UNIVERSITY FOR DEVELOPMENT STUDIES

ASSESSING THE UNIVERSAL SALT IODISATION PROGRAM AMONG SALT PRODUCERS AND TRADERS IN TEN SALT PRODUCING DISTRICTS OF GHANA

BY

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DECLARATION

I hereby declare that, this thesis is as a result of my own efforts and that it has never been submitted anywhere either in part or whole for the award of any degree.

…… ……

ABDUL-KAHAD AMADU **DATE**

(STUDENT/AUTHOR)

I hereby declare that the preparation and presentation of the dissertation was supervised in accordance with the guidelines on supervision of thesis laid down by the University for Development Studies.

…… ……

DR. VIDA NYAGRE YAKONG **DATE**

(SUPERVISOR)

ABSTRACT

In 1996, Ghana enacted the Universal Salt Iodization law under the Food and Drug (Amended) Act 523 to achieve 90% household consumption of iodized salt as recommended by the World Health Organization (WHO) and United Nations Children's Fund (UNICEF). Despite existence of regulation on mandatory iodization of salt for human consumption, implementation of strategies, policies and numerous educational programs, less than half of Ghanaian households are consuming adequately iodized salt. The aim of this study is to assess the knowledge and practices of salt producers and traders on universal salt iodization in ten major salt producing districts. The study was descriptive cross-sectional and the Lot Quality Assurance Sampling (LQAS) methodology was used. The sample size nineteen (19) was selected from each salt producing district which represents the minimum sample size that provided an alpha and beta error of ≤ 10% acceptable for making management decisions at least 92% of the time. Forty five percent (45%) of salt traders were aware of the Universal Salt Iodization (USI) law in the study catchment area. Traders in Awutu Senya, Ningo Prampram and Ada East districts were less aware of the Universal Salt Iodization law. Eighty five percent (85%) salt sample from producers tested above 15ppm and about 51% of the salt samples from traders tested above 15ppm. Traders in Ketu, Gomoa West and Ada East had most of their salt below 15ppm. Salt artisans and most medium scale producers of salt still lack adequate knowledge of salt iodization techniques and are also limited by the lack of access to salt iodization machine and salt iodization input (potassium iodate). Quality control and ensuring that all salt produced is iodize to 50ppm at production site is still a challenge in the ten salt producing districts. Quality controls and enforcement of the USI law through the salt value chain is necessary to achieving USI including Social and Behavioral Change Communication (SBCC) programs to increase knowledge on the benefits iodized salt and awareness of the USI law.

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DEDICATION

This work is dedicated to my parents and family

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LIST OF ABBREVIATIONS

CBD: Central Business District

CIDA: Canadian International Development Agency

DA: District Assembly

DHMT: District Health Management Teams

EHOs: Environmental Health Officers

EPA: Environmental Processing and Associate Ltd

FANTA: Food and Nutrition Technical Assistances

FDA: Food and Drugs Authority

FHD: Family Health Division

GAIN: Global Alliance for Improved Nutrition

GDHS: Ghana Demographic and Health Survey

GEPC: Ghana Export Promotion Council

GHS: Ghana Health Service

GNA: Ghana News Agency

GSA: Ghana Standards Authority

GSMF: Ghana Social Marketing Foundation

IDDs: Iodine Deficiency Disorders

IGF: Internally Generated Funds

IQ: Intelligence Quotients

KEEA: Komenda Edina Eguafo Abrem Municipality

KO3: Potassium Iodate

LQAS: Lot Quality Assurance Sampling

MICS: Multiple Indicators Cluster Survey

MLGRD: Ministry of Local Government and Rural Development

MOH: Ministry of Health

MoTI: Ministry of Trade and Industry

NASPAG: National Association of Salt Producers of Ghana

NGOs: Non-Governmental Organisations

NSIC: National Salt Iodisation Committee

PSI: Presidents Special Initiative

RDA: Recommended Daily Allowance

RTKs: Rapid Test Kits

SBCC: Social and Behavioral Change Communication

SBCs: Salt Bank Cooperatives

UNICEF: United Nation Children's Fund

USI: Universal Salt Iodisation

WB: World Bank

WFP: World Food Programme

WHO: World Health Organisation

C HAPTER ONE

INTRODUCTION

1.0 Background

Prevention of the detrimental effects of inadequate intake of iodine is still of global public health concern despite lot of global efforts made to address the problem (Pearce, Andersson and Zimmermann, 2013). Iodine deficiency has been identified as one of the world's factors that contribute to impaired child developments and poor pregnancy outcomes (Pearce, Andersson and Zimmermann, 2013). In most countries, iodine deficiency is addressed through Universal Salt Iodization (USI) which is seen as the best strategy due to its cost effective way to contribute to both economic and social development (Zimmermann, 2009). Investments in economic development and education will not achieve their desired outcomes unless the problem of iodine deficiency is addressed (WHO, 2014).

Iodine is an essential nutrient that our body needs to perform its normal functions. However, it is not always readily available in the foods that we often eat, depending on our diets, culture and geographical location (IDD Newsletter, 2014). Although not mostly thought about, not having adequate iodine in our diet can have serious health implication. Iodine deficiency is the world's leading cause of preventable mental retardation and impaired psychomotor development in young children (WHO, 2014). Severe iodine deficiency causes cretinism and also increases the risk of stillbirth and miscarriage in pregnant women (Lancet, 2008). Goiter is a visible outcome of iodine deficiency and it also contributes to reducing intellectual ability which can lead to poor school performance and impaired work performance (Zimmermann, 2009). Maternal

health can also be affected by this deficiency. For example, in the case of pregnant women, not having adequate iodine before and during pregnancy can be a matter of life and death for the unborn child. That is, very poor iodine status during pregnancy increases the risk of spontaneous abortion or stillbirths (WHO, 2007). Even when the child survives, it may do so at a huge cost to their physical and mental development in terms of being born with deformities as well as having poor intellectual ability. This is often largely irreversible since pregnancy is a critical stage where iodine is needed for brain development (Zimmermann, 2009). The adverse health conditions outlined above are known collectively as Iodine Deficiency Disorders (IDD).

WHO in 2007 estimated that about two billion people world-wide were at risk of iodine deficiency disorders and about a third of these were school-age children whose capacity for school performance and achievement was threatened by iodine deficiency (Lancet, 2008). On average iodine deficiency affected children lose up to 13 points of their learning capacity (IQ) (Zimmermann, 2008).

Between 1992 and 1994, it was concluded that Ghana had serious IDD problems affecting at least 33% of the districts which require urgent intervention with the situation in the Upper East Region being the most severe. The remaining 67% districts had traces of the problem (Ghana USI Strategy II, 2008). In 2014, only 39% of Ghanaian households were consuming adequately iodized salt (GDHS, 2014). In 2011 Ghana Health Service Nutrition Department and the Food and Nutrition Technical Assistance (FANTA) project of USAID conducted a profile analysis on micronutrients deficiencies in the country. The results showed that using the projected birth rates for the period 2011 to 2020, if investment in nutrition is not made to address iodine deficiency, almost 1.5 million

children will be affected by mild to severe irreversible brain damage due to iodine deficiency (Ghana Nutrition Profile, 2011).

Since 1994, the World Health Organization and the United Nations Children Fund have recommended Universal Salt Iodization (USI) as a safe, cost-effective and sustainable strategy to ensure sufficient intake of iodine by all individuals. This recommendation also seeks to achieve at least 90% of household consumption of adequately iodized salt (WHO, 2014). Ghana in 1996 enacted Universal Salt Iodization under the Food and Drug Act 523, which states that "No person shall: (a) Mine salt for human or animal consumption; or (b) Import, manufacture, package, label, advertise, store, deliver, distribute, trade, sell or export any salt that is not fortified with potassium iodate in accordance with this Act" (p. 904-905).

Ghana has set up a National Salt Iodization Committee (NSIC) to develop and facilitate the implementation of strategies towards achieving universal salt iodization in accordance with the Food and Drugs Amended Act. The USI strategic plan I (2005 -2007) and USI strategic plan II (2009-2011) were developed and implemented. These two strategic plans aimed at achieving the USI target of sustainable elimination of IDDs in Ghana.

Despite existence of regulation on mandatory iodization of salt for human consumption, considerable investments and numerous educational programs to create awareness about iodized salt usage and iodine deficiency disorders (IDDs), high proportion of households still consumed non-iodized salt (GDHS, 2014). Household consumption of iodized salt have ditched over the past years, with a target of about 90% recommended by WHO, household availability of iodized salt has declined in Ghanaian households from 68% to

65.5% from 2011 to 2014 (MICS, 2011; GDHS, 2014). Currently only 39% of households in Ghana are consuming adequately iodized salt (GDHS, 2014).

In order to ensure that adequately iodized salt reaches the household level, salt producers must produce only iodized salt and salt traders must also buy and retail only iodized salt to household consumers. This process makes both salt producers and traders very important in the iodized salt value chain (UNICEF, 2011). The availability of iodine in salt through the iodized salt value chain to consumers is widely influenced by a number of factors, including variability in the amount of iodine added during production, storage and meal preparation. Iodine levels dropped in salt to about 10% to 30% in refined salt and about 10% to 100% in raw crystal salt when exposed to various storage conditions especially sunlight (Cynthia and Palig-Ba, 2013). Ghana's ability to eliminate iodine deficiency through universal salt iodization could therefore hinge on salt production and handling practices, Knowledge of salt producers and traders on the detrimental effect of iodine deficiency and adherence of salt producers and traders to the laws on USI (UNICEF, 2011).

