Situation analysis of salt iodization and iodine status in Angola
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FINAL

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EXECUTIVE SUMMARY

Iodine deficiency adversely impacts the cognitive development and growth of the fetus and the young child, and impairs the cognitive performance in school-aged children. Globally, the iodization of household salt has improved and expanded in the past two decades, which has reduced the prevalence of caseloads of iodine deficiency and its disorders. This situation analysis report, initiated by the Iodine Global Network, summarizes all available information related to salt iodization and iodine deficiency disorders (IDD) in Angola. The assessment took place in July 2016, and included detailed discussions with all critical stakeholders involved in the USI program.

The Angolan salt industry currently consists of 23 salt producers, situated in 6 coastal provinces (Benguela, Namibe, Kwanza Sul, Bengo, Luanda, Zaire). Of these producers, 3 can be classified as large producers (>5000 ton per year) and the rest as medium producers (1000 – 5000 ton per year) based on their 2015 production. According to 2014 domestic production figures, only six of the 23 companies account for >90% of all domestic salt production destined for human or animal consumption. Domestic salt production is complemented by salt imports, which have been estimated at ~40% of Angola's total salt market. Salt for humans is consumed directly as table salt, in processed foods or as part of salted fish.

The salt iodization program began in 1996, and legislation has been passed to regulate the packaging requirements, establish the national salt iodization "Technical Committee" (Comissão Nacional Técnica para a iodização do Sal), and mandate that all salt sold in Angola is iodized according to national standards (i.e. 25-55 ppm). The Technical Committee is a multi-sectoral body coordinated by the Ministry of Fisheries.

Over the past several years, the Technical Committee has conducted routine assessments in some provinces on an annual basis by taking convenience samples from markets, churches, and households testing for iodine using rapid test kits. Such assessments enable estimates of the proportion of salt which contains any iodine. National surveys in 2001 (MICS), 2007 (National Nutrition Survey), and 2015 (MICS) have also measured the presence of iodine in salt using rapid test kits. The results from these surveys show that the coverage of iodized salt has steadily increased and ~80% of salt in Angola contains some iodine. However, there have been no assessments that quantitatively measure to the iodine concentration in salt. Only one study measuring urinary iodine status has been conducted in 2006, and showed that nearly 100% school-age children in Bié province had urinary iodine concentrations <100µg/L and a median UIC of 29 µg/L, suggesting moderate deficiency.

To assess the performance of Angola's salt iodization program, IGN and GroundWork used assessment tools from WHO/UNICEF/ICCIDD salt iodization monitoring guide, the GAIN/UNICEF salt iodization partnership sustainability framework, and the UNICEF NutriDash sustainability index. These
three tools illustrate that the strongest components of Angola's salt iodization program are the existence of legislation and standards. In contrast, national coordination and communication efforts are established but can be improved, while the programs’ quality assurance/control and evaluation components are in greatest need of improvement. The assessment also included visits to salt producers, which provided a better understanding of opportunities and challenges of salt production in Angola.

In response the observations made in this assessment, the IGN and GroundWork have made multiple recommendations to enhance the performance of Angola’s salt iodization program. The implementation of the below recommendations would help to accelerate improvements in Angola’s salt iodization program and help to increase the overall production of salt in Angola and improve the quality of domestically-produced and imported salt.

1. **Strengthen the enabling environment**
   - Enhance coordination of Technical Committee to ensure clear roles and responsibilities of all stakeholders
   - Ensure that key ministries (e.g. Fisheries, Health, Commerce, and Industry) incorporate salt iodization into annual budget to ensure sufficient funding for promotion, monitoring, and evaluation activities

2. **Extend support to salt industry**
   - Use phased approach to providing technical support to salt producers, whereby technical support and monitoring are initially targeted at the six largest producers, followed by efforts at the remaining producers
   - Contract salt consultant to assist producers improve the quantity and quality of iodized salt produced

3. **Strengthen routine USI monitoring systems**
   - Revive salt iodine laboratories in Angola
   - Transfer from rapid test kits to quantitative methods for routine monitoring
   - Quantitatively measure iodine concentration of imported salt as part of regulatory monitoring efforts

4. **Generate evidence to inform national USI program**
   - Conduct a study examining the household coverage of adequately iodized salt, all potential sources of iodine in the diet (such as salted fish), and the iodine status in vulnerable population groups as primary indicators
   - Investigate the consumption of salted fish since iodized salt is used in the salting process

5. **Enhance advocacy and communications**
   - Routinely sensitize producers to the importance of salt iodization
Over the past decade, the salt iodization program in Angola has made considerable strides. Angola has established legislation and standards, a coordinating body, and promotional and awareness-raising materials. Moreover, according to the existing survey and monitoring data, the majority of salt in Angola is iodized, although the adequacy of iodized salt is unknown. Despite these improvements, multiple stakeholders communicated that some provinces have endemic goiter. However, the only data to illustrate this are outdated as no recent national data on iodine deficiency has been collected. Thus, to build upon and sustain recent advances in the salt iodization program and expand the supply and coverage of adequately iodized salt, efforts are needed to review and strengthen the salt supply chain and generate updated evidence on the status of iodine nutrition in the population. Through these efforts, Angola can further its efforts to grow its domestic salt iodization industry and reduce iodine deficiency and its disorders.
1 INTRODUCTION

Iodine deficiency adversely impacts the cognitive development and growth of the fetus and the young child [1], and impairs the cognitive performance in school-aged children [2]. Globally, the iodization of all edible salt has increased and expanded in the past two decades, which has reduced the prevalence and burden of iodine deficiency and its disorders [3]. Nonetheless, globally there was an estimated 1.8 billion people were at risk of sub optimal iodine intakes in 2011 [3].

In Africa, progress has been made in addressing iodine deficiency and its disorders, but additional progress is required. Of the 10 countries with the highest number of iodine-deficient school children in the world, seven are in Africa: Ethiopia, Sudan, Algeria, Angola, Mozambique, Ghana, and Morocco [4]. To understand the severity of iodine deficiency, considerable research has been conducted in Africa in the past decade. From 2003 and 2013, national iodine status surveys were conducted in 25 countries. Despite this progress, data are outdated or non-representative in many countries; 17 countries have iodine status data that were collected before 2003, and 10 African countries have no data on iodine status, as measured by urinary iodine concentration [4].

The Iodine Global Network (IGN) has classified Angola's iodine status as "insufficient" and has estimated that approximately 520,000 Angolan infants (or ~60% of all infants according the 2014 Census) are at risk of iodine deficiency [5]. Though the existing data sources indicate that iodine is a severe public health problem in Angola, there has not been a comprehensive and recent assessment of iodine status nor of the iodized salt sector. The IGN has undertaken this situation analysis in order to compile all available data related to salt iodization program and iodine nutrition in Angola, and to make research and programmatic recommendations for stakeholders in the country.

1.1 Demographics of Angola

According to Angola's 2014 Census [6], there are nearly 26 million inhabitants in Angola. Sixty-three percent of the population resides in urban areas, and 27% of the total population resides in Luanda province (see Figure 1). The population of Angola is young; the median age is 20.6 years and 47% of the population is between 0-14 years of age. Angola is comprised of 18 administrative provinces (see Map), which are themselves comprised of 162 municipalities.

