shows adverse effects on cognitive development [Jukes et al, 2008]. The mild and chronic form of an infection with Trichuris colitis may result in growth retardation in children. Even when there are no symptoms, there are effects on nutritional status and physical and intellectual development. [Stephenson et al, 2000] As well as the hookworm, which can have negative impacts on cognitive functions. [Satki et al, 1999]
In 2016 The Ghana Health Services (GHS) and Ghana Education Service (GES) initiated a deworming program including pupils from kindergarten to Junior High School all over the country. 1.3 million school children from public and private schools were targeted in about 8,200 schools across Ghana, with the goal to reduce the problem until it reaches a level without public health significance by 2020 and final elimination by 2025. Until now, the biggest challenges have been weak social mobilization and delayed or missing data in reports. [Government of Ghana Official Portal, 2018] *Braveaurora's* first step shall be to get in touch with the GHS and the GES to find out about ways to involve the kindergarten and schools of Guabuliga. At least one team member of *Braveaurora* needs to be included to ensure sustainability of the project, that can be supported through volunteers.

**Preventing Malaria**

Malaria is part of a vicious circle. Undernourishment goes hand in hand with a lack of micronutrients and is what makes people more vulnerable to infectious diseases. Once an infectious disease occurs, more micronutrients are needed to help the body recover. Malaria is one of the main health problems in sub-Saharan Africa. The 2013 World Malaria Report indicates that there were 627,000 deaths due to Malaria worldwide, where approximately 90% of deaths occurred in sub-Saharan Africa and mostly in children under five. [WHO, 2013] It is most fatal if a child is severely undernourished (<70% normal weight/height), and the typical symptoms such as fever don't appear. This means that all children or everyone should be screened proactively, even if no signs of malaria are visible. WHO recommends that all children who are severely undernourished must be tested for malaria as soon the diagnosis of severe malnutrition appears, and as soon as possible an admission of a therapeutic feeding program will help. After this first administration,

every week the medicine must be given until the program ends. Only if artemisinin-based combination therapy (ACT) treatment has been received, can testing be skipped in the following week. Rapid diagnostic test or microscopy can be used for diagnosis. What the WHO also specifically points out is that all therapeutic feeding centers need easy access to good malaria microscopy. If a test is positive the case must be treated even if no symptoms or clinical signs are present. If a child is moderately undernourished then the same signs as patients with a normal nutritional status will be present, so no proactive testing with asymptomatic children is necessary. [WHO/RBM, 2005]

A study in Ethiopia confirmed the correlation between malaria and malnutrition. If a child suffered from malaria it is more probable to show signs of wasting or stunting [3]. Also, caretakers without education were observed to be associated with malaria especially among children under the age of five years. Therefore, it is important to prevent and control malaria, especially for severely wasted children. [Shikur et al, 2016]

Four main strategies to control malaria diseases have been pointed out by the Ghana Health Services:

- Promoting the usage of treated bed nets, chemoprophylaxis during pregnancy and environmental management
- Improving the management of malaria cases from the household level to health facilities
- Supporting evidence-based research
- Enhancing partnerships with partners at all levels

Bed nets have rarely been witnessed during household visits in Guabuliga. *Braveaurora* could effectively contribute if donations in the form of malaria nets were given. The hospital onsite provides the community with malaria testing kits and antimalarial drugs. The aim should be that 100% of households own an insecticide treated bed net, especially for any children under 5 years of age and pregnant woman should permanently sleep under it. Furthermore, all pregnant women should be encouraged to take chemoprophylaxis. The environmental management is present, since indoor residual spraying takes place regularly. However, observing regularity of this precautionary method would be advantageous. Regular trainings for parents, caretakers and teachers could be provided to recognize early signs of malaria. [Ghana Health Service, 2018]

[3] „**Wasting**: below minus two standard deviations from median weight for height of reference population. **Stunting**: below minus two standard deviations from median height for age of reference population.“ Definitions by UNICEF