A market research carried out in 2011 by UNICEF on USI revealed that 36% of traders sold iodized salt even though awareness was high on USI among both salt producers and traders (UNICEF, 2011). This suggested that salt consumers had access to 36% of adequately iodized on the market. These findings drive the need to research in to the production and iodization of salt in the major salt production hubs of Ghana.

Aside Daboya in the northern region of Ghana, most of Ghana's salt comes from the coast. The major salt producing districts in Ghana include; Komenda Edina Eguafo

Abrem (KEEA), Awutu Senya, Ketu, Ahanta West, Ga South, Gomoa East, Gomoa West, Ada East, Ningo Prampram, and Effutu (UNICEF, 2011). Geographically all these district are located along the coastal line of Ghana where major salt deposits are found and mined for commercial purpose (Affam and Asamoah, 2011).

Figure 1.1: *Location of Salt Depositions in Southern Ghana (Affam and Asamoah, 2011)*

There is quite sufficient literature on universal salt iodization in Ghana. However, most of the research falls short of providing both qualitative and quantitative data on universal salt iodization on key actors such as producers and traders in the iodized salt value chain

from major salt producing hubs of the country. Household surveys have been conducted in many parts of the country and there is literature on the proportion of Ghanaian households with adequate access to iodize salt (GDHS, 2014).

The assessment of the USI program among key players in the salt industry such as traders and producers in these salt producing districts is therefore crucial to determine the quality of iodized salt moving out to other parts of the country. This will provide information to consolidate the effort made by government and NGOs to address challenges in the Ghana USI program. This research will also provide information on salt mining practices in these key salt producing districts in order to address identified gaps leading to inadequate salt iodization in the salt value chain.

The research method chosen will also aid the identification of salt producing districts or priority areas that needs urgent interventions to address key salt production challenges accounting for the poor performance in the Ghana USI program. This will further provide input for program management and evaluation and give timely warning on the need for intervention to prevent critical deteriorations in iodine deficiency control services through USI.

1.2 Problem Statement

In 2007, the WHO estimated that about two billion people world-wide were at risk of iodine deficiency disorders, about a third of these were school-aged children whose capacity for school performance and achievement was threatened by iodine deficiency (Lancet, 2008). Iodine deficiency disorders (IDDs) have been known in Ghana for at least five decades and are found in a number of communities. In 1994, it was concluded that

Ghana had serious IDD problems affecting at least 33% of the districts which require urgent intervention with the situation in the Upper East Region the most severe. The remaining 67% districts had traces of the problem (Ghana USI Strategy II, 2008).

Egbi (2012) concluded that about 94% of children in the Manya-Krobo district of Ghana had low urinary iodine levels. This showed that many household in the district do not have access to adequately iodized salt. A recent study in one of Ghana's salt producing district KEEA in the central region revealed that 43% of pregnant women had mild iodine deficiency and the need for national measures to address the problem (Simpong et al., 2016). A projection made by the Ghana Health Service Nutrition Department also indicated that 1.5 million children will suffer from mild to severe irreversible brain damage due to iodine deficiency between the period of 2011 to 2020 (Ghana Nutrition Profile, 2011).

Ghana in 1996 enacted Universal Salt Iodization under the Food and Drug Act 523, which states that: "No person shall: (a) Mine salt for human or animal consumption; or

(b) Import, manufacture, package, label, advertise, store, deliver, distribute, trade, sell or export any salt that is not fortified with potassium iodate in accordance with this Act" (p.904-905). This among other interventions by key ministries, departments and agencies has contributed to a rather slow increase in the consumption of iodized salt at the household level in Ghana (GDHS, 2014).

According to the Ghana Demographic Health Survey (GDHS) and the Multiple Indicators Cluster Survey (MICS) reports on USI, Ghana has only obtained and increase

in household consumption of adequately iodized salt from 28% to about 39% between 2003 and 2014 (GDHS, 2003;GDHS, 2014).

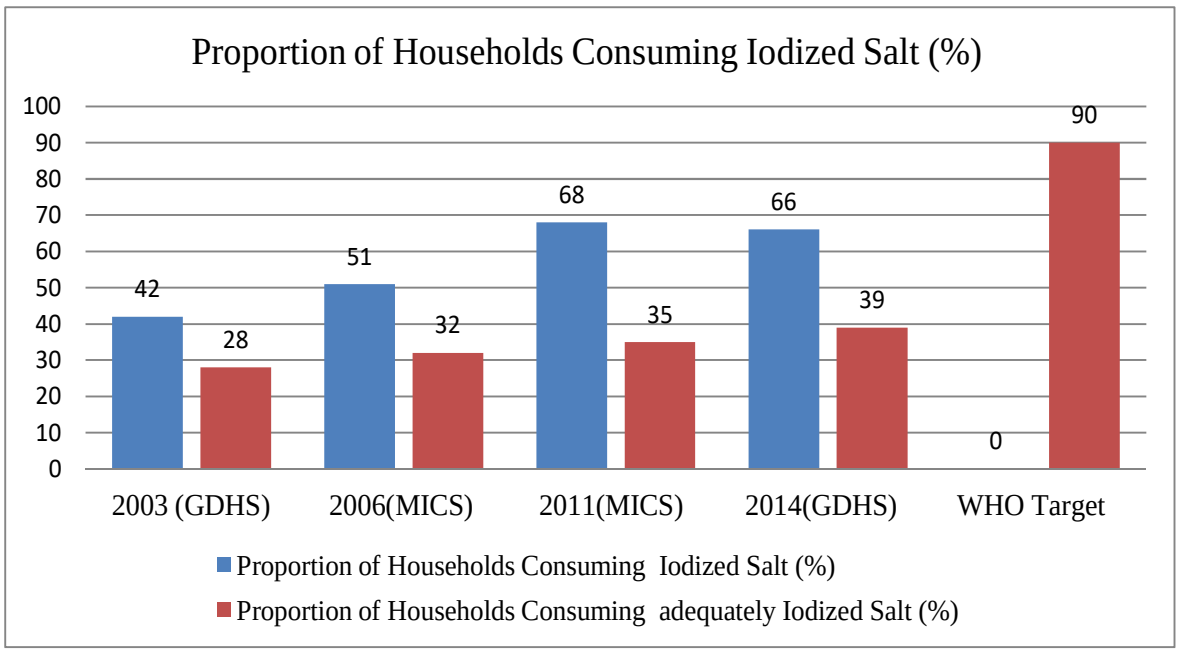


Figure 1.2: *A graph showing trend in household consumption of iodized salt in Ghana*

Source: *MICS, 2011 and GDHS, 2014*

In the quest towards achieving universal salt iodization in Ghana, the National Salt Iodization Committee (NSIC) was set up to develop and facilitate the implementation of strategies towards achieving universal salt iodization in accordance with the Food and Drugs Amended Act. The USI strategic plan I (2005 -2007) and USI strategic plan II (2009-2011) was developed. Despite the implementation of these strategies, coverage is actually still far away from the recommended WHO 90% household consumption of adequately iodized salt. Though there has not been progress in the percentage coverage of iodized salt, it has been observed that significant amount of consumed iodized salt is inadequately iodized to offer the required ≥ 15 parts per million (ppm) iodine at the

household level (GDHS, 2014). In Ghana, salt is iodized at production site and transported to the market for wholesale and retail. The major districts along Ghana's coast where salt is produced in commercial quantities include KEEA, Awutu Senya, Ketu, Ahanta West, Ga South, Gomoa East, Gomoa West, Ada East, Ningo Prampram, and Effutu (UNICEF, 2011). Salt produced in these districts contains insufficient iodine and incapable of addressing IDD (Ghana USI Strategy II, 2008). A study conducted by UNICEF in 2011 revealed that the general quality of iodized salt from medium scales producers was not the best in terms of grade and iodization and has a negative implications for human health (UNICEF, 2011).

1.3 Justification

Ghana has adapted and is implementing a Universal Salt Iodization program backed by the Food and Drugs Amendment Act (Act 523) passed in 1996. Despite the formation of a national salt iodization committee (NSIC) and the implementation of various USI strategies that is USI strategy 1 to 3, Ghana is still far from reaching the WHO recommended coverage of households consuming adequately iodized salt. Currently 39% of Ghanaian households are consuming adequately iodized salt according to the Ghana Demographic and Health Survey in 2014. This is still far from the 90% recommended by the WHO. Salt is mostly mined along the coastal regions of Ghana and transported to other parts of the country for both industrial use and for consumption (Affam and Asamoah, 2011). Salt producers and salt traders play a major role in the Ghana USI program. Salt production practices and handling, knowledge and awareness of existing regulations on iodization of salt among salt producer and traders have a greater influence on the availability of iodized salt at the household level.

This assessment will generate both qualitative and quantitative information to complement existing data and literature on the Ghana USI program. It is envisaged that this assessment will provide information that will aid long-term planning in health and development regarding the Ghana USI program. This study also aimed at providing data and recommendations for program management and evaluation as well as to give timely warning on the need for interventions to address critical factors affecting the salt iodization program in the areas under study.