According to the 2015 Human development index, Angola ranked 149 out of 188 countries, and was placed in the "low" human development category [7]. However, some human development indicators have improved over the past 15 years. According to the World Bank, under-5 mortality rate decreased from 217 to 157 (per 1000) from 2000 to 2015 [8]. Despite this improvement, the under-5 mortality rate is still considered very high. Life expectancy at birth increased from 45 years in 2000 to 52 years in 2014 [8]. Regarding malnutrition in childhood, Angola's 2007 National nutrition survey estimated that 29.2% and 8.2% of children < 5 years of age were stunted and wasted, respectively [9].
Figure 1. Proportion of total population by province, 2014

According to the World Bank, per capita income was 4,180 USD in 2015 [8]. Despite this mean income level, UNICEF estimated that approximately 43% of the population was below international poverty line of US$1.25 per day in 2011 [10]. Nationally, 65.6% of the population is literate, ranging from 46.1% in Bié Province to 85.9% in Luanda [6]. At the national level, 81.5% of children 6-17 years of age are attending school, however, differences between urban (88.6%) and rural (69.0%) areas are notable [6].

Map. Provincial map of Angola
2 APPROACH AND METHODS

This situation analysis summarizes available information related to salt iodization and iodine deficiency disorders (IDD) in Angola. Program documents, survey reports, and information from workshop presentations served as primary data sources for this review. In addition, key documents from the international development and nutrition literature were consulted as appropriate.

The review of existing literature was complemented by a mission to Angola from 18-23 July 2016 where the consultants (Dr. Pieter Jooste & Mr. James Wirth) met with governmental nutrition stakeholders, representative of international agencies and NGO’s, and members of the salt manufacturing sector in Angola. In addition, a visit was conducted to two salt producers in Angola’s Bengo Province. Appendix A contains the mission agenda, including all meetings held and stakeholders participating in each meeting. Appendix B contains the names, affiliations, and contact information for the main iodine stakeholders.

Frameworks developed by the WHO/UNICEF/ICCIDD [11], the GAIN/UNICEF salt iodization partnership [12], and UNICEF’s Nutridash USI Programme Performance Score Calculator [13] were used to assess the status of the salt iodization program.

3 SALT MARKET IN ANGOLA

3.1 Angolan salt industry

The Angolan salt industry currently consists of 23 salt producers, situated in 6 coastal provinces (Benguela, Namibe, Kwanza Sul, Bengo, Luanda, and Zaire). Of these producers, 3 can be classified as large producers (>5000 ton per year) and the rest as medium producers (1000 – 5000 ton per year) based on their 2015 production. There are no small producers (<1000 ton per year) in Angola. In 2015, when only 19 salt producers were present, the total country production was approximately 43,000 metric tons, which was slightly lower than the approximately 46,000 metric tons produced in 2014. The reduced production was mainly due to rainy and wet conditions in 2015. The 2014 and 2015 production figures for each producer are provided in Appendix C and the proportion of each producer in 2014 is presented in Figure 2.

There is no clear estimate of the national demand of salt, Angola’s population (~26 million) and an average daily consumption of 10 grams (3.65 kg per year), the total annual salt market would be approximately 95,000 tons. Currently, domestic salt production is supplemented by salt imported from other countries. Despite this substantial amount of salt imported, several stakeholders mentioned that the total amount of salt available (i.e. domestic production + imports) was not enough to satisfy the national demand. Thus, there is continuous pressure on the salt producers to increase the total yield and overall supply of raw salt. In 2011, the Ministry of Fisheries supported five salt producers to rehabilitate and expand their raw salt production by helping them to access required funding [14].
All salt producers are members of the national salt association called *Associação dos Produtores e Transformadores de Sal de Angola* (APROSAL). APROSAL is managed by a president, vice-president and general secretary, all of whom are located in different provinces to enhance the geographical representation in the management of the association. Meetings occur irregularly, but the association has a good relationship with the government and they have representation on the multi-sectoral salt iodization technical committee (Comissão Nacional Técnica para a iodização do Sal), henceforth referred to as the "Technical Committee".

![Figure 2. Share of domestic salt production by producer, 2014](image)

Salt is produced using different technologies varying from mechanical methods to manual methods. Similarly, salt is iodized using a variety of methods, ranging from highly mechanical (large producers), semi-mechanical and manual methods (medium producers) such as knapsack sprayers and other methods (see Section 6.1). In earlier years, UNICEF procured KIO3 and distributed it for free to the salt producers. However since 2013, the Ministry of Fisheries, in coordination with the state enterprise *Empresa Nacional de Abastecimento Técnico Material da Indústria Pesqueira* (ENATIP) procures KIO3 and sells to salt producers at cost but tax-free.

According to the general secretary of APROSAL, all of the salt producers are aware of the reason for iodizing salt, i.e. “to comply with the law aimed at the prevention of goiter and brain damage”. After the drying of salt, it is iodized and packaged in either 25 kg or 1 kg packaging for distribution. As it is
forbidden to sell non-iodized salt, all salt for human and animal consumption, as well as for the production of processed foods and even for salting dried fish, is supposedly iodized. In 2014, Angola produced 442,000 tons of fish [15]. It is estimated that Angolans consume 14.2 kg of fish annually, which would translate to a per-capita consumption of 272 grams per week (39 grams per day). A smaller proportion of fish consumed is salted, however, salted fish are predominantly consumed by the coastal population, whereas the population in the central and eastern areas of Angola consume un-salted freshwater fish according to a member of the technical committee.

Internal quality control is done either by calculating the amount of KIO3 used for a specific weight of salt or by means of rapid test kits. Only one salt producer, Calombolo, has a titration facility in collaboration with a university laboratory for quality control. The standards agency (Instituto Angolano de Normalização e Qualidade) in the Ministry of Industry certifies that producers comply with the legislation and standards, and has assessed the compliance of salt producers by quantitatively analyzing salt samples for iodine and other minerals. The main challenges voiced by the salt producers are listed below:

1. Due to high moisture content, iodine leaks from packed iodized salt during transportation between producers and the markets.
2. Due to high demand, producers do not let salt dry enough for iodization
3. Government monitoring of iodine in salt is insufficient resulting in some salt producers not complying
4. Not enough rapid test kits at different levels for monitoring
5. Technical staff at production plants need updated information on iodine, such as pamphlets, posters, workshops, etc.
6. Procuring new pumps for pumping sea water to the salt pans is challenging due to price increases (current cost is about 300,000 kwanzas)(~180US$)
7. Transportation cost from the producers to the markets
8. Lack of information about modern methodologies for salt iodization

3.2 Imports / Exports

According to communications with Walvis Bay Salt Holdings (personal communication, Gregory Swartz, 19 May 2016), there are several companies importing salt to Angola. The various importers and estimated quantity of salt imported is provided in Table 1. Of note, the estimates presented do not account for fluctuations in the quantity of salt imported, which was reported by Walvis Bay Salt Holdings to vary substantially by year. If correct, this quantity of salt would account for ~40% of Angola's current salt market (see Figure 3). However, as mentioned previously, the current market may not satisfy the national demand for salt.

Walvis Bay Salt Holdings Ltd states that salt imported to Angola is typically iodized at either 45 – 75ppm of iodine or 75 – 125ppm (KIO3), and that iodometric titration is used by salt producers outside of Angola to assess the concentrations of iodine in salt. Salt is typically imported in bulk in 25 kilogram bags,
however, smaller packages (1kg) are also imported. All imported salt for human consumption should be iodized, and imported non-iodized salt is used for industrial purposes only, such as oil extraction. Of note, as of 2015, Angola established import quotas on several food commodities [16], which requires that salt importers (and importers of other food stuffs) must apply to the Angolan government prior to importing. For salt, it has been reported that the quota was for 100,000 tons in 2015 [17].

According to the Ministry of Fisheries, rapid test kits are sometimes used at the port to examine if salt contains iodine. It was reported that, in some instances, salt found to contain no iodine at the port was sampled, and then iodine concentration was measured quantitatively. Salt importers/retailers are also required to confirm that the iodine content of salt meets national iodization standards.