**Preventing anemia**

Several strategies need to be undertaken for fighting the high prevalence of anemia which represents a common global goal. The second Global Nutrition Target 2025 aims at reducing anemia among women of reproductive age by 50%. Anemia is an indicator of poor nutrition and poor health. Personal well-being is reduced overall, as it leads to fatigue and lethargy which causes impaired physical productivity and work performance. [Horton, Ross, 2003] Deficiency is caused by many sources. Primarily it is caused by iron deficiency, resulting from a prolonged low intake of dietary iron, inadequate absorption, higher RDI needs due to pregnancy or growth, or increased losses due to events such as menstruation or intestinal worms. About 50% of all cases of anemia in women are due to iron deficiency. [Stevens et al, 2013] Other causes of anemia are infections, nutritional deficiencies like folate, vitamin B12, vitamin A and vitamin C or inherited genetic disorders like sickle cell disease. The prevalence of anemia is also high in cases of severe malaria and other secondary bacterial infections. This especially puts a great toll on pregnant women in moderate- and high-transmission areas of malaria. Mainly women during their first pregnancy are very vulnerable to severe anemia. Furthermore, pregnant adolescent women have dual iron requirements, which makes them even more vulnerable to anemia.

It is important to recognize the complexity of anemia so that successful strategies can be implemented. The current strategies for implementation for women of reproductive age have been set by the WHO using systematic reviews of the corresponding literature. Not only the mother and infant benefit but also the neonate benefit from the following strategies, since breastmilk is an important and highly bioavailable source of iron. Summarized strategies for reducing anemia are outlined below:

- In settings where prevalence of anemia is a minimum of 20% it is advised to give supplementation of iron and folic acid among menstruating women.
- Other vitamins and minerals may be included in supplements to reduce maternal micronutrient deficiencies.
- Supplementation after birth should be carried on for at least 3 months to improve iron status and thus reduce the risk of anemia.
- Where wheat and maize flours are major staples in the diet fortification of these items can be done.
- Distributing supplements should relate to the diagnosis and treatment of malaria.
- In emergency cases lactating and pregnant women can be given the chosen micronutrient supplement of UNICEF/WHO which provides all of the daily recommended micronutrients.
- Pregnant women who suffer from active tuberculosis should be given multiple micronutrient supplements for meeting the maternal needs of micronutrients.

- The promotion and support of exclusive breastfeeding up to 6 months is important.
- And finally, it is important to care for a diet which contains enough bioavailable iron.

Possible interventions must be planned and be multidimensional including a diverse diet rich in iron, but also malaria control with preventative treatments and insecticide-treated nets as previously described. Also, the deworming of all women of reproductive age with medicines needs to be done, even when no diagnosis is present. Moreover, education is one of the most important inputs to be able to transfer knowledge about reproductive health and hygiene, in order to reduce the risk of infection. Water and sanitation interventions which are already regularly done in Guabuliga should also be integrated. [WHO, 2014]
An effective method to achieve a higher intake of a certain micronutrient in nutrition, without the difficult task of social mobilization and changing behavioral patterns is biofortification. Through conventional breeding and transgenic methods, the concentration of iron and prebiotics can be increased, and at the same time phytic acid can be reduced.
Iron fertilizers would be costly and could be harmful to the environment. Fertilization with iron chelates is not a long-term and sustainable approach. Bio-fortification, however, is cheap and sustainable. The enhancement of nutritional benefits must be achieved without reduction in agronomic performance, protein concentration, crop yield or any other major traits. The main obstacle for crop fortification is the strict law for transgenic crops. A huge amount of time passes between the production of the fortified crops and the allowance to legally distribute them to the public. This is a severe burden for those who could fight deficiencies with these transgenic crops. [Murgia et al, 2012]
The already existing cooperation between *UNICEF* and *Braveaurora* should be used to investigate in the possibility of distributing supplementation among women of reproductive age.