1.4 General Objective

To assess the knowledge and practices of salt producers and traders on universal salt iodization in ten major salt producing districts in Ghana, that is KEEA, Awutu Senya, Ketu, Ahanta West, Ga South, Gomoa East, Gomoa West, Ada East, Ningo Prampram, and Effutu.

1.5 Specific Objectives

1. To assess salt production practices in respect with iodization among salt producers in the ten districts
2. To determine the awareness of the USI law among salt traders and producers
3. To determine the proportion of traders who sell adequately iodized salt and know its correct benefits in the ten salt producing districts
4. To determine the proportion of salt traders who properly package and display salt at the point of sale and their preference of sales between local (crude) salt and refined salt
5. To determine the misconceptions about iodized salt among traders and producers

1.6 Research Questions

1. Do salt producers practice adequate salt iodization in the major salt production sites in Ghana?
2. What are the quality control measures to ensure salt at production sites are adequately iodized?
3. What is the level of awareness of salt producers and traders on legislation on USI?
4. How is salt handled by traders who retail salt to household consumers?
5. Are salt producers and traders in the salt producing districts aware of the health benefits of iodizing and the selling of only iodized salt?
6. Are there misconceptions about the sales and use of iodized salt?

1.7 Conceptual Framework

The figure 1.3 below represents the study conceptual framework, it illustrates the major actors and the government ministries and agencies working to ensure adequately iodized salt reach the consumers through the iodized salt value chain. This conceptual framework described as the "The iodized salt producer to consume hill" by the author also state some of the reasons in the salt value chain that could account for un-iodized salt to reach consumers. The framework also shows the point at which each government agency is responsible to address the challenges in the iodized salt value chain.

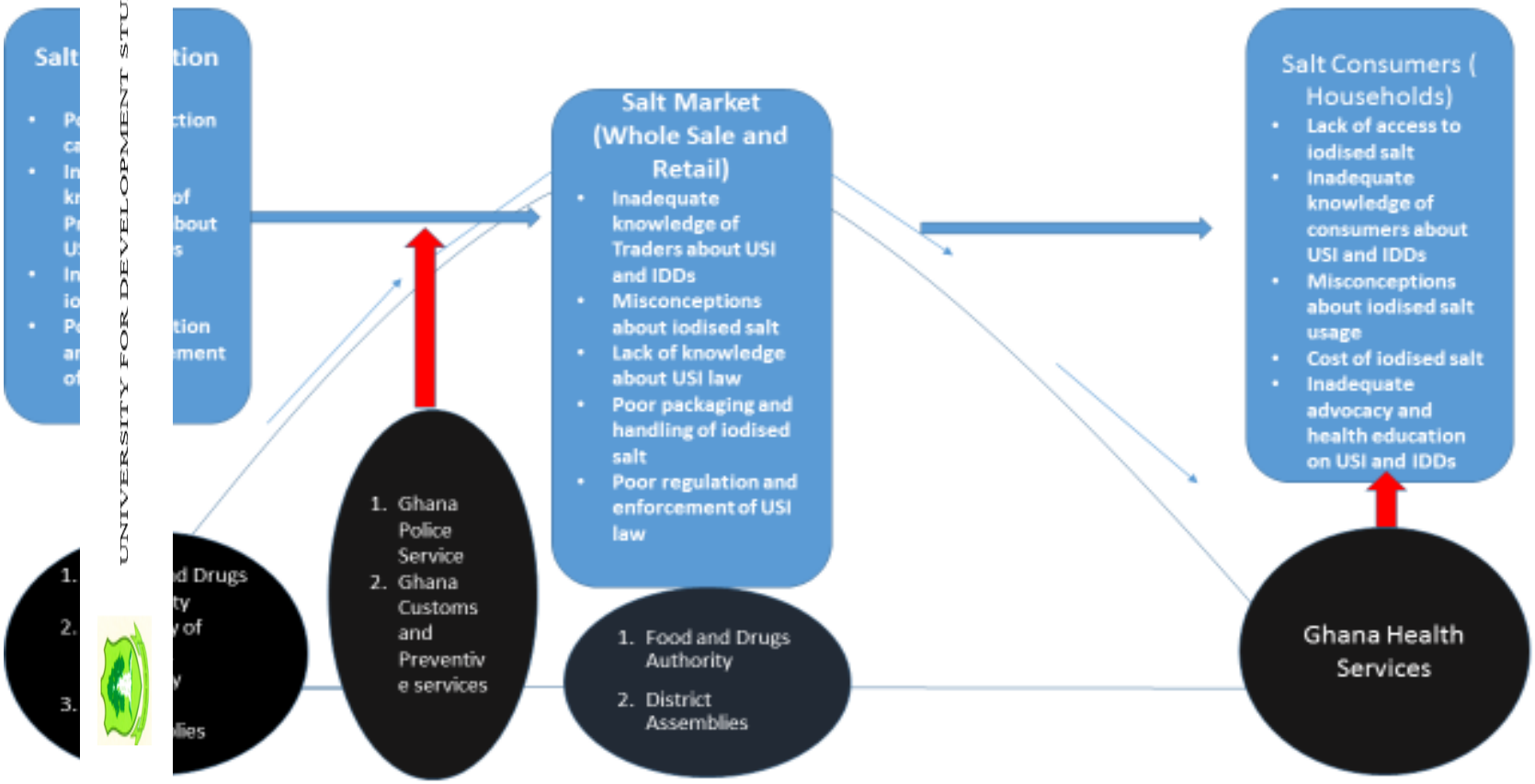


Figure 1.3: *Iodized salt producer to consumer hill*

Source: *Author*

1.8 Overview of Thesis

This thesis is presented in six chapters. Chapter one provides the background to the study, the problem statement and the need to research universal salt iodization in Ghana. This chapter also includes the study objectives and research questions as well as a conceptual framework of the study.

Chapter two of the thesis presents a comprehensive review of existing literature on universal salt iodization and iodine deficiency disorders (IDDS), this include study publications and findings in relation to the study.

Chapter three of this thesis explains the study methodology and the study type. Information on the 10 salt producing areas where the study was conducted is also provided in this chapter. The Lot Quality Assurance Sampling (LQAS) method, sample size determination and data collection procedures are all presented in chapter three.

Chapter four includes the findings of the study in the study catchment area (the 10 salt producing districts) on universal salt iodization. Both qualitative and quantitative results are presented in graphs, charts and tables to reflect the study objectives.

Chapter five of the thesis discusses the study findings in relation to the study objectives and research questions. This chapter also provides analysis of the study results in relation to the current literature on universal salt iodization in Ghana.

Chapter six of the thesis presents the conclusion of the study findings and recommendations to the Ghana universal salt iodization program.

1.9 Definition of terms

Universal salt iodization: Iodine is a trace element and an essential micronutrient that is often required in small amounts for the normal physiological function of the human body. Universal salt iodization is the fortification of salt meant for both human and animal consumption with potassium iodate. This process is achieved by mixing a standard solution of potassium iodate and mixing it with crude salt or refined salt either through mechanical means or manually. In Ghana, the Food and Drug Authority standards for iodization of salt for producers who produce salt for consumption is 50ppm, whilst at the household level the salt should still be at least above 15ppm (WHO, 2014; USI strategy III, 2015).

Iodine Deficiency Disorder: Iodine has been found to be a key component of the thyroid hormones which are necessary for a number of metabolic and enzymatic processes such as control of the body's metabolic rate; growth and development as well as neuron functions and their development. Inadequate consumption of foods with iodine results in a deficiency which may lead to certain abnormalities in the body, such as the enlargement of the thyroid gland which is seen physically as a lump in the neck and referred to us goiter. Other iodine deficiency disorders include; stunted growth due to insufficient production of growth hormones, a severe form of which is called cretinism and also poor cognitive functions and low mental capacity (Pearce, Andersson and Zimmermann, 2013).

Lot Quality Assurance Sampling (LQAS): LQAS is a statistical methodology used for data collection in health and other programs. The methodology is statistically identical to stratified sampling. This method originated in the manufacturing and factory production industry that was dealing with huge production numbers and had to ensure quality control.

The methodology is relative rapid and inexpensive and very suitable for conducting surveys in large areas. The LQAS method uses a relatively smaller sample size usually 19 being the minimum to provide an alpha and betta error of less than 10% with 95% confidence interval suitable for making management decision. LQAS works by subdividing a program Catchment Areas (e.g. salt producing areas of Ghana) into smaller areas that are referred to us Supervision Areas (e.g. districts) (Valadez et al., 2003; Hedt et al., 2008).

Decision rule: A **decision rule** is a procedure that is use to decide whether to accept or reject the null hypothesis. In LQAS, decision rules are used to identify Supervision Areas (SAs) that are performing below the Catchment Area (CA) average coverage or pre-selected targets. These areas are then prioritised. A detailed statistical description of LQAS decision rule table is included in appendix 1 (Valadez et al., 2003).

Iodine Rapid Test Kits (RTKs): Iodine RTKs are used to test whether salt samples contain iodine or not. They consist of three solutions, two test solutions and one recheck solution. During the test a few drops of reagents was introduced on about 5gram salt sampled from respondents (salt traders and producers). The intensity of the color varies with the amount of iodine in the salt and by matching it with the colour chart in the RTK, the range of iodine was ascertained between 0ppm to over 15ppm (Gorstein et al., 2016).