Table 1. Salt importers and estimated quantity of salt imported for human consumption

<table>
<thead>
<tr>
<th>Country</th>
<th>Company Name</th>
<th>Estimated annual salt imports (Metric Tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Namibia</td>
<td>Walvis Bay Salt Holdings</td>
<td>18,000</td>
</tr>
<tr>
<td></td>
<td>Salt Co</td>
<td>4,000</td>
</tr>
<tr>
<td></td>
<td>Oranje Soutwerke</td>
<td>1,000</td>
</tr>
<tr>
<td>Portugal</td>
<td>Salexpor</td>
<td>3,000</td>
</tr>
<tr>
<td>China</td>
<td>Rinoceronte</td>
<td>3,000</td>
</tr>
<tr>
<td>India/Pakistan</td>
<td></td>
<td>2,000</td>
</tr>
<tr>
<td>South Africa</td>
<td>Cerebos/Royal Salt through Shoprite and other retailers</td>
<td>1,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>32,000 MT</td>
</tr>
</tbody>
</table>

Stakeholders reported that only small quantities of salt were imported from salt producers located near the borders of neighboring countries. In addition, it was reported that non-iodized salt is sometimes stolen from salt producers and informally/illegally transported across borders.
4 SALT IODIZATION PROGRAM

4.1 Salt iodization legislation

In 1996, Decree 24/96 established the salt iodization program [18]. Specifically, this Decree stated that salt should be iodized using potassium iodate (KI03) and that the iodine content in salt should be regularly inspected. The Decree also outlined the packaging and storage requirements to prevent the degradation of iodine, and stipulated that salt for export should be iodized at levels defined by the importing country. This Decree did not, however, make the iodization of salt mandatory and did not define the iodization levels to be used.

In 1997, the Ministry of Fisheries’ Dispatch (Despacho) 7-B/97 established the multi-sectoral salt iodization Technical Committee, defined its mandate, and noted the governmental ministries and other members of the committee [19].

In 2006, the Angolan standards agency (Instituto Angolano de Normalização e Qualidade) established the quality standards related to iodized salt. These standards stated that all salt for human consumption should be iodized, and that iodized salt should contain 25 – 55 ppm iodine in the form of potassium iodate (KI03).
In 2008, Decree 79/08 mandated that all salt (imported and domestically produced) for human and animal consumption in Angola be iodized, and prohibited the sale of non-iodized salt within Angola. Salt used for oil extraction is not required to be iodized and non-iodized salt can be sold for this purpose. The decree also established a system for fining non-compliant salt producers, and noted that salt should be iodized according to the specifications established by the Ministries of Fisheries, Health, and Industry and Commerce. While the decree noted that “all iodized salt ... must be analyzed to verify the level of iodine”, but no details related to analysis methods were given.

### 4.2 Salt iodization policies and plans

In addition to the aforementioned legislative efforts, Angola has established policies and multiple interventions and strategies related to salt iodization. In 2002, the Angolan government established the 2002-2004 IDD strategy plan [20]. This plan aimed to eliminate IDD in Angola by 2004 by a) ensuring that at least 95% of the salt produced in Angola was iodized, b) reinforcing the organizational system by creation of provincial technical committees (Comissões Provinciais Técnicas de Iodização do Sal) in each province, c) establishing a quality control system for salt produced and marketed, d) establishing a surveillance system that estimates the magnitude of iodine deficiency, and e) designing and implementing a national social behavior change communication strategy to promote universal salt iodization (USI).

In 2011, the Ministry of Health drafted a national nutrition strategy. This strategy incorporated multiple interventions for improving child nutrition, including salt iodization. According to stakeholders we met, this strategy was never formally approved by the Ministry of Health. Accordingly, a new national food and nutrition policy and strategic plan is being developed in 2016. The national Technical Committee has drafted the iodine component of this strategy plan, and this component of the strategy is expected to be reviewed by the other members of the Technical Committee.

In addition, the Technical Committee has develops annual work plans, which detail the various activities to be conducted in calendar year. The 2016 work plan has been established, and provides the a timeline of activities to be completed by the various members of the technical committee [21].

### 4.3 Salt iodization stakeholders in Angola

There are multiple agencies involved in salt iodization efforts in Angola. A brief description of the roles and responsibilities of each agency are provided below.

**Ministry of Fisheries:** The Ministry of Fisheries is the main coordinating body of Angola's national salt iodization and iodine deficiency disorders prevention program (Programa Nacional de Iodização do Sal e de Combate às Doenças por Deficiência De Iodo). The national salt iodization program is hosted by the Ministry of Fisheries, and the ministry also coordinates the Technical Committee. Inspectors, responsible for verifying the salt production and iodization procedures are also based in the Ministry of Fisheries.
**Ministry of Health:** The Ministry of Health is responsible for advocacy, promotion, and social mobilization activities related to salt iodization. These efforts include production of pamphlets, posters, and television public service announcements; many of these advocacy efforts are coordinated with the national salt iodization day each October. The ministry also serves as a key member of the Technical Committee.

**Ministry of Industry:** The Ministry of Industry houses the standards agency (*Instituto Angolano de Normalização e Qualidade*). The standards agency is responsible for establishing the regulations for salt iodization and packaging of salt (see Section 4.1). The agency is also responsible for certifying salt producers and certifying salt imported by retailers.

**APROSAL:** APROSAL is the association of salt producers in Angola. All salt producers in Angola are members of APROSAL.

**UNICEF:** UNICEF provides technical and logistical support to agencies involved in salt iodization. Specifically, UNICEF supports the Ministry of Fisheries by providing salt iodization rapid test kits and supports the Ministry of Health to develop and produce promotional materials. UNICEF also serves a key coordinating function to promote salt iodization.

### 4.4 Governmental control structure(s), monitoring, enforcement

Inspectors within the Ministry of Fisheries Inspection Division (*Serviço Nacional de Fiscalização Pesqueira e da Aquicultura*) are responsible for inspecting the production of salt, including compliance with national salt iodization standards. Inspectors operate at the national, provincial, and municipal levels, and information on producer compliance is shared amongst inspectors working at different administrative levels. Inspectors can issue fines to producers not complying with salt production and iodization standards. The inspection division does not, however, appear to have the capacity to quantitatively assess if salt is being iodized to the required levels. The Inspection Division began site visits to salt producers in early 2016, and the inspectors noted that some producers are informally exporting non-iodized salt to neighboring countries.

### 4.5 Coverage of (adequately) iodized salt

There is sparse representative data that assess the coverage of iodized salt at the household level, let alone the coverage with adequately iodized salt. The 2001 MICS survey found that 36% of households consumed salt with >15 ppm iodine as measured using rapid test kits; this survey report unfortunately does not provide the proportion of salt with no iodine [22]. The 2007 National Nutrition Survey also measured salt iodine concentrations using rapid test kits, and found that 45% of households consumed salt with >15 ppm iodine, and approximately 80% of households consumed salt with any iodine [9]. Since 2007, there has been no national assessment that has measured the household coverage of iodized and adequately iodized salt. A MICS survey was conducted in 2015 and tested iodine in salt using rapid test kits, however, the results were not publicly available at the time of the mission.
In addition to representative household-based data, the Ministry of Fisheries has conducted non-representative monitoring exercises in schools, churches, and markets to gauge the coverage of iodized salt. As part of these exercises, salt iodine content has been measured using rapid test kits, and the proportion of salt samples was calculated separately for each collection point. It was noted that these efforts have been conducted for many years, and results from 2011-2015 [14,23–25] were reviewed as part of this situation analysis (see Appendix D). As these monitoring efforts are based on non-representative convenience samples, and coverage is calculated separately for each collection point, it is not possible to observe trends in the coverage of iodized salt.