### 8.1.3. Food based interventions

**Promoting fermented foods**

It has been proven in several studies from developed and developing countries around the globe that defined probiotic cultures shortens the duration of diarrhea significantly. The same effects can be seen with indigenous fermented foods. Probiotic starter cultures are expensive and therefore not sustainable. Research onsite revealed that in Walewale, the market town nearby, a fermented millet drink is sold on a few stands. It was bought to

show the drink to people in Guabuliga, and they knew the product and liked it. Acceptance of the product is high, production is probably cheap and well known from people nearby and surely could be done by people in Guabuliga to reduce the morbidity from diarrhea, especially among children. A controlled randomized intervention study was carried out in different villages in Northern Ghana among children under the age of 5 years with diarrhea (3 or more watery stools in 24 hours).

The production of the millet drink is shortly described in Lei et al, 2006:

„Pearl millet (*Pennisetum glaucum*) is steeped overnight and wet-milled together with spices such as ginger, chilli pepper, black pepper, and cloves. Addition of water to the flour makes a thick slurry, which is then sieved and left to ferment and sediment for 2–3 h. The fermented top-layer (called koko sour water; KSW) is then decanted to a pot and boiled for 1–2 h. After boiling, the thicker sediment from the fermentation is added until the desired consistency is achieved."

In this study no significant changes, only trends, were observed regarding stool frequency, consistency and the duration of diarrhea. It is discussed that one of the reasons may have been the broad-spectrum antibiotics that have been handed to a third of the children during intervention. The mechanisms behind this are not yet known. Before production could start and the introduction of the millet drink to the public, it must be proven that the predominant lactic acid bacteria is able to reduce the morbidity from diarrhea. [Lei et al, 2006]

Not only drinks, but also vegetables may bring big benefits through fermentation. It is a home-based process with minimal technology requirements and prevents the food from spoilage. Fermenting food as a post-harvest strategy may reduce food wastage and contribute to food security. It can reveal new flavors, aromas and detoxifies the products. Non-edible products can be made edible, and raw material may improve the sensory characteristics. Furthermore, it can improve the economic security of families, especially women when products are processed and traded for income. Trainings to overcome microbial safety challenges must be regularly carried out as pathogenic bacteria like *Bacillus cereus, Enterococcus facium* or *Enterococcus faecalis* may appear in fermentations of vegetal protein or leafy vegetables. [Oguntoyinbo et al, 2016] Products like *fufu* (fermented cassava) and *kinkey* (fermented maize) are widely eaten in Northern Ghana and should get more recognition in Guabuliga. Dietary status could be improved, especially when starter cultures increase bioavailability of different nutrients. Leafy products are not common, and sensory acceptability should be tested before intervention. The losses after the harvest of leafy vegetables are high, and the fermentation of those would bring many benefits. [Oguntoyinbo et al, 2016] A close cooperation between universities, research institutions, local producers and *Braveaurora* as the local NGO is needed to establish the

appropriate technology for developing appropriate starter cultures and sustainable packaging and marketing in the village.

**Promoting *Moringa Oleifera***

This tropical plant grows perfectly in the surroundings of Guabuliga and many could be observed onsite. The inhabitants also seem to know about the benefits from the plants once they are sick. Traditionally Moringa Oleifera is only used as a medicine against nearly any kind of sickness. It is however, not consumed on a daily basis, which could enrich the diversity of the diet a lot more.

**Illustration 12**: Moringa oleifera in Guabuliga © Vera Högl, 2017

The fast-growing plant shows a wide range of advantages regarding agricultural and nutritional benefits. It not only has a low demand for nutrients in the soil and for water, but it also tolerates long and heavy rainfalls (about 250mm$^3$ - 3000 mm$^3$ rainfall annually). Its leaf production peaks towards the end of the dry season, where the harvest of other nutritious foods is scarce.