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

The objective of this chapter is to explore existing literature to inform the current study in order to make useful conclusion and recommendation that may address challenges in the Ghana USI program. This chapter provides a background on iodine and iodine deficiency disorders and how it affects both human and socio-economic development globally and in Ghana. Salt production and iodization in Ghana is also reviewed to enhance understanding on the current practices and gaps in the salt production sector on universal salt iodization. Awareness of the legislation on USI in Ghana and the knowledge of iodize salt and its benefits in the iodized salt value chain are explored. This chapter also discusses publications on the practices that may influence the stability of iodine in salt, availability of adequately iodized salt on the market and sales of refine and un-refined salt by salt traders in Ghana. This chapter also touched on publications on misconceptions surrounding the used of iodized salt in Ghana. Social and behavioral change communication theories are also discussed to further the understanding on why salt producers and traders may choose to adapt adequate salt iodization practices or not. Publications on the current trend in Ghanaian households currently consuming adequately iodized salt is also presented in this chapter.

2.1 Background of Iodine and Iodine Deficiency

The fight against iodine and other micro nutrient deficiencies is of significant importance in public health globally (Pearce, Andersson and Zimmermann, 2013). The successful elimination of iodine deficiency will be of great importance to international development

and could play a significant role in improving child development and maternal health (Pearce, Andersson and Zimmermann, 2013). In most countries iodine deficiency is addressed through Universal Salt Iodization (USI) which is seen as the best strategy due to its cost effective way to contribute to both economic and social development (Zimmermann, 2009). Investments in economic development and education will not achieve their desired outcomes unless this problem is addressed (WHO, 2014).

The name iodine emanated from Greek "ioeides" which means violet color and it is a chemical element which is represented by the symbol (I) and has an atomic number of 53 (Etymology Dictionary, 2016). In nutrition iodine is a trace element and an essential micronutrient that is often required in small amounts for the normal physiological function of the human body. Iodine has been found to be a key component of the thyroid hormones which are necessary for a number of metabolic and enzymatic processes such as control of the body's metabolic rate; growth and development as well as neuron functions and their development (Zimmermann, 2009).

According to the Office of Dietary Supplement (2011), of the National Institute of Health (United States), iodine is a mineral found in some foods which the body needs in the synthesis of thyroid hormones which is required to control the body's metabolism and many other important functions such as proper bone and brain development during pregnancy and infancy (Iodine section). Zimmermann et al. (2008) indicated that inadequate intake of foods containing iodine causes inadequate thyroid hormone production, which leads to various adverse outcomes, collectively termed iodine deficiency disorders (IDDs). IDDs include both severe and mild mental retardation, dwarfism, goiter, increased risked of miscarriages and still births,

congenital abnormalities and physical deformities (Zimmermann, 2008). If the thyroid does not have enough iodine to do its job, feedback systems in the body cause the thyroid to work harder. This can cause an enlarged thyroid gland causing goiter, which becomes evident as a swollen neck. Low levels of thyroid hormone can cause women to stop ovulating, leading to infertility (Zimmermann, 2012). Iodine deficiency can also lead to an autoimmune disease of the thyroid and may increase the risk of getting thyroid cancer. Studies suggest that iodine deficiency might also increase the risk of other cancers such as prostate, breast, endometrial, and ovarian cancer (Zimmermann, 2012).

Iodine deficiency during pregnancy is serious for both the mother and the baby due to the impairment of neurological development of the fetus (Zimmermann, 2012). In areas of severe chronic iodine deficiency, maternal and fetal iodine deficiency can occur from early gestation onwards (Zimmermann, 2012). Thyroid hormone is required for normal neuronal migration and myelination of the brain during fetal and early postnatal life, and iodine deficiency during these critical periods causes irreversible brain damage, with mental retardation and neurological abnormalities (Zimmermann, 2012). It can lead to high blood pressure during pregnancy for the mother. In extreme cases, iodine deficiency can lead to cretinism or dwarfism, a disorder that involves severe stunting physical and mental growth (Zimmermann, 2012).

The body requirement for iodine varies widely according to age and life stages. Children less than six months require less iodine daily as compared to adults and teenagers (Office of Dietary Supplement, 2011, Iodine Section). Pregnant women and lactating mothers will require enough iodine from their diet or supplements in order to

ensure the proper growth and development of their babies. This is because developing fetuses get their iodine from the mother and breastfeeding infants through breast milk and these are largely dependent on how much iodine the mother takes (Office of Dietary Supplement, 2011, Iodine Section). The table below is the recommended amount of iodine required for the various stages in life according to the Office of Dietary Supplement (2011) of the National Institutes of Health in the United State (Iodine Section).

Table 2.1: *Recommended amount of iodine for various stages in life*

Life Stage	**Recommended Amount**
Birth to 6 months	110mcg
Infant 7 to 12 months	130mcg
Child 1 to 8 years	90mcg
Child 9 to 13 years	120mcg
Teen 14 to 18 years	150mcg
Adult	150mcg
Pregnant teens and women	220mcg
Breastfeeding teens and women	290mcg

Source:*Office of Dietary Supplement, National Institutes of Health, United State, (2011)*

The devastating effect of iodine deficiency emanate from poor iodine nutrition during pregnancy which translates in to fetal deficiency. A daily intake greater than 500 mcg is not necessary as it would not provide any additional benefit for health and theoretically may be associated with impaired thyroid function. However, the scientific evidence for this is weak because the risk is related to the history of iodine nutrition in the specific population before the correction of an iodine deficiency, and the risk is greater in formerly iodine deficient populations (WHO, UNICEF & ICCIDD, 2001). Nevertheless, it is still considerably important to monitor the risk of thyroid disease due to excessive consumption of iodine, as well as due to deficiency (WHO, UNICEF &

ICCIDD, 2001).

The foods we eat daily mostly do not contain the required quantities of iodine our bodies need in order to carry out the necessary metabolic and physiological functions. Therefore, most people need an additional source of iodine in their diet (WHO, 2014). Naturally iodine exists in the soil and seawater (American Thyroid Association, 2012). This means that the level of iodine in plants and the food that is made from them depends largely on the level of iodine in the soil on which it was grown. Dairy products such as cheese, cow milk and yogurt together with eggs are noted to contain some iodine. Salted water fish, seaweeds and other marine foods also are good sources of iodine (American Thyroid Association, 2012).

Approximately one third of the world's population lives in areas where natural sources of iodine are low, and therefore they require the permanent presence of iodine-supplying interventions. This population at risk of iodine deficiency is unevenly distributed across the world and within countries (WHO, 2014).

2.2 Global Iodine Deficiency and Universal Salt Iodization

Iodine deficiency resulting in goiter occurs in 187 million people globally as of 2010 (2.7% of the population) (Vos et al., 2012). It resulted in 2700 deaths in 2013 up from 2100 deaths in 1990 (GBD, 2013).

Pearce, Andersson and Zimmermann (2013) in their study on Global iodine nutrition Indicated that approximately 70% of all households worldwide currently have access to adequately iodized salt in 2013, as defined by a national or sub national median urinary iodine concentration of 100-299 µg/L in school-aged children. Pearce et al. (2013) also revealed that 111 countries have sufficient iodine intake and thirty (30) countries remain

iodine-deficient; 9 are moderately deficient, 21 are mildly deficient, and none are currently considered severely iodine-deficient. Ten countries had excessive iodine intake. In North America, both the United States and Canada were generally iodine-sufficient, although recent data suggested that pregnant U.S. women were mildly iodine-deficient (Pearce et al., 2013).

Pearce et al. (2013) concluded that; although substantial progress has been made over the last several decades, iodine deficiency remains a significant health problem worldwide and affects both industrialized and developing nations. The ongoing monitoring of population iodine status remains crucially important and particular attention may need to be paid to monitoring the status of vulnerable populations, such as pregnant women and infants. Pearce et al. (2013) also suggested the need for ongoing monitoring of iodized salt and other dietary iodine sources in order to prevent excess as well as insufficient iodine nutrition. Their study recommended the coordination of interventions designed to reduce population sodium intake with salt iodization programs in order to maintain adequate levels of iodine nutrition as salt intake declines.

Zimmermann (2012) in the study of the effect of iodine deficiency in pregnant women and infants reported that iodine requirements are increased during pregnancy by ≥ 50%. His study also pointed out that in moderate-to-severely iodine-deficient areas, controlled studies demonstrated that iodine supplementation before or during early pregnancy eliminates new cases of cretinism, increases birth weight, reduces rates of prenatal and infant mortality and generally increases developmental scores in young children by 10-20%. His study also indicated that the effect of mild maternal iodine deficiency on cognitive functions of offspring's was uncertain. He said two meta-analyses have

estimated that iodine-deficient populations experience a mean reduction in IQ of 12-13.5 points in nearly all regions affected by iodine deficiency and concluded that salt iodization was the most cost-effective way of delivering iodine and improving maternal and infant health.