Of note, all salt coverage results have been determined using rapid test kits. While rapid test kits can accurately and consistently determine if there is any iodine present, researches have noted that rapid test kits cannot accurately be used to quantitatively determine the concentration of iodine in salt [26,27]. Therefore, data on proportions of the population using adequately iodized salt >15ppm should be questioned.

5 EXISTING EVIDENCE OF IODINE DEFICIENCY DISORDERS IN ANGOLA

In Angola, endemic goiter was first observed in Northeastern areas of the Luanda Province in 1968 [28]. In 1992, a survey of women in Huambo province found goiter prevalence ranging from 10% in the provincial capital to 60% in some districts [29]. In Bié province in 1994, a study of children found the prevalence of goiter ranging from 31% to 69% [29].

In 2006, Tomlinson et al [30] examined the urinary iodine concentration (UIC) of children 6-10 years of age (n=826) in a survey of 24 schools in the Bié Province. This study observed a median UIC of 29 µg/L, which indicates moderate iodine deficiency. The researchers observed that 35%, 43%, and 14% of children had UICs<20 µg/L, 20-49 µg/L, and 50-99 µg/L, respectively. Only 8% of children had UIC >100 µg/L. In areas with such a low median UIC, clinical manifestations of iodine deficiency disorders, like cretinism, may be expected. Though the study by Tomlinson et al is an invaluable data source, the study did not measure the iodine status of women of reproductive age, a vulnerable population group that is more directly linked to the consequences of iodine deficiency. Moreover, this study was conducted only in one province more than 10 years ago. Thus, more representative and current information related to iodine status is required.

The results from the aforementioned study by Tomlinson et al were used in the IGN's 2015 iodine nutrition scorecard [31] along with results from coverage results from the 2007 national nutrition survey [9]. Using the percentage of households consuming non-iodized salt in 2007 (i.e. 55.3%) [9] and the number of live births in 2012 (i.e. 934,000) [32] to estimate that 517,000 infants in Angola are unprotected against iodine deficiency. Notably, the 2007 national nutrition survey was conducted prior to legislation mandating salt iodization in 2008. If Angola’s salt iodization program succeeded in some capacity to improve the coverage of the population with adequately iodized salt and, by extension,
6 VISITS TO SALT PRODUCERS AND FISHERIES LABORATORY

6.1 Visit to Naterçia e Filhos and SalFramar salt companies

These two salt production plants visited are situated north of Luanda on the coast of Bengo province. Both producers have a limited production capacity and were flooded during the heavy rains of 2015. Although the salt pans at the first producer (Naterçia e Filhos) were small, they were reasonably well constructed. Salt is harvested manually, and the salt iodization process is semi-mechanized and all salt is iodized by means of a dry premix. If rapid test kits are available, they are used by the producer as a form of quality control. Virtually all of their salt, packaged in 25 or 1 kg packaging, is sold to fisherman and companies in a nearby village for salting fish. Currently the facility is being expanded by constructing more pans to increase their production.

The salt pans at the second producer, SalFramar, were even more basic in construction with no wooden or other rigid walls around the crystallization pans. Retaining walls constructed of soil were used, resulting in the production of salt containing impurities. All of their salt is iodized by wetting small heaps of salt with a KIO3 solution in a water bottle and mixing it manually with a shovel. The salt is similarly marketed directly or through small scale traders to the nearby communities mostly in 25 kg plastic bags.

Because of the demand for salt and the limited production, also due to the rains in 2015, no reserve salt in stock piles were present at the time of the visit at SalFramar plant while no production was possible during the past year at the Naterçia e Filhos plant due to the rains. Due to low supply and consistent demand, salt is dried for a short period and marketed while it contains high levels of moisture. Lastly, these visits confirmed that producers’ limited production capacity directly impacts the quality of salt produced and may negatively impact the iodization process. As salt producers have a small profit margin, increased production would help to increase revenue and working capital, which could be used to improve salt quality and iodization processes.

6.2 Ministry of Fisheries Laboratory

This laboratory performs a wide range of analyses for the fishing industry and, at times, also analyses the iodine concentration in salt samples. It is an accredited laboratory with skilled staff, sophisticated instrumentation, and laboratory equipment suitable to routinely conduct the iodine concentration in salt using iodometric titration. It appears that lack of resources and formalized quantitative monitoring procedures are currently limit the laboratory’s involvement in the salt iodization program. The laboratory has the potential to play a much bigger role in the monitoring function of the Ministry of Fisheries, for example for the measurement of iodine in the salt samples collected at the salt
producers, in household surveys, etc. It also has the potential to replace the currently inappropriate use of the rapid test kits, which are now used by government to monitor the salt iodization program by assessing iodization levels in convenience samples from collected from markets, schools, and churches.

7 SUMMARY ASSESSMENT OF ANGOLA’S SALT IODIZATION PROGRAM

7.1 Current status of Angola USI program - Opportunities

The summary of the country assessment (see Table 1) shows the strengths and weaknesses of the salt iodization program in Angola. The outstanding strength is the existence of the iodized salt legislation creating a framework within which the iodine program is expected to operate as is subsequently outlined in the Operational Plan. Unfortunately, due to financial and other limitations, the implementation of the salt iodization program seems not to be optimal. This is evident from the limited availability of national data on the iodine content at the factory and household levels as well as the limited quality control and quality assurance (QA/QC) being done at the factory level by producers and limited external verification performed by the Ministry of Fisheries. Furthermore, there is also no recent national data available on the iodine status of the population as measured by the urinary iodine concentration in school aged children or in women of reproductive age. However, given the small number of players and high degree of commitment from the government and international development partners, there is the prospect for accelerated actions which will enable the salt iodization program to be transformed and the program gaps can be addressed.

Table 1. Assessment of Angola’s USI program using key program indicators recommended - 2007 WHO/UNICEF/ICCIDD Guidelines [11]