All parts of the tree are edible and each part has its own nutritional and therapeutic virtue. Important beneficial components are glucosinolates and isothiocyanates which can reduce high blood pressure, prevent cancer and fight bacteria. Furthermore, it contains phenolic compounds like flavonoids, mostly quercetin, which has a high antioxidant, antidiabetic, antidyslipidemic and hypotensive potential. In addition, high levels of chlorogenic acid have been identified which is proven to reduce hepatic gluceneogensis in rats. Moreover, phytosterols like β-sitosterol was isolated from the Moringa leaves, which are known to be able to reduce the uptake of dietary cholesterol in the intestine. β-carotene is another important bioactive compound of the leaves. What is highly relevant is that it is also able to contribute to protein intake. Animal source foods were observed to be extremely

low, so the essential amino acids contained in the plant such as arginine, histidine, and iron would be a major benefit to combat micronutrient malnutrition. [Alegbeleye, 2017]
A study concerning the fortification of maize, soybeans and peanuts with Moringa has been conducted in Nigeria. With different blends of the ingredients, the ratio of mixing 60 maize: 30 soybean: 10 peanut, fortified with 10% dried Moringa leaves showed the best results. For example, 100g will satisfy the protein requirements of an infant and it is fortified with many of the nutrients mentioned above. [Shiriki, 2015]
Moringa Oleifera has huge potential to diversify diets due to its excellent source of nutrients.

# 9. Conclusions

The dietary diversity of women of reproductive age is below the standard recommendation which puts them at a high risk of being underweight, with micronutrient deficiencies. This is especially true in young women who show a poor level of diversity, which most probably will show negative effects on the newborn, and subsequently later in life.
The assessment of the intake of different food groups showed that there is little or no consumption of eggs, Vitamin A-rich fruits and vegetables, milk and milk products, meat, nuts and seeds. Generally, only a few women reported to eat foods from animal origin because the diet is dominated by starchy staples. Vegetables like tomatoes, okra and baobab leaves are the second most consumed food group. Additionally, soybeans and groundnuts contribute to a higher dietary diversity. Therefore, the focus of food promotion should be on foods from animal origin, fruits and nuts.
No significant correlation could have been observed between the diversity of the diet and size of the household, number of people with income, and farmers living in the same household or wealth. The only significant correlation could have been observed between the dietary diversity and age. The older a woman gets, the more diverse the diet becomes.
Indicators evaluated for breastfeeding and young child feeding practices do not meet the recommendations of WHO. Not even a third of children have been put to the breast immediately after birth. The minimum acceptable diet, which combines the two dimensions of dietary diversity and minimum meal frequency was not sufficient, in the same vein as continued breastfeeding.
The causes which lead to a poor diet are multifactorial and to shift behaviors which are so deeply rooted is a long, difficult, but essential task. A key element to a nutritious diet is the enhancement of knowledge regarding a healthy diet, what can be initiated from the NGO onsite *Braveaurora*. Regular training with women and children will lead to a sustainable shift towards a healthier life. Also, well planned food interventions, which can be planned in cooperation with a university in the region, as for example it is currently in Tamale in Northern Ghana with a Public Health Institute, can help to defeat deficiencies and diversify the nutrient intakes. A source of great potential is the plant *Moringa oleifera*, which trees grow in the surroundings but are not consumed on a regular basis.
But not only the nutrition itself affects the health of the individuals. Sicknesses such as anemia, malaria and worms additionally weaken the immune system and revoke multiple macro- and micronutrients. Deficiencies are even more likely to be present during those

periods of higher needs, which puts people even at a higher risk to an insufficient nutrient status. This vicious cycle needs to be broken.
Programmes that will be implemented in the future need to be monitored, well documented, evaluated and properly communicated to ensure proper action is taken.

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**Table 2:** Estimates of mortality in Ghana among children under age 5 and children aged 5–14:
UN IGME (United Nations Inter-agency Group for Child Mortality Estimation): *Levels & Trends in Child Mortality: Report 2017, Estimates Developed by the UN Inter-agency Group for Child Mortality Estimation.* New York, 2017

**Table 4:** Minimum number of times of feeding complementary foods, adapted from WHO:
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**Table 5**: Criteria for reaching the minimum acceptable diet, adapted from WHO:
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**Table 14:** In Vitro Iron Bioaccessibility Using Caco-2 Cells:
AMAGLOH FK, ATUNA RA, MCBRIDE R, CAREY EE, CHRISTIDES T: *Nutrient and Total Polyphenol Contents of Dark Green Leafy Vegetables, and Estimation of Their Iron Bioaccessibility Using the In Vitro Digestion/Caco-2 Cell Model.* Foods, 2017;6(7):54, DOI: 10.3390/foods6070054