Andersson, Benoist and Rogers (2010) in the study of the epidemiology of iodine deficiency and salt iodization also pointed out the fact that Universal salt iodization (USI) and iodine supplementation were effective strategies for preventing and controlling iodine deficiency and that USI is now being implemented in nearly all countries worldwide, and two-thirds of the world's population was covered by iodized salt. The study however indicated the future challenge in ensuring higher coverage of adequately iodized salt, strengthening regular monitoring of salt iodization and iodine status in the population, together with targeted interventions for vulnerable population groups.

A study conducted in the Khumbu region of Nepal by Murdoch et al. (1999) on the persistence of iodine deficiency, revealed that most people preferred un-iodized Tibetan rock salt, although 44% regularly consumed iodized salt. All granulated salt tested from the local market contained adequate amounts of iodine. Only 11% of those surveyed knew that goiter was caused by iodine deficiency.

Murdoch et al. (1999) concluded that local cultural and commercial factors can severely limit the impact of interventions to control iodine deficiency such as universal salt iodization among other interventions. To be successful, the study recommended that control programs for iodine deficiency disorders also needs assessment of the salt trade, monitoring, education and occasional targeted interventions with iodized oil or other

supplements (Murdoch et al., 1999).The preference of rock/coarse salt by salt consumers which is mostly un-iodized was indicated by Murdoch et al. (1999).

Subhash et al. (2010) in a study to determine the impact of Universal Salt Iodization (USI) on the prevalence of iodine deficiency in iodine deficient areas in northern India also concluded that; Although there was an overall improvement in iodine nutrition as revealed by decreased goiter prevalence and increased median urinary iodine levels, there were several pockets of severe deficiency that require a more targeted approach. Subhash et al. (2010) indicated that poor coverage, the use of unpackaged crystal salt with inadequate iodine and the washing of salt before use by 90% of rural households were the major causes of persisting iodine-deficiency disorders. This they indicated demonstrated lapses in USI implementation, lack of monitoring and the need to identify hot spots. Subhash et al. (2010) recommended strengthening of USI programs with a mass education component, the supply of adequately iodized salt and the implementation of complementary strategies for vulnerable groups, particularly neonates and lactating mothers.

2.3 Universal Salt Iodization and Iodine Deficiency in Ghana

Salt iodization is the preferred strategy for control of iodine deficiency disorders and is implemented in more than 120 countries around the world (WHO, 2014). Many countries worldwide have successfully eliminated iodine deficiency disorders or made substantial progress in their control, largely as a result of salt iodization (WHO, 2014). Salt is considered an appropriate vehicle for fortification with iodine, for the following reasons: (i) it is widely consumed by virtually all population groups in all countries, with little seasonal variation in consumption patterns, and salt intake is proportional to

energy intake/requirements; (ii) in many countries, salt production is limited to a few centers, facilitating quality control; (iii) the technology needed for salt iodization is well established, inexpensive and relatively easy to transfer to countries around the world; (iv) addition of iodate or iodide to salt does not affect the taste or smell of the salt or foods containing iodized salt, and therefore consumer acceptability is high; (v) iodine (mainly from iodate) remains in processed foods that contain salt as a main ingredient, such as bouillon cubes, condiments and powder soups, and hence these products become sources of iodine; and (vi) iodization is inexpensive (the cost of salt iodization per year is estimated at US$ 0.02–0.05 per individual covered, and even less for established salt-iodization programs). Additionally, the concentration of iodine in salt can easily be adjusted to meet policies aimed at reducing the consumption of salt in order to prevent cardiovascular disease (WHO, 2014).

2.4 Salt Production in Ghana

Salt production in Ghana started somewhere in the 19th century and served as a major economic activity for people living in the coastal region of the country. Some salt mining activities can also be located in some part of the Northern region. The Daboya salt mine is one of such examples. The major salt producing areas in the coastal region of Ghana include the Songhor lagoon, the Keta lagoon, the Densu Delta area, Amisa lagoon, Nyanya lagoon, Benyah lagoon, Oyibi lagoon among others (Asante, 2012).

Salt wining by local people in the coastal regions is a major source of livelihood and the sector provides employment for more than thousand people in these areas (Yaboah, 2011). These locals use rudimentary technologies in weaning the salt and these methods allow them to gather about 15 bags of salt daily (Asante, 2012). The harvested

salts are sold to the local market including markets in the Northern and Ashanti regions of the country. Some of the salt is also exported to neighboring Togo, Bukina Faso, Ivory Coast and Benin (Yaboah, 2011).

It is estimated that about 3 million tons of industrial salt is required to meet the demands of the West African sub region (UNICEF, 2011). Unfortunately, this demand cannot be met by the major salt producing countries in the sub region. Senegal and Ghana are the key countries in the ECOWAS region that have the potential to produce large quantities of commercial salt (GEPC, 2009). Production estimate from both countries unfortunately does not meet the tonnage required annually and the gap is filled with imported salt from Brazil, Europe and Australia (UNICEF, 2011).

The annual salt production for Ghana alone was estimated in 2004 as 240,000MTper annum (Ghana Universal Salt Iodization [USI] strategy II, 2008) and as of 2009 the Ghana salt industry produced between 250,000 and 300,000 MT of salt annually but 2013 production was estimated to have increased to approximately 350,000 MT (Ghana Universal Salt Iodization [USI] strategy III, 2015). Despite the increase in production, experts from the Ghana Export Promotion Council (GEPC) indicated Ghana was underachieving in terms of production capability (GEPC, 2009; Ghana USI Strategy III, 2015). About seventy per cent (70%) of the salt produced is exported to countries within the sub region (GEPC, 2009). An appraisal of the salt industry carried out by the government and UNICEF in 2013 indicated that the current annual salt production may represent only ten per cent (10%) of the country's potential capacity (Ghana USI Strategy III, 2015).

Ghana together with Senegal forms the two large salt producing countries in the West

African sub-region. Ghana's 573 km coastline on the Gulf of Guinea stretching from the eastern border with Togo, traversing Volta, Greater Accra, Central and Western regions to the Cote D'Ivoire border to the west, extends 200 nautical miles out to the sea provides abundant sea water resource for salt production. An estimated 50,000 hectares of land in coastal Ghana can be used for salt production but only 28,000 hectares has been licensed to salt producers out of which only 40% are being used as of January 2006 (Quashie and Oppong, 2006; USI Strategy III, 2015). This excludes the surface area of lagoons which are used in open salt winning. Solar salt production in Ghana is conservatively estimated at 5 Million MT/yr based on estimated average productivity of Ghanaian salt works at 1,600 tons' per anum per hectare of crystallizer area (Quashie and Oppong, 2006; Ghana USI Strategy III, 2015).

Ghana has identified the salt production sector as an important one to aid the diversification of its economy and make it a potential commodity which can contribute significantly to GDP (Ghana USI Strategy III, 2015). Salt is being referred to us white gold because of its economic potentials. Before Ghana can make economic gains from the salt industry, investment is required in the sectors to boost production capacity. This will require government's commitments in driving the process to achieve this goal (Asante, 2012). It is important to stress that "white gold" is the only renewable natural resource that could enhance the livelihoods of generations. It is on such note that government steps in to increase and enhance local production. Salt contributes more than 70% of internally generated funds (IGFs) of the Dangme East District Assembly (Asante, 2012). Research indicates that Ghana has a potential production capacity of more than two million tonnes, but can only manage a maximum of 250,000 tones,

which represents just 10 per cent of what nature offers on the coast (Asante, 2012). Attempts made to develop the industry by government and the private sector has not achieved sustained positive results. Although accurate current data on national salt production exports are not readily available, in 2004 it was reported that of about 250, 000 Tons of salt produced, 60% was exported to neighboring countries (Quashie and Oppong, 2006). Estimates by the Presidential Special Initiative (PSI) on Salt projected as of September 2009 Ghana exported about 67% of production amount to Burkina Faso, Niger, Togo, Nigeria, Mali, The Ivory Coast, Benin and Congo while about 33% was for domestic consumption (Ghana USI Strategy III, 2015).

Findings from a baseline studies in Ghana conducted in 1994 prior to the adaption of USI as a strategy to eliminate IDDs, showed that salt produced in Ghana contains insufficient iodine and incapable of addressing IDD (Asibey-Berko, 1995). The iodine levels of natural un-iodized sea salt are too low in iodine to supply the Recommended Daily Allowance (RDA) of 150mg (Asibey-Berko, 1995). Therefore, without iodization to the acceptable level needed to deliver 15ppm at household level, the exclusive consumption of natural salt with food will not serve the reduction of IDD.

Ghana's salt industry is widely decentralized with very diverse production levels ranging from individual independent salt winners or harvesters, through sole proprietor informal sector micro-scale producers to medium scale formal sector firms. These decentralized sectors use a range of technologies, business models and other practices that govern their operations making it difficult to develop a single iodization strategy that will address the needs of all these sectors (Ghana USI Strategy III, 2015).

Salt production is the country is undertaken by various individuals who can be

categorized as artisanal to large scale producers. The salt production industry in Ghana is mainly categorize in to three main groups based on the quantity of salt produced, that is the large scale salt producers, the medium scale producers, and the cottage scale or small scale producers (UNICEF, 2011).

The large scale salt producers usually have a production capacity of 10,000 metric tons per annum, the table below shows the production capacity of each of the salt production groups.