<table>
<thead>
<tr>
<th>Programmatic indicators</th>
<th>Country program situations</th>
<th>Actions required to sustain USI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Presence of a multi-sector coalition responsible to the government for the national programme for the elimination of IDD with the following characteristics:</td>
<td>A national technical committee for salt iodization exists with the Ministry of Fisheries serving as the Coordinator. This committee is multi-sectoral and includes Ministries of Health, Industry, Commerce, Education, Agriculture, Internal Affairs, UNICEF and the salt producers’ association. Meetings are periodical with all members, and side meetings held with a sub-group of members (Ministries of Fisheries, Health, Industry, and Commerce).</td>
<td>The National Technical Committee needs to continue to implement its 2016 work plan. Key activities from the work plan should be incorporated into the National Food and Nutrition Strategic Plan currently being developed.</td>
</tr>
<tr>
<td>- National stature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- All concerned sectors, including the salt industry, represented, with defined roles and responsibilities; Convenes at least twice yearly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Programmatic indicators</td>
<td>Country program situations</td>
<td>Actions required to sustain USI</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>2. Demonstration of political commitment as reflected by:</td>
<td>- Legislation in place</td>
<td>Funding required for maintaining monitoring, education, training.</td>
</tr>
<tr>
<td>- inclusion of iodine in the national budget (either as specific programme funds or</td>
<td>- Limited budget in Ministries of Fisheries, Health, and Industry and others</td>
<td>Budgeting for operating the salt iodization program should be a standard item on the annual budget of ministries involved in the Technical Committee.</td>
</tr>
<tr>
<td>through inclusion in existing programme funds) particularly with regard to</td>
<td>- Depends on agency funding for projects</td>
<td></td>
</tr>
<tr>
<td>procurement and distribution of KIO3</td>
<td>- ENATIP procures KIO3 for salt producers to purchase, tax exempted. Ministry of Fisheries</td>
<td></td>
</tr>
<tr>
<td></td>
<td>is aiming to re-open their salt titration laboratory</td>
<td></td>
</tr>
<tr>
<td>3. Enactment of legislation and supportive legislation on USI, which</td>
<td>- Legislation in place but not efficiently implemented due to insufficient funding</td>
<td>Angolan iodization legislation is sufficient but the implementation, quality assurance, and regulatory monitoring is lacking. As such there is limited verification of compliance or ability to use data towards corrective responses.</td>
</tr>
<tr>
<td>establishes a routine mechanism for external quality assurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Establishment of methods for assessment of progress in the elimination of IDD as</td>
<td>- No nationally representative quantitative survey has been done, and no quantitative data</td>
<td>Updated national data on both salt and urinary iodine is urgently required to be able to manage the salt iodization program efficiently.</td>
</tr>
<tr>
<td>reflected by:</td>
<td>collection system has been established.</td>
<td></td>
</tr>
<tr>
<td>- Reporting on national programme progress every three years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Access to laboratories as defined by:</td>
<td>- Laboratories at the Ministries of Fisheries and Industry are not currently utilized to</td>
<td>- The capacity of the laboratory at the Ministry of Fisheries should be</td>
</tr>
<tr>
<td>- Laboratories able to provide accurate data on urine and salt iodine levels and</td>
<td>their capacity to measure iodine in salt.</td>
<td>supported to establish protocols for their titration approach.</td>
</tr>
<tr>
<td>thyroid function</td>
<td>- No laboratories in Angola measure urinary iodine</td>
<td>- Technical support should be given to producers to quantitatively test iodine concentration.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Rapid quantitative tests can</td>
</tr>
<tr>
<td>Programmatic indicators</td>
<td>Country program situations</td>
<td>Actions required to sustain USI</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>6. Establishment of a programme of education and social mobilization as defined by:</td>
<td>- Ministry of Health focuses mainly on education, social mobilization and promotion through pamphlets, posters, a short video and TV clips around IDD day in October rather than adapting school or tertiary training curricula</td>
<td>The program of education and social mobilization should be extended to the salt industry, governmental decision makers, schools and relevant tertiary educational courses</td>
</tr>
<tr>
<td>- Inclusion of information on the iodine and the use of iodized salt, within educational curricula</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Routine availability of data on salt iodine content as defined by:</td>
<td>No regular salt iodine data from factories available and none from households on a national basis.</td>
<td>- Technical support should be given to producers to quantitatively test iodine concentration and report results to the Technical Committee</td>
</tr>
<tr>
<td>- Availability at the factory level at least monthly, and at the household level at least every 5 years</td>
<td></td>
<td>- Salt samples should be collected by the Ministry of Fisheries at least 6 monthly from all salt producers for iodine measurement.</td>
</tr>
<tr>
<td>8. Routine availability of population-based data on urinary iodine every 5 years</td>
<td>No population UI data ever collected in Angola</td>
<td>A national urinary iodine survey is urgently required in Angola.</td>
</tr>
<tr>
<td>9. Demonstration of ongoing cooperation from the salt industry as reflected by:</td>
<td>Salt producers’ cooperation with ministries is good but quality control is limited to RTK when kits are available. Producers pay for KI03 since 2013, but KI03 is tax exempt.</td>
<td>The relevant Ministries should support the salt producers towards optimal salt iodization.</td>
</tr>
<tr>
<td>- Maintenance of quality control measures and absorption of the cost of iodate/iodide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Presence of a national database for recording of results of regular monitoring procedures which include population-based household coverage and urinary iodine (with other indicators of iodine status and thyroid function included as available)</td>
<td>No national database exists either for salt iodine at the factories or of urinary iodine. Data on salt iodine using rapid test kits from household surveys on convenience samples collected in some provinces during the last decade is available.</td>
<td>A national database for maintaining and updating records on provincial and national salt and urinary surveys should be kept in the Ministry of Fisheries and Ministries of Health.</td>
</tr>
</tbody>
</table>
7.2 Programmatic sustainability

By using the grading system and sustainability indicators from the GAIN/UNICEF USI partnership (see Table 2), it is clear that the legislative and operational framework of the Angolan salt iodization program is mostly in place and functional. However, the implementation of the salt iodization program is weak and requires support and funding to overcome the barriers preventing the sustainable execution of the iodization program.

Table 2. Sustainability assessment using GAIN/UNICEF USI partnership approach [12]

<table>
<thead>
<tr>
<th>Sustainability indicator</th>
<th>Status*</th>
</tr>
</thead>
<tbody>
<tr>
<td>National multi-sector coalition</td>
<td>A</td>
</tr>
<tr>
<td>Legislation and supportive regulations</td>
<td>A</td>
</tr>
<tr>
<td>Participation of salt industry</td>
<td>B</td>
</tr>
<tr>
<td>Program of public education and social mobilization</td>
<td>B</td>
</tr>
<tr>
<td>Regulatory monitoring of iodized salt supply</td>
<td>C</td>
</tr>
<tr>
<td>Regular data on coverage of household use of iodized salt</td>
<td>C</td>
</tr>
<tr>
<td>Regular data on iodine status</td>
<td>C</td>
</tr>
<tr>
<td>Elimination of IDD and USI efforts are integrated into a national food and nutrition policy</td>
<td>B</td>
</tr>
</tbody>
</table>

*Status: A = Present, in good standing, B = Present, but needs work, C = Not present

As part of the Nutridash USI Programme Performance Score Calculator, a thorough questionnaire and scoring system was used to assess the sustainability of four aspects of Angola's salt iodization program. As shown in Figure 4, the salt iodization policy environment component is considered the most sustainable part of the USI program, receiving a score of nearly 80%. The performance of the national ownership and program governance and the communications components received scores of approximately 60%, illustrating that while some activities are implemented and in place, further efforts can be made to strengthen these aspects of the salt iodization program. Lastly, the monitoring and evaluation (M&E) and QA/QC component is the least sustainable aspect of the program, and the area in greatest need of improvement. Overall, Angola's IDD program received a sustainability score of 59%, showing that while the program is somewhat sustainable and has many achievements, improvements are still needed.
Figure 4. Summary scores derived from the Nutridash USI Calculator

8 RECOMMENDATIONS

8.1 Strengthen the enabling environment

Enhance communication and coordination between actors of technical committee: The Technical Committee is currently a vital forum for engaging and coordinating all the stakeholders involved in salt iodization. However, greater communication and coordination between all actors is required to ensure that information is regularly shared and activities coordinated. It is recommended that the members of the Technical Committee meet either quarterly or biannually, and that members with more responsibility (e.g. Ministry of Fisheries, Ministry of Health, Ministry of Industry, APROSAL, and UNICEF) meet separately when required. At these meetings, agenda minutes should be kept documenting the follow-up actions of each agency. Efforts should be made to sustain commitment to salt iodization activities throughout the year, culminating with Angola's national iodine day on 19 October.

Incorporate USI efforts into annual budgets of key ministries: Multiple stakeholders mentioned that there was an insufficient budget to conduct various salt iodization activities. As consistent financial resources are required to increase the coverage of adequately iodized salt and reduce iodine deficiency, it is recommended that key ministries in Angola (e.g. Ministries of Fisheries, Health, Commerce, and Industry) incorporate salt iodization activities into their annual budgets to ensure sufficient funding is available for technical assistance, promotion, monitoring, and evaluation activities.
8.2  Extend support to salt industry

**Use phased approach to providing technical support to salt producers:** As of 2014, six salt companies accounted for 92% of the domestic salt production, and the remaining 13 companies accounted for only 8% of the total domestic production. As such, it is recommended that the Ministry of Fisheries introduce a two-phased approach to providing technical assistance to Angolan salt producers. As a first phase, technical support and monitoring would be focused on the six largest producers to ensure that salt is consistently iodized according to national standards. Once these producers are capable to consistently iodize salt, the second phase would commence, whereby technical assistance would be provided to the remainder of the producers.