**Table 16**: Criteria for reaching the minimum acceptable diet, adapted from WHO:
WHO: *Indicators for assessing infant and young child feeding practices, Part 2: Measurements.* Switzerland, 2010

**Illustration 1:** The vegetation of Savanna:
*The Bamboo Alternative: a Neglected Opportunity? Exploring the potential of bamboo biomass energy for Forest Landscape Restoration in the Western Region, Ghana – a Livelihoods perspective*. Master's Thesis Wageningen University, 2012. DOI: 10.13140/RG.2.1.1965.8648

**Illustration 2:** Ethnic groups in Ghana:
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**Ilustration 3:** Historical Ghana:
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**Illustration 4:** Location of Guabuliga, (left: Africa, right: Ghana):
Google Maps, 2017, search: „*Guabuliga, Ghana*", online source accessed on Nov 21st 2017

**Illustration 5:** Detailed surroundings of Guabuliga:
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**Illustration 6:** Ingredients of Banku with okra stew:
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**Illustration 7:** Ingredients of Tuo Zaafi and Alefu leaves:
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**Illustration 8:** Ingredients of Yam with cabbage stew:
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# Annex

**Annex 1:** Questionnaire for women

#
Date of recall: __/__ (DD/MM) Date of Birth: __/__/____ (DD/MM/YYYY)

| | | |
|---|---|---|
| **Number of people in hh 7** | ~~**Weight** _____ kg~~ | ~~**Height** _____ cm~~ |

| No. | Question | Yes = 1<br>No = 2 |
|---|---|---|
| **1** | In what month and year were you born? | Month:<br>Year: |
| **2** | Please tell me how old you are. What was your age at your last birthday? | |
| **3** | Have you ever been pregnant? | |
| **4** | Have you ever given birth? | |
| **5** | Do you currently have a child aged between 6 and 23 months? | |

| | | | | |
|---|---|---|---|---|
| | | | **Index of wealth** ∑ | |
| Car/Truck | | Motorbike | | |
| Bicycle | | Fridge | | |
| Television | | Radio | | |
| Cattle/Goats/Donkeys | | Chicken/Guinea fowl | | |
| Cellphone | | Electricity | | |
| | | | Cash income 0 (none), 1 (one person), 2 (of two people in the household or more) | |
| | | | Farmers in the hh (Yes=1, No=2) | |

| 6 | Food category | Description | Yes = 1<br>No = 2 |
|---|---|---|---|
| **A** | Foods made from grains | Bread, porridge, rice, noodles, banku, tuo zaafi (tz) amaranth, oats or other foods made from grain, | |
| **B** | White roots and tubers | Potatoes, yams, cassava, cocoyam, plantain or other foods made from white roots or tubers | |
| **C** | Pulses (beans, peas, lentils) | Beans, peas, soybean (including tofu, soy milk/cheese) | |
| **D** | Nuts and seeds | Tree nut, groundnut, seeds, groundnut butter, shea butter, baobab seed | |
| **E** | Milk and milk products | Fresh, canned, tinned, boxed milk, cheese, yogurt<br>***NOT**: butter, cream, sour cream (cat. Q)* | |
| **F** | Organ meat | Liver, kidney, heart, gizzard/stomach, blood sausage or other blood products | |
| **G** | Meat and poultry | Beef, pork, lamb, goat, domesticated or wild mammals, chicken, guinea fowl, duck or other bird, pale organ meats, rat, crocodile, frog, snake | |
| **H** | Fish and seafood | Fresh, frozen or dried fish, canned fish, seafood | |
| **I** | Eggs | Bird eggs (chicken, duck, guinea fowl, quail) | |
| **J** | Dark green leafy vegetables | Medium-to-dark green leafy vegetables such as Alfalfa greens, Amaranth greens, Baobab greens, Bean greens, Broccoli, Carrot greens, Cassava greens, Kale, Lettuce, Okra greens, Spinach, Sweet potato leaves | |
| **K** | Vitamin A-rich vegetables, roots and tubers | Pumpkin, carrots, sweet potato (yellow or orange inside), red pepper | |
| **L** | Vitamin A-rich fruits | Mango, papaya (if not ripe: Cat N), passion fruit | |
| **M** | Other vegetables | Tomatoes, Cucumber, Okra, fresh/green peas and beans, bamboo shoots, eggplant, artichoke, asparagus, beets, spinach, fennel, green pepper, jicama (yam bean), lettuce, mushroom, onion, palm hearts, radish, zucchini and others | |
| **N** | Other fruits | Bananas, avocado, baobab fruit, berries, cashew fruit, coconut flesh, dates, grapefruit, grapes, melons, lemon, lime, orange, pineapple, 100 % fruit juices and others | |
| **O** | Red palm nut products | | |
| **P** | Other oils and fats | Butter, cream, animal fats, margarine, mayonnaise, palm oil (not red palm oil), sour cream, vegetable/fruit/nut/seed oils | |
| **Q** | Savoury and fried snacks | Plantain chips, potato chips or other deep-fried, mainly carbohydrate, snack foods | |