Table 2.2: *Table of Production Capacity of Salt Producers and Market Shares*

Category of salt producers in Ghana	**capacity/unit MT/year**	**Local Market share**
Large-Scale Producers	> 10,000	50%
Medium scale Producers	500 - 10,000	15%
Cottage Scale Producers (Artisanal)	< 500	35%

Source: *Euro Health Group, (2011)*

The UNICEF Market Research Study (2011) on iodated salt to examine the knowledge, attitude and practices of salt consumers, traders and producers in Ghana, reported a number of issues and findings. The report indicated that 40 to 50 medium scale producers are located in the Central, Volta and the Greater Accra regions and usual operate in cooperatives, associations or as individuals. The report also disclosed that the small scale producers are mostly individuals and are typically referred to as salt winners whose operation are outside government legal and administrative frame work. Most of these artisans are mostly not registered under any assembly or group. Their activities usually

result in small quantities of salt production. However, this group possess up to about 35% of market shares in the salt industry (UNICEF, 2011).

It was also revealed in the study that these small scale producers are mostly less informed about the need to iodized salt due to their mode of operations, their businesses are also so small that they do not have the financial power to purchase iodization equipment and therefore function outside the formal economy which also place them outside the purview of the national regulatory and enforcement agencies (UNICEF, 2011).

Whereas compliance to salt iodization regulations are relatively high among large scale producers

(95 per cent compliance with some companies) very little iodization is done by small scale producers who have 35 per cent of the domestic market share in Ghana (UNICEF, 2006).

2.5 Iodization of Salt in Ghana

Salt iodization is the preferred strategy for control of iodine deficiency disorders and is implemented in more than 120 countries around the world. Many countries worldwide have successfully eliminated iodine deficiency disorders or made substantial progress in their control, largely as a result of salt iodization (WHO, 2014). In 1996 the Government of Ghana in responds to the WHO recommendation of Universal Salt Iodization as an intervention to address iodine deficiency disorders globally, made a lesgislative amendments to include the mandatory fortification of salt with potassium iodate. This did not include salt that was meant for industrial use. This was only limited to salt that was meant for both animal and human consumptions. The Food and Drug Board (FDB) act of parliament 523 of the republic of Ghana therefore made it an offence to mine or sell salt for both animal and human consumption without

fortification with potassium iodate (Ghana USI Strategy II, 2008).

The recommendation by WHO to use salt iodization to fight iodine deficiency was deduced from the fact that, salt was an appropriate food commodity that could be iodized to reach wide population groups. Salt is consumed globally by many population groups as a food additive for taste and its wide spread usage makes it an appropriate vehicle for iodine fortification as an intervention to control IDD (WHO, 2014).

The Act 523 of the FDB did not only forbid the mining and sale of unfortified salt with potassium iodate but also the importation and exportation of salt that was not fortified with potassium iodate. The Ghana Standard Authority had the responsibility of prescribing the standards for salt iodization. The Food and Drugs Authority was inaugurated in 1997 to monitor and ensure compliance to the FDB act of parliament in the salt industry (Ghana USI Strategy II, 2008).

A national multi sartorial committee was formed in 2005 called the National Salt Iodization Committee (NSIC) to stir the affairs of the universal salt iodization programs in the country. The composition of the committee was made up of members from the Ministry of Health and the Ghana Health Service, the Food and Drugs Authority, the Ghana Standard Authority, the Ministry of Interior and the Ghana Police Service, the Ghana Customs and Preventive Services and the Ministry of Trade and Industry. The private sector was also represented in the committee, this included the National Association of Salt Producers of Ghana (NASPAG), UNICEF, Global Alliance in Nutrition (GAIN) and other development partners (Ghana USI Strategy II, 2008).

A national Universal Salt Iodization strategy document was also developed and the

NSIC created a forum for discussing, planning and monitoring the implementation of the comprehensive USI strategy (UNICEF, 2011).

At salt production sites, the Food and Drug Authority (FDA) is responsible for monitoring salt iodization levels, the FDA is to ensure that all salt before it leaves production site is adequately iodized to 50ppm. They are also expected to monitor the transportation of salt in collaboration with the Ghana Police Service and the Customs division of the Ghana Internal Revenue Service (IRS) at various road check points. The FDA is also mandated to give certification for all salt that is transported including salt that is meant for industrial use and therefore not fortified with potassium iodate (Ghana USI Strategy II, 2008).

The Ministry of Local Government and Rural Development (MLGRD) through the various district assemblies are expected to monitors salt traders with the FDA being the lead agency. This is to ensure that all salt at sale outlet are adequately iodized for consumption. The Ghana USI strategy II indicated that the MLGRD whose actions are implemented through the various district assemblies and the FDA in consultation with the Ghana Standards Authority (GSA) are to collaborate with the Ministry of Interior to update legislation on salt iodization, disseminate and enforce by laws on USI (Ghana USI Strategy II, 2008).

Salt iodization in Ghana is challenged by the numerous small scale producers, according to the Ghana USI strategy II (2008) document, about 30 to 40 percent of domestic salt consumption comes from small scale salt producers. This makes it difficult for the monitoring and enforcement of the USI law by the regulatory and

enforcement agencies (Ghana USI Strategy II, 2008).

The iodization of salt for human and animal consumption is carried out by a variety of wet methods, ranging from the simple manual knapsack spraying to complex mechanical iodization plants (UNICEF, 2011). In knapsack spraying, a predetermined concentration of potassium iodate (1kg in 12L of water) is put in a knapsack and sprayed over a pre-determined quantity of salt. According to industry experts, this method is cheap and used by majority of salt producers (UNICEF, 2011). In contrast, the drip feed method is used by salt producers who are mostly beneficiaries of the current UNICEF and WFP support program which provides iodization machines and potassium iodate. Additionally, the spray mixing techniques is a continuous iodization technique which is mostly integrated as part of the salt production and refining system. Comparatively, this method is structurally complex and capital intensive (UNICEF, 2011).

Access to potassium iodate by salt producers has been indicated in some literature concerning the Ghana Universal Salt Iodization program as a challenge (Nyumuah et al., 2012). The current annual raw salt production from Ghana requires 20-34 MT of potassium iodate for complete adequate iodization at the current potassium iodate price of USD 50 to 60 kg (USI Strategy III, 2015). Achieving the mandated addition of 50 ppm potassium iodate (KIO_3) at the point of production requires more than USD 1.25 to 2.75 Million to finance the annual potassium iodate requirement of Ghana (Guyondet, Spohrer, & Quashie, 2013). Through The Global Alliance for Improved Nutrition (GAIN) Premix Facility, GAIN has established a mechanism to ensure a regular and sustainable supply of potassium iodate to Ghana. This has stabilized the

price and prevented the frequent shortage of the chemical in the country (UNICEF, 2011).

The Global Alliance for Improved Nutrition (GAIN) began facilitating the procurement of potassium iodate in Ghana through a partnership established in 2009 with the President's Special Initiative on Salt (PSI-Salt) under the Ministry of Trade and Industry (MoTI). In 2010, the partners established a system to improve supply of the potassium iodate to small and medium scale salt producers. GAIN provided an upfront supply of 5 MT potassium iodate to PSI-Salt under a consignment arrangement. PSI then sold the potassium iodate to salt producers in scale-appropriate quantities. Revenues were used to fund the regular supply of the fortificant that is potassium iodate (Guyondet et al., 2013).

The PSI played a very central role in the distribution of potassium iodate to both the medium and small scale salt producers; however in 2010 the PSI on salt was closed following a restructuring of the MoTI. The government through the National Salt Iodization Committee NSIC and GAIN then outsourced the management and distribution of the potassium iodate to a private company that is the Environmental Processing and Associate Ltd (EPA) (Guyondet et al., 2013). The GIAN Premix Facility offered a very good model for sustainable supply of potassium iodate to the Ghana salt industry through the EPA. The figure below is a further explanation of how the GAIN potassium iodate supply model worked (Guyondet et al., 2013).

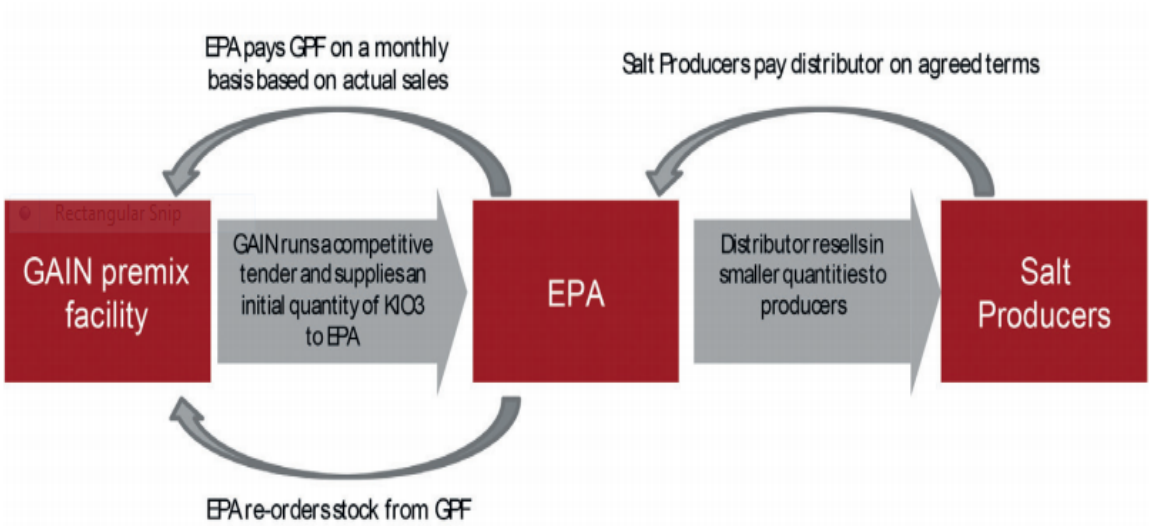


Figure 2.1: *GAIN potassium iodate supply model.*
Source: *GAIN, 2013*

The model enabled the supply of 5,000kg of potassium iodate resulting in 27.6% of salt iodized through the model (Guyondet et al., 2013). Nyumuah et al., (2012) in the review of the lessons learned in the implementation of large scale food fortification in Ghana, concluded that Salt Bank Cooperatives (SBCs) has the potential of increasing the proportion of people consuming adequately iodized salt, this paper also indicated that the use of the iCheck CHROMA rapid test device for salt can help improve quality control with respect to USI.