**Salt consultant to assist producers:** Multiple stakeholders mentioned that Angolan salt producers face many technical challenges to expand their production capacity and increase the quality of the iodized salt produced. As these challenges negatively impact iodization efforts, it is recommended that a salt manufacturing expert be contracted to help salt producers identify technical approaches to improving quantity and quality of iodized salt produced. As expanding salt production often requires capital investments, the consultant could also explore the financing approaches in Angola (e.g. loans from the Angolan Development Bank; *Banco de Desenvolvimento de Angola*) that are suitable for salt producers.

8.3  Strengthen routine USI monitoring systems

**Utilize and support salt iodine laboratories in Angola:** Though some laboratories in Angola have the technical capacity to *quantitatively* measure salt iodine content by iodometric titration, few labs (or salt producers) are actively measuring the iodine content of salt quantitatively on a routine basis. As the Ministry of Fisheries plays a central role in the salt iodization programs, it is recommended that a plan for monitoring the salt iodization efforts using quantitative tools should be developed and salt iodine testing should be done the Ministry of Fisheries laboratory (*Instituto Nacional de Investigação Pesqueira*). This laboratory currently has sufficient equipment and technical capacity, but stakeholders noted that reagents are sometimes unavailable. As such, steps should be taken to ensure that sufficient reagents are available to support the Ministry of Fisheries' monitoring efforts. Other laboratories in Angola, such as the Ministry of Industries laboratory and laboratories of salt producers (Calombolo) should also be enhanced. Salt producers, particularly the large producers, should be trained to regularly conduct internal quality control using titration or some other quantitative tool [33] to assess the accuracy of their iodization process.

**Transfer from rapid test kits to quantitative methods:** The current coverage of iodized salt in Angola is high in some provinces, and the program data show that salt producers and government are committed to universal salt iodization. Due to these efforts, Angola is poised to increase the rigor in which they measure salt iodine content. Though rapid test kits can
determine if salt has *any* iodine, rapid test kits are notoriously inaccurate in determining if salt is *adequately* iodized (>15ppm) [27]. Quantitative methods, such as titration, should be mainstreamed in Angola to determine definitively if Angola's salt meets the national standards. Quantitative methods should be used for all government routine monitoring, national/provincial assessments and surveys, as well as for salt producers' internal quality control.

**Measure iodine concentration of imported salt:** The iodine concentrations of imported salt are sometimes measured by suppliers as part of product certification. It was also mentioned that the Ministry of Fisheries sometimes tests salt samples at the port using rapid test kits. As imported salt represents a large share of Angola's salt market, the iodine content of salt should be investigated quantitatively and following a systematic approach to estimate the proportion of imported salt that meets Angolan salt iodization standards. Rather than testing of imported salt at the border posts/ports, it is recommended that the Ministry of Fisheries launch an investigation of the iodine concentration of imported salt. Such an investigation would enable iodine stakeholder to determine the proportion of imported salt that is adequately iodized and to determine if the certification process is ensuring that all imported salt is adequately iodized.

**8.4 Generate evidence to inform national USI program**

**Conduct iodine study:** The data documenting the household coverage of iodized salt and iodine status in Angola is either insufficient or outdated. To address these data gaps, it is highly recommended that key members of the national Technical Committee conduct a study examining the iodine nutrition of women and children and coverage of adequately iodized salt. As part of this survey, salt iodine concentrations should be *quantitatively* measured using either iodometric titration [11] or an acceptable quantitative testing system [33]. Urinary iodine concentration should also be quantitatively measured in high-risk groups, such as women of reproductive age (15-49 years) in a laboratory with rigorous internal/external quality assurance procedures. Such a study has been identified previously by Technical Committee as an approach to fill critical data gaps [34]. The study would also examine consumption of foods containing iodized salt, such as processed foods, salted fish, and other foods. Appendix E presents issues that should be considered during the planning phase of an iodine study.

**Investigate the consumption of salted fish:** An important food vehicle of iodine in Angola in coastal areas appears to be salted and dried saltwater-fish. To understand the consumption patterns in different provinces and populations groups, it is recommended that the consumption (e.g. frequency and quantity) of salted fish, as well as other potential processed foods with a high salt content is estimated. The iodine content of salt used for salting fish and these products could also be investigated at the stage of consumption of the fish to establish if a significant amount of iodine is retained in the salt, and to determine the potential contribution of iodine to the diet if these products use adequately iodized salt.
8.5 Enhance advocacy and communications

**Routinely sensitize producers to the importance of salt iodization:** To ensure that salt producers fully understand the negative health impact of iodine deficiency (i.e. cretinism, impaired mental development, diminished IQ, goiter), it is recommended that trainings and sensitizations be given to the six largest producers and APROSAL on a bi-annual basis. These meetings should include both the managers of the salt companies and technical staff so that multiple individuals in each salt company are aware of the health benefits of salt iodization.

9 CONCLUSIONS

Over the past decade, the salt iodization program in Angola has made considerable strides. Angola has established legislation and standards, a coordinating body, and promotional and awareness-raising materials. Moreover, according to the existing survey and monitoring data, the majority of salt in Angola is iodized. However, the coverage of adequately iodized salt has never been measured with quantitative methods, and stakeholders noted that iodine deficiency may exist in selected provinces. Thus, to build upon and sustain the salt iodization program and expand the coverage of adequately iodized salt, it is recommended that the collaboration between government and industry be strengthened, monitoring efforts be enhanced, and quantitative data on iodized salt coverage and iodine nutrition be collected. Through these efforts, Angola can further its efforts to grow its domestic salt industry and reduce iodine deficiency disorders.
10 REFERENCES


24. Ministério das Pescas. Relatório de actividades do ano de 2012 - Programa de iodização do sal e de combate às doenças por carência de iodo. Luanda, Angola;