| | | | |
|---|---|---|---|
| **R** | Sweets | Biscuits, cakes, candies, chocolates, coconut snacks, cookies, ice cream, fruit canned in sugar syrup, fruit gummy candies, honey, jam, sweetened condensed milk, any other sweets | |
| **S** | Sugar-sweetened beverages | Chocolate drinks, coffe/lipton with sugar, malt drinks, energy drinks, any other sweetened drink, sweetened dairy drinks | |
| **T** | Condiments and seasonings | Buoillon cubes, fish powder/sauce, ketchup, herbs, seeds and nuts when used for flavouring a dish, soy sauce, sugar (when added to flavor a mixed dish), tomato paste, any other seasoning or garnish added during cooking or when serving | |
| **U** | Other beverages and foods | Alcohol, Clear broth, Coffee/Lipton (with or without milk, unsweetened, any other food or beverage not included in previous group<br><br>_____ | |

**Annex 2:** Questionnaire for caregivers of infants and young children

Caretaker #
Date of recall: __/__ (DD/MM) Date of Birth: __ __ ____ (DD/MM/YYYY)

| No | Questions | Yes= 1<br>No = 2 |
|---|---|---|
| 1 | Has your child ever been breastfed? | |
| 2 | Did your child consume breast milk in any of these ways yesterday during the day or at night? | |
| 3 | Is your child currently exclusively breastfed? | |
| 4 | Was your child given any vitamin drops or other medicines as drops yesterday during the day or at night? If yes, which: _____ | |
| 5 | How long after birth did you put your child to the breast?<br>Immediately=0, Hours=#hours***h***, Days=#days***d*** | |