Ahiadeke et al. (2012) concluded in their study paper on the factors influencing the use of adequately iodized salt in Ghana that the numerous small scale salt producers located at hard to reach areas and the lack of local expertise to run iodization machines were challenges facing the Ghana USI program.

Asibey-Berko et al. (2008) look at the double fortification of salt to address anemia and

iodine deficiency. The study concluded the possibility of fortifying salt with both iron and iodine to address both anemia and iodine deficiency in vulnerable groups. Even though the study indicated a slight color change with the fortification, it did not affect the taste of the salt when put in food. The success of the USI program in Ghana can therefore be used in addressing other micronutrient deficiencies of public health concern such as iron, Vitamin A and Zinc (Asibey-Berko et al., 2008).

Diosady et al. (2006) conducted a similar study in Kenya on the storage and distribution of double fortified salt with various formulations of iodine and microencapsulated iron in the coastal and highland regions of Kenya. High iodine retention values were obtained during the three-month study. Most of the iron was retained with less than 20% of the ferrous iron oxidized to ferric iron, and about 25% of the iron in formulations with sodium ferric EDTA (NaFeEDTA) reduced to ferrous iron. Double fortified salt with ferrous fumarate was more stable than those prepared with the other iron premix. The polyethylene film overwrap of salt packs in the bundles provided significant protection from ambient humidity. Salt double fortified with iodine and microencapsulated iron ferrous fumarate premix was generally quite stable because both iodine and the ferrous iron were protected during the three months in the distribution and retail network in typical tropical conditions in Kenya's highlands and humid lowlands. This shows that the prospects of the Ghana USI program with iodine can be replicated to solve other micro nutrient deficiencies in Ghana (Diosady et al., 2006).

As part of endeavors to ensure universal salt iodization for both consumption and for export, the Ministry of Health (MoH) and its agencies such as the Nutrition Department

of Ghana Health Service and the Food and Drugs Authority (FDA) in partnership with UNICEF and other development partners have developed guidelines for monitoring the salt iodization program in Ghana (UNICEF, 2011). This guideline were meant to assist the various regulatory agencies such the FDA, District Assemblies, Ghana Health Service, the Ghana Police Service and the Ghana Customs and Preventive Services to adequately monitor iodine in salt at production stage, transportation stage, whole sale points, retail outlets and at household levels (MOH & UNICEF, 1999).

The World Food Program (WFP) in its operations requires thousands of tons of iodize salt to work with during it operations in development and emergency situations throughout the West African sub region. In December, 2007 the WFP with support from CIDA initiated a program in effort to combat iodine deficiency in Ghana. The initiative provided technical assistance in the form of eight salt iodization units to promote the productions and distribution of iodized salt. The broad goal of the WFP as part of this program was also to develop Ghana in to a WFP procurement hub for the supply of food commodities including iodized salt (UNICEF, 2011).

2.6 Awareness of the USI Law

In accordance with the public health act of Ghana (2012) part seven under the sub heading; mandatory fortification of food, article 107 indicates the following; (1) a person shall not import, manufacture, package, label, advertise, store, deliver, distribute, trade, sell or export food for human or animal consumption that is not fortified in accordance with this Part, the Regulations or Guidelines; (2) Food is fortified where it has additives such as potassium iodate, protein, essential amino acids, vitamins, minerals, essential fatty acids or any other nutritional substance added to it to

enhance its nutritional value; (3) the Food and Drugs Authority shall prescribe and implement the standards for the fortification of food, (4) a person shall not label, package for sale or advertise food in a manner that is likely to be mistaken for food of the prescribed standard, (5) this section does not apply to salt for industrial purposes.(6) Salt for industrial purposes shall *(a)* be labelled clearly to that effect, *(b)* be stored and displayed separately from salt intended for human or animal consumption, and *(c)* not be transported unless covered by a permit issued by the Authority.

In a study conducted by Ahiadeke et al. (2012) on the factors influencing the use of adequately iodized salt in Ghana recommended a reduction in the cost of iodized salt in order to make it accessible to the poor since some literature shows that wealth is a factor that could influence the use of iodized salt. The study also recommended the monitoring and enforcement of the law on salt fortification with potassium iodate to facilitate the achievement of universal salt iodization in the country. The study conducted by Chirewurah et al. (2015) in assessing the use of iodized salt in rural northern Ghana concluded that as much as 97 percent of these rural inhabitants were not aware of the law on salt iodization.

Kissi (2012), in the study of the utilization of iodized salt among households in the Danfa community found out that the study participants were generally unaware of the legislation on USI. Most of the respondents in his study did not know the sales of un- iodized salt was unlawful. Kissi (2012) also revealed that enforcement of the ban on the use of non-iodized salt was non-existent in the community. Kissi (2012) concluded that perception and beliefs were key determinants in the use of iodized salts and recommended that there

should be public education on awareness of the law and the benefits of iodized salts to demystify negative local beliefs about the use of iodized salts.

According to Chirewurah et al. (2015) noncompliance by both salt producers and traders to the law on iodization accounted for low utilization at the household level. The study also showed that 80% of key informants reported that ignorance of the salt iodization law and lack of adequate knowledge of iodized salt by consumers and traders contributed to the noncompliance to the USI law. A major contributory factor to noncompliance to the salt iodization law is the fact that those who flout the law are not sanctioned (Chirewurah et al., 2015). According to Chirewurah et al. (2015), although Ghana has passed a law on USI the absence of strict enforcement of the law in addition to weak monitoring of the salt value chain could serve as a major drawback for Ghana in its quest to achieve 90% availability and utilization of iodized salt at the household level.

Traders are between salt producers and salt consumers and their awareness of the USI law could facilitate the sale of only salt that is iodize (UNICEF, 2011). Environmental health workers should be empowered by law to prosecute or take legal action against salt sellers found selling salt that is not iodized. Also, manufacturers who do not comply with the universal salt iodization Act should attract some sanctions. The Food and Drugs Board should enforce laws that will require all salt produced to bear brand names and contact addresses of manufacturers in order to easily identify unionized products (Ghana USI strategy III, 2015).

2.7 Knowledge of iodized salt and its benefits

The Family Health Division (FHD) of the Ghana Health Service annual report (2014) reported a monitoring activity that was carried out in 13 salt producing districts in the southern part of the country to assess the progress made in the implementation of programs to control iodine deficiency disorders and the universal salt iodization program. The report concluded that about 85% of the people interviewed during the assessment had ever heard about the universal salt iodization program. The report also showed that most of the people obtained information on USI through the radio stations followed by television advertisement. The findings showed that knowledge on USI remain high but outcome on the proportion of respondents who knew the correct benefit of iodize salt has been low over the past years. According to the report only 68% of the people living in the 13 salt producing districts knew at least one benefit of iodized salt.

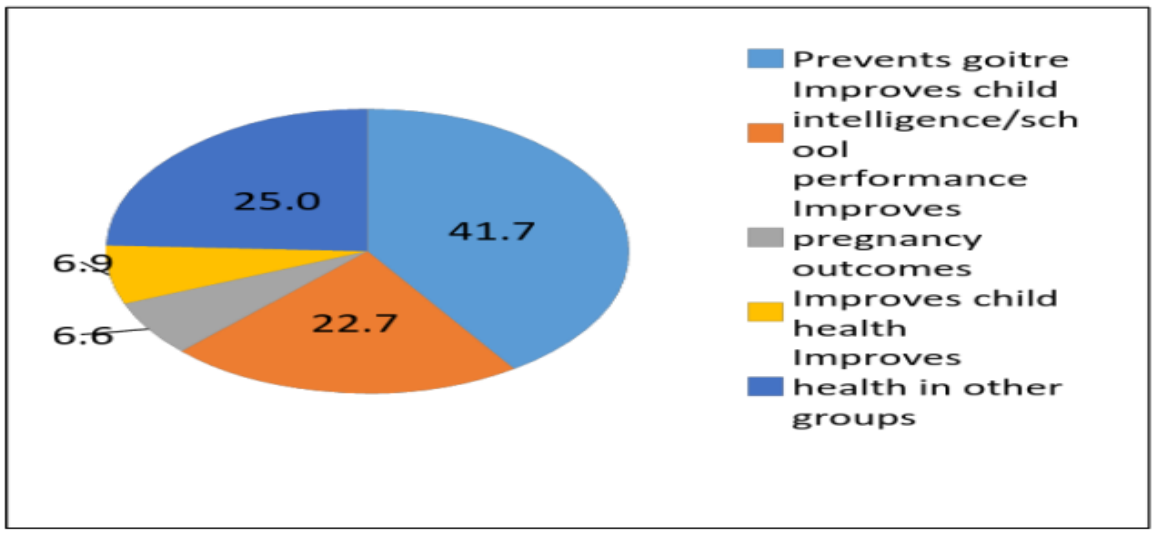


Figure 2.2: *Pie chart showing the proportion of known benefits of USI by respondents in the assessment*
Source: *Ghana Health Service - FHD, 2014*

The FHD (2014) report also revealed that respondents (Traders) received information on iodized salt predominantly from Environmental Health Officers (EHOs) from the District Assemblies. The report also indicated that all traders in the markets that were visited had ever come in contact with an Environmental Health Officer on issues regarding iodized salt (100%). This indicates that EHOs can play a vital role in promoting USI among market traders (FHD, 2014).