## APPENDIX A. IGN-GROUNDWORK MISSION AGENDA

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Activity</th>
<th>Stakeholders consulted (Agency)</th>
</tr>
</thead>
</table>
| 19.07.2016 | 9am - 12 noon | Meeting at UNICEF with salt stakeholders to discuss mission objectives and meet main stakeholders | Dra. Cidalina Costa (Ministry of Fisheries)  
Mrs. Nsalambi Celestina André (Ministry of Fisheries)  
Ms. Henriqueta Agostinho (Ministry of Health)  
Sr. Adriano Joao Domingos (Ministry of Health)  
Madalena Tenazinha (Ministério da Indústria, IANORQ)  
Dr. Samson Agbo (UNICEF)  
Dr. Titus Angi (UNICEF) |
| 19.07.2016 | 3 - 4 pm      | Meeting at the Ministry of Health with the National Director of Public Health | Dr. Miguel de Oliveira (Ministry of Health)  
Dra. Maria Futi (Ministry of Health) |
| 19.07.2016 | 4:30 - 5:30 pm| Meeting with the Deputy Minister of Fisheries                            | Dra. Maria Antónia Nelumba (Ministry of Fisheries)  
Dra. Cidalina Costa (Ministry of Fisheries)  
Mrs. Nsalambi Celestina André (Ministry of Fisheries) |
| 20.07.2016 | 10am - 12 noon| Meeting at Ministry of Fisheries with salt producers and salt inspectors | Dra. Cidalina Costa (Ministry of Fisheries)  
Mrs. Nsalambi Celestina André (Ministry of Fisheries)  
Sr. Domingos Motta (Serviço Nacional de Fiscalização das Pescas e Aquacultura)  
Sr. Antonio Francisco (Serviço Nacional de Fiscalização das Pescas e Aquacultura)  
Sr. Omar Rodrigues (Natercia e Filhos / APROSAL)  
Sr. André Sèbastião Issegule (Salframar) |
| 21.07.2016 | All day       | Visit to salt producers in Bengo province:  
1. Natercia e Filhos, Ambriz  
2. Salframar, Caxito | Dra. Cidalina Costa (Ministry of Fisheries)  
Mrs. Nsalambi Celestina André (Ministry of Fisheries)  
Sr. Adriano Joao Domingos (Ministry of Health)  
Madalena Tenazinha (Ministério da Indústria, IANORQ)  
Sr. Domingos Motta (Serviço Nacional de Fiscalização das Pescas e Aquacultura)  
Antonio Francisco (Serviço Nacional de Fiscalização das Pescas e Aquacultura)  
1. Omar Rodrigues  
2. André Sèbastião Issegule |
<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Event</th>
<th>Participants</th>
</tr>
</thead>
</table>
| 22.07.2016| 10am - 12 noon | Debriefing meeting at UNICEF              | Dra. Cidalina Costa (Ministry of Fisheries)  
Mrs. Nsalambi Celestina André (Ministry of Fisheries)  
Ms. Henriqueta Agostinho (Ministry of Health)  
Sr. Adriano Joao Domingos (Ministry of Health)  
Madalena Tenazinh (Ministério da Indústria, IANORQ)  
Sr. Domingos Motta (Serviço Nacional de Fiscalização das Pescas e Aquacultura)  
Antonio Francisco (Serviço Nacional de Fiscalização das Pescas e Aquacultura)  
Dr. Samson Agbo (UNICEF)  
Dr. Titus Angi (UNICEF) |
| 22.07.2016| 2-3pm     | Visit to Ministry of Fisheries Laboratory  | Dra. Cidalina Costa (Ministry of Fisheries)  
Mrs. Nsalambi Celestina André (Ministry of Fisheries)  
Dra. Maria Futi (Ministry of Health)  
Sr. Domingos Motta (Serviço Nacional de Fiscalização das Pescas e Aquacultura)  
Antonio Francisco (Serviço Nacional de Fiscalização das Pescas e Aquacultura) |
### APPENDIX B. IODINE STAKEHOLDERS IN ANGOLA

<table>
<thead>
<tr>
<th>AGENCY</th>
<th>FIRST NAME</th>
<th>LAST NAME</th>
<th>POSITION</th>
<th>EMAIL ADDRESS</th>
<th>PARTICIPATED IN ESARO 2015 WORKSHOP IN TZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ministry of Fisheries</td>
<td>Dra. Cidalina</td>
<td>Costa</td>
<td>National Director of Production and Salt Iodization</td>
<td><a href="mailto:cidalinacostano@gmail.com">cidalinacostano@gmail.com</a></td>
<td>NO</td>
</tr>
<tr>
<td>Ministry of Fisheries</td>
<td>Ms. Nsalambi Nsenga</td>
<td>Celestina André</td>
<td>Coordinator of the National Technical Committee of salt Iodization</td>
<td><a href="mailto:nsengado3@gmail.com">nsengado3@gmail.com</a></td>
<td>YES</td>
</tr>
<tr>
<td>Ministry of Fisheries</td>
<td>Dra. Maria Antónia</td>
<td>Nelumba</td>
<td>Deputy Minister of Fisheries. Secretária de Estado</td>
<td></td>
<td>NO</td>
</tr>
<tr>
<td>Ministry of Health</td>
<td>Dr. Maria Futi</td>
<td>Tati</td>
<td>Director of Nutrition</td>
<td><a href="mailto:mati_33@hotmail.com">mati_33@hotmail.com</a></td>
<td>YES</td>
</tr>
<tr>
<td>Ministry of Health</td>
<td>Ms. Henriqueta</td>
<td>Agostinho</td>
<td>Programs, Nutrition Department</td>
<td><a href="mailto:queta_46@yahoo.com">queta_46@yahoo.com</a></td>
<td>YES</td>
</tr>
<tr>
<td>Ministry of Health</td>
<td>Mr. Adriano</td>
<td>Joao Domingos</td>
<td>Monitoring, Nutrition Department</td>
<td><a href="mailto:garness1970@hotmail.com">garness1970@hotmail.com</a></td>
<td>NO</td>
</tr>
<tr>
<td>Ministry of Health</td>
<td>Dr. Miguel</td>
<td>dos Santos de Oliveira</td>
<td>National public health Director</td>
<td><a href="mailto:misaol65@yahoo.com.br">misaol65@yahoo.com.br</a></td>
<td>NO</td>
</tr>
<tr>
<td>Ministry of Industry / IANORQ</td>
<td>Ms. Madalena</td>
<td>Tenazinha</td>
<td>Directora Geral Adjunta</td>
<td><a href="mailto:Madalena.tenazinha@ianorq.co.ao">Madalena.tenazinha@ianorq.co.ao</a></td>
<td>NO</td>
</tr>
<tr>
<td>Ministry of Industry / IANORQ</td>
<td>Ms. Filomena</td>
<td>Da Mata</td>
<td>Nutrition Department</td>
<td><a href="mailto:mariafilomena@gmail.com">mariafilomena@gmail.com</a></td>
<td>YES</td>
</tr>
<tr>
<td>UNICEF</td>
<td>Dr. Titus</td>
<td>Angi</td>
<td>Health/Immunization Specialist</td>
<td><a href="mailto:tangi@unicef.org">tangi@unicef.org</a></td>
<td></td>
</tr>
<tr>
<td>AGENCY</td>
<td>FIRST NAME</td>
<td>LAST NAME</td>
<td>POSITION</td>
<td>EMAIL ADDRESS</td>
<td>PARTICIPATED IN ESARO 2015 WORKSHOP IN TZ</td>
</tr>
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<td>--------------</td>
<td>-----------------------------------------------</td>
<td>------------------------------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>UNICEF</td>
<td>Dr. Samson</td>
<td>Agbo</td>
<td>Chief, Child Survival &amp; Development, UNICEF Angola</td>
<td><a href="mailto:sagbo@unicef.org">sagbo@unicef.org</a></td>
<td>YES</td>
</tr>
<tr>
<td>World Vision</td>
<td>Mr. Alfredo</td>
<td>Pascal francis</td>
<td>Health Director</td>
<td><a href="mailto:alfredo_fransisco@wvi.org">alfredo_fransisco@wvi.org</a></td>
<td>YES</td>
</tr>
<tr>
<td>Natercia e Filhos</td>
<td>Mr. Omar</td>
<td>Rodrigues</td>
<td>Salt producer &amp; APROSAL</td>
<td><a href="mailto:omar.rodrigues@isomarlda.com">omar.rodrigues@isomarlda.com</a></td>
<td>NO</td>
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</table>
### APPENDIX C. 2014 & 2015 PRODUCTION FROM ANGOLAN SALT PRODUCERS