Gender (f=1, m=2): Age: __ months

| 6 | Food category | Description | Yes = 1<br>No = 2 |
|---|---|---|---|
| **A** | Foods made from grains | Bread, porridge, rice, noodles, banku, tuo zaafi, amaranth, fufu, oats, other foods made from grain | |
| **B** | White roots and tubers | Potatoes, yams, cassava, cocoyam, plantain or other foods made from white roots or tubers | |
| **C** | Pulses (beans, peas, lentils) | Beans, peas, soybean (including tofu, soy milk/cheese) | |
| **D** | Nuts and seeds | Tree nut, groundnut, seeds, groundnut butter, shea butter, baobab seed | |
| **E** | Milk and milk products | Fresh, canned, tinned, boxed milk, cheese, yogurt, ice cream<br>***NOT**: butter, cream, sour cream (cat. Q)* | |
| **F** | Organ meat | Liver, kidney, heart, gizzard/stomach, blood sausage or other blood products | |
| **G** | Meat and poultry | Beef, pork, lamb, goat, domesticated or wild mammals, chicken, guinea fowl, duck or other bird, pale organ meats, rat, crocodile, frog, snake | |
| **H** | Fish and seafood | Fresh, frozen or dried fish, canned fish, seafood | |
| **I** | Eggs | Bird eggs (chicken, duck, guinea fowl, quail) | |
| **J** | Dark green leafy vegetables | Medium-to-dark green leafy vegetables such as Alfalfa greens, Amaranth greens, Baobab greens, Bean greens, Broccoli, Carrot greens, Cassava greens, Kale, Lettuce, Okra greens, Spinach, Sweet potato leaves | |
| **K** | Vitamin A-rich vegetables, roots and tubers | Pumpkin, carrots, sweet potato (yellow or orange inside), red pepper | |
| **L** | Vitamin A-rich fruits | Mango, papaya (if not ripe: Cat N), passion fruit | |
| **M** | Other vegetables | Tomatoes, Cucumber, Okra, fresh/green peas and beans, bamboo shoots, eggplant, artichoke, asparagus, beets, spinach, fennel, green pepper, jicama (yam bean), lettuce, mushroom, onion, palm hearts, radish, zucchini and others | |
| **N** | Other fruits | Bananas, avocado, baobab fruit, berries, cashew fruit, coconut flesh, dates, grapefruit, grapes, melons, lemon, lime, orange, pineapple and others | |
| **O** | Red palm nut products | | |
| **P** | Other oils and fats | Butter, cream, animal fats, margarine, mayonnaise, palm oil (not red palm oil), sour cream, vegetable/fruit/nut/seed oils | |
| **Q** | Savoury and fried snacks | Plantain chips, potato chips or other deep-fried, mainly carbohydrate, snack foods | |
| **R** | Sweets | Biscuits, cakes, candies, chocolates, coconut snacks, cookies, fruit canned in sugar syrup, fruit gummy candies, honey, jam, sweetened condensed milk, any other sweets | |
| **S** | Sugar-sweetened beverages | Chocolate drinks, coffe/lipton with sugar, malt drinks, energy drinks, any other sweetened drink, sweetened dairy drinks, 100 % fruit juices | |

| | | | |
|---|---|---|---|
| **T** | Condiments and seasonings | Buoillon cubes, fish powder/sauce, ketchup, herbs, seeds and nuts when used for flavouring a dish, soy sauce, sugar (when added to flavor a mixed dish), tomato paste, any other seasoning or garnish added during cooking or when serving | |
| **U** | Other beverages and foods | Clear broth or any other food or beverage not included in previous group<br><br>_____ | |

| | | |
|---|---|---|
| **7** | How many times did your child eat solid, semi-solid or sot foods other than liquids yesterday during the day or at night? | |

| A,B | C,D | E | F,G,H | I | J,K,L | M,N | **IYCF** |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

**Annex 3:** T-Test MDD-W and Householdsize

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. |
| 1 | (Constant) | 3,472 | ,352 | | 9,866 | ,000 |
| | Householdsize | ,001 | ,041 | ,003 | ,025 | ,980 |

a. Dependent Variable: MDDW

**Annex 4:** T-Test if MDD-W=2 shows significantly lower wealth scores than MDD-W>2

**Independent Samples Test**

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| Wealth | Equal variances assumed | ,018 | ,893 | 1,595 | 73 | ,115 | 1,088 | ,682 | -,271 | 2,448 |
| | Equal variances not assumed | | | 1,598 | 17,446 | ,128 | 1,088 | ,681 | -,345 | 2,522 |

**Annex 5:** Spearman Correlation MDD-W and age

**Correlations**

| | | Age_y | MDDW |
|---|---|---|---|
| Age_y | Pearson Correlation | 1 | ,245* |
| | Sig. (2-tailed) | | ,034 |
| | N | 75 | 75 |
| MDDW | Pearson Correlation | ,245* | 1 |
| | Sig. (2-tailed) | ,034 | |
| | N | 75 | 75 |

*. Correlation is significant at the 0.05 level (2-tailed).

**Annex 6:** T-Test for MDD-W and Age

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. |
| 1 | (Constant) | 17,691 | 4,067 | | 4,350 | ,000 |
| | MDDW | 2,434 | 1,127 | ,245 | 2,160 | ,034 |

a. Dependent Variable: Age_y