<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Benguela</td>
<td>Calombolo</td>
<td>20,186</td>
<td>43%</td>
<td>21,008</td>
<td>49%</td>
</tr>
<tr>
<td></td>
<td>Macaca</td>
<td>5,383</td>
<td>12%</td>
<td>5,937</td>
<td>14%</td>
</tr>
<tr>
<td></td>
<td>APS</td>
<td>4,529</td>
<td>10%</td>
<td>2,393</td>
<td>6%</td>
</tr>
<tr>
<td></td>
<td>Chamume</td>
<td>2,452</td>
<td>5%</td>
<td>4,094</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>Cabaia</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Gengo</td>
<td>1</td>
<td>0%</td>
<td>17</td>
<td>0%</td>
</tr>
<tr>
<td>Namibe</td>
<td>Sal do sol</td>
<td>5,200</td>
<td>11%</td>
<td>5,452</td>
<td>13%</td>
</tr>
<tr>
<td></td>
<td>Angosal</td>
<td>4,750</td>
<td>10%</td>
<td>2,365</td>
<td>6%</td>
</tr>
<tr>
<td></td>
<td>Sosal Lda</td>
<td>180</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Barreiras</td>
<td>40</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Bentiaba</td>
<td>422</td>
<td>1%</td>
<td>900</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>Mucuio</td>
<td>6</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Kwanza Sul</td>
<td>Ngola Kiluanje</td>
<td>329</td>
<td>1%</td>
<td>13</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Rui Teixeira</td>
<td>1,436</td>
<td>3%</td>
<td>395</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>Barbas</td>
<td>1,168</td>
<td>3%</td>
<td>102</td>
<td>0%</td>
</tr>
<tr>
<td>Bengo</td>
<td>Salframar</td>
<td>275</td>
<td>1%</td>
<td>155</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Narércia e Filhos</td>
<td>52</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Luanda</td>
<td>Wenji</td>
<td>27</td>
<td>0%</td>
<td>14</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Zaire</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>46,436</strong></td>
<td><strong>100%</strong></td>
<td><strong>42,845</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
# APPENDIX D. SUMMARY OF 2011-2015 MONITORING RESULTS

<table>
<thead>
<tr>
<th>Year</th>
<th>Provinces monitored</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>10 provinces (Zaire, Bengo, Luanda, Kwanza Norte, Kwanza Sul, Namibe, Bié, Benguela, Moxico, Kunene) [23]</td>
<td>In most of the provinces, &gt;80% of samples, measured using rapid test kits, contained more than 15 ppm iodine. However, there was a wide range (0-100%) in the proportion of samples exhibiting &gt;15 ppm iodine in Luanda, Kwanza Sul, Namibe, and Kunene.</td>
</tr>
<tr>
<td>2012</td>
<td>8 provinces (Zaire, Luanda, Kwanza Sul, Namibe, Bié, Benguela, Moxico, Kunene) [24]</td>
<td>Only in Zaire province was the proportion of salt samples exhibiting &gt;15 ppm consistently high, estimated at 100% in samples taken from both a school and a market. In other provinces, the proportion of salt with more than 15 ppm was highly variable, ranging from 28-92% depending on the collection point.</td>
</tr>
<tr>
<td>2013</td>
<td>3 provinces (Cuando-Cubango, Lunda Sul, Moxico) [25]</td>
<td>In Cuando-Cubango and Lunda Sul, the vast majority of salt samples collected had &gt;15 ppm iodine, whereas in Moxico, the proportion of salt samples with less than 15 ppm ranged from 25-71%.</td>
</tr>
<tr>
<td>2014</td>
<td>5 provinces (Luanda, Bengo, Bié, Lunda Norte, Lunda Sul) [14]</td>
<td>In all provinces except Bié, &gt;85% of the salt was iodized with &gt;15 ppm iodine. In Bié, 48% of samples contained &gt;15 ppm iodine, 42% contained 1-15 ppm iodine, and 10% contained no iodine.</td>
</tr>
<tr>
<td>2015</td>
<td>1 province (Luanda) [14]</td>
<td>In 2015, salt samples from six Municipalities in Luanda were tested for iodine using rapid test kits. In Samba, Rangel, Icolo e Bengo Catete, Viana, and Quiçama Municipalities, &gt;95% of the salt samples contained &gt;15 ppm iodine, and in Cazenga Municipality 75% of samples contained &gt;15 ppm iodine.</td>
</tr>
</tbody>
</table>
APPENDIX E. CONSIDERATIONS FOR CONDUCTING AN IODINE STUDY

There are several considerations that should be taken into account when planning an iodine study. Though multiple stakeholder mentioned the need for a such as study, there was no discussion about the possible design or implementation of such a study. Thus, the below points are judgments made by Dr. Jooste and Mr. Wirth, and are based on their experiences conducting iodine studies in other countries and their understanding of salt iodization and iodine nutrition in Angola. When the planning of a study begins in earnest, further investigation on the below points should be made.

**Household rather than school-based study:** According to Angola's 2014 Census [6], the proportion of children 6-17 years of age attending school varied considerably by urban and rural residence. In urban areas, 89% of children were attending school, whereas only 69% of children in rural areas were attending school. Because of the relatively low school enrolment rates, particularly in rural areas, a study of school children would contain a clear bias by not including children outside of the school system. Thus, a household-based study is recommended to achieve an un-biased sample and collect data directly from woman of reproductive age, a population group vulnerable to iodine deficiency.

Moreover, as Angola has recently conducted a national census, there is current data of census enumeration areas that can be used as a sampling frame for a household-based study.

**Determining strata for an iodine study:** There are different options that can be used to design an iodine study. While some iodine studies in other countries have used administrative provinces as strata, which permit both provincially- and nationally-representative estimates, this approach is likely not be feasible in Angola since it has 18 provinces, and would result in a very large sample size which is not needed to understand the iodine nutrition of vulnerable groups and household coverage of adequately iodized salt. When planning the study, statisticians should aim to obtain a reasonable sample size (e.g. ~ 2000 or fewer subjects).

Thus, other approaches to stratify such a study should be considered. For example, using historical and anecdotal information about salt iodization in Angola, the country could be divided into three zones: 1) coastal, 2) central, and 3) east, which could serve as strata for an iodine study (see details below). Differences in population size will have to be taken into account, but it is likely that the sample size of the three zones will probably differ because of the highest population density in coastal Luanda province. Using this approach, it is possible to use a somewhat smaller sample size. Another approach would be to use the seven strata utilized in Angola’s 2007 nutrition survey[9].

1. **Coastal zone:** This zone would consist of all the coastal provinces, including Cabinda, Zaire, Bengo, Luanda, Kwanza Sul, Benguela, and Namibe. The rationale for grouping these provinces into a singular zone is due to the likely consumption patterns of coastal
residents. Specifically, coastal residents may consume iodized salt on dried fish, table salt, and possibly to processed foods containing iodine.

2. **East Zone:** This zone would consist of all the eastern provinces bordering on the Democratic Republic of Congo and Zambia (i.e. Lunda Norte, Lunda Sul, Mexico, Cuando-Cubango) and the Bié province. These provinces are speculated to have the highest risk for iodine deficiency. Fresh-water lake fish are typically eaten in this region, but this type of fish is not salted.

3. **Central Zone:** This zone would consist of all provinces between the coastal and eastern provinces with the exception of the central province Bié. The provinces would include Uige, Kwanza Norte, Malanje, Huambo, Huila, and Kunene. The rest of the provinces mostly situated in between the coastal and eastern provinces.

**Laboratory analyses for salt iodine and urinary iodine concentrations:** It is likely that the iodine content of salt can be quantitatively measured by an Angolan laboratory, such as the Ministry of Fisheries laboratory. If done using titration, it is recommended that the laboratory standardize is procedure and demonstrate its ability to accurately and precisely measure salt iodine. If this is not done, quantitative rapid kits such as the iCheck or I-Reader [33] can be used. For measurement of urinary iodine, it is recommended that urine samples be shipped to a laboratory with that has successfully participated in an external quality assurance scheme, such as CDC's *Ensuring the Quality of Urinary Iodine Procedures* (EQUIP) program. Such a laboratory exists in Tanzania and can be contacted prior to commencing the study.

**Questionnaire:** While the coverage of adequately iodize salt and median urinary iodine concentration can serve as the primary outcomes of a study, a comprehensive questionnaire should be developed to assess other factors related to salt consumption and iodine deficiency. These factors may include consumption of salted fish intake and other potential sources of iodine (e.g. bread). In addition, basic demographic data should be collected to examine the study's primary outcomes by various sub-groups (e.g. respondent's age and education status, household wealth quintile, etc).