Adjei (2002), in her research on the determinant of iodated salt consumption in households in the Kintampo sub district, assessed the knowledge of respondents on the awareness of iodated salt and its benefits. Adjei (2002), study revealed that 79% of inhabitants were aware of iodized salt but only 20% could link the lack of iodine as a cause of goiter. Most of the people who were aware of iodized salt got the information through the television and radio with the least being from salt traders (Adjei, 2002). Adjei (2002) also assessed the knowledge of respondents on the benefits of usinf iodized salt and found out that goiter was the most known benefit of iodized salt (48%). Most of the respondents in Adjei (2002) study could not link the benefit of iodized salt to intelligence, that is only 3% responded positively. In looking at the relationship between knowledge and use of iodized salt, Adjei (2002) concluded that the more people become knowledgeable about the benefits of iodated salt, the more likely they will use it. Awareness on iodated salt alone may not be enough. Kissi (2012), in the study of the utilization of iodized salt among households in the Danfa community also revealed that knowledge on the availability of iodized salt was high but that did not translate into it use.

According to UNICEF (2011) a fair percentage, that is about 82% of the traders interviewed were aware of iodated salt. It was however very sad revealing that only 2% spontaneously recalled at least one benefit of consuming iodized salt; across all traders 42% believed there was no difference between iodated salt and non-iodated salt. Goitre is the only IDD recalled spontaneously and even this was recalled by only 2% of traders. 46% of traders said they knew that there was a difference between iodated salt and none iodated salt but could not tell which particular differences.

Buxton and Baguune (2012) concluded in their study on the knowledge and practices of people in the Bia district of Ghana with regard to the intake of iodize salt, that the participants in their study were aware of the importance of consuming iodized salt and iodine deficiency disorders, that is about 90.4% but this translated to only 64.6% of households using adequately iodized salt. They therefore suggested in their study that high levels in the proportion of people who know the importance of iodized salt did not necessarily translate in to an increase in the number of households who use adequately iodized salt and therefore recommended the enforcement of the USI law and related policies on universal salt iodization. In addition Buxton and Baguune (2012) recommended quality assurance of iodized salt throughout the salt value chain to the consumers. Buxton and Baguune (2012) study also showed that the radio was the medium through which most of the participants got their information about iodized salt. Goiter was the most known consequence of not consuming iodized salts, that is about 69.3% of the respondents in their study while 31.4% said the consumption of iodized salt enable one to stay healthy.

The UNICEF Dip-Stick baseline report on universal salt iodization in 2012 also

revealed some interesting finding on the universal salt iodization program in Ghana. This baseline assessment was carried out prior to a national communication campaign by an advertising agency called Charterhouse to promote the consumption of iodized salt across the country.

The assessment looked at the status of the universal salt iodization program with respect to the knowledge, attitude and practices of major actors in the salt chain that is salt Producers, Traders and Consumers (Charterhouse, 2012). The report indicated that averagely 80% of all salt producers expressed knowledge about iodized salt and the radio still stands out as the major source of information among this group followed by the television.

Despite the high awareness of about 80%, the study also indicated that 45% of salt producers knew the correct benefits of iodized salt and its related consequences. Goiter was reported as the highest recalled consequence of not consuming iodized salt, that is about 95% of salt producers recalled goiter as a consequence, 10% recalled polio as a consequence and only 5% related birth deformities as a consequence of not consuming adequately iodized salt (Charterhouse, 2012).

Salt traders on the other hand according to the report were aware of iodized salt, that is about 83% of traders were aware of iodized salt. However, the report showed that wholesalers were more aware of iodized salt than salt retailers that are about 72% and 52% respectively. In general, 66% of the Traders knew at least one benefit of iodized salt (Charterhouse, 2012).

2.8 Availability of Adequate Iodized Salt on the Market

The FHD (2014) annual report on the issue of market availability of iodized salt in a

monitoring activity that was carried out in 13 salt producing districts along the coastal regions using iodized salt Rapid Test Kits (RTKs) found out that only 48.8% of salt samples tested were adequately iodized. The idea of universal salt iodization is to have close to 100% of all salt on the market meant for both animal and human consumption adequately iodized above 15 ppm and available about 90% at the household level.

Adjei (2002) in her finding on the determinant of iodated salt consumption in households in the Kintampo sub district revealed that 39% of salt consumers indicated iodized salt was always available and about 20% indicated it was not available. The salt tested on the markets in the study disclosed that 59% of the salt on the market were adequately iodized. Adjei (2002) also indicated that, households in which respondents said that they could get iodated salt to buy any time they need it, were more likely to use iodated salt (83.9%), compared to those in which respondent said they could not get iodated salt to buy (58.6%).

Paa-Nii Quaye (2010) of the Global Alliance for Improved Nutrition, (GAIN) Africa, expressed concern, in a news item published on Ghana business news in 2010 that about 50% of salt on the Ghanaian market was not iodated despite 16 years after the introduction of iodized salt in the country. According to him, only about 30% of iodized salt on the market have the requisite iodine supplementation needed for the prevention of iodine related deficiency problems such as low Intelligence Quotient (IQ), still births, low birth weight and goiter.

The UNICEF Dip-Stick baseline report on universal salt iodization in 2012 also looks at various categories of traders and the type of salt they sell. The traders were asked

whether they sell iodized salt or not? And the findings indicated that averagely 66% of distributive traders sold iodized salt. This evaluation was however not based on the use of RTKs or any instrument to estimate the levels of iodine in the salt that was being sold by the traders but rather based on verbal responds to the survey questionnaire (Charterhouse, 2012). These findings point out that a lot of efforts are still required by the relevant agencies to ensure that most of the salt on the markets are adequately iodized to achieve the WHO recommendation of 90% of household availability of iodized salt (Charterhouse, 2012).

2.9 Sale of Refine and Un-Refined Salt by Traders

Most of the salt found in urban kitchens and restaurants are ordinary, white and highly refined salt. However the use of crystal unrefined salt is still very common in rural areas including some peri - urban and urban areas. Salt that is obtained from salt mines or evaporated from sea and lagoon water which is unprocessed and packaged directly with nothing else done to it is mostly referred to us unprocessed or unrefined salt, this is mostly approximately 84% sodium chloride (NaCl) and 16% other minerals, such as sulfur, magnesium, potassium, silicon, zinc, phosphorous (Health Basics, n.d).

Salt that is cleaned and processed chemically to remove impurities and to add other agents to absorb moisture and ensure even flow is what is referred to as refined salt. These products are aproximatly 97% NaCl and 3% man-made chemicals (Health Basics, n.d).

Heshmati (2014) evaluated the presence of heavy metals in both refined and unrefined salt. Trace elements of heavy metals such as lead (Pb) are widely present in the earth's

crust, in air and water. Heavy metal contamination in food through the addition of salt which is a common food additive is a matter of great concern for human health because they are toxic in nature and even at relatively low concentrations can cause adverse effects with time. Heshmati (2014) concluded that unrefined salt has a relatively high presence of heavy metals as compared to refined salt in Iran. Excessive intake of heavy metals such as lead can harm different systems and organs such as central and peripheral neural system, gastrointestinal tract, muscles, kidneys and hematopoietic system (Ciobanu et al., 2012). There is no much literature or research done to look at the levels of heavy metal in both refined and unrefined salt in Ghana. Base on Heshmati (2014) conclusion of unrefined salt having a relatively higher amount of heavy metals as compared to refined salt, it may be better to stick to the consumption of refined salt to lower the risk effect of consuming heavy metals.

Adjei (2002), in her research on the determinant of iodated salt consumption in households in the Kintampo sub district concluded that 44% of households preferred the use of crystal unrefined salt as compared to fine refined salt which was used by 28% of households.

Chirawurah et al. (2015) in their study in northern Ghana on the use of iodized salt in rural northern Ghana indicated the high cost of refine salt as a limiting factor to the patronage of iodized salt, other reasons included that respondents reported they were used to crystal unrefined salt. In the study 27% of respondents said iodized salt (refined salt) was expensive and accounted for the reason for low usage. Buxton and Baguune (2012) also concluded that some salt consumers in the Bia district could not distinguish iodized salt from non-iodized salt. Buxton and Baguune (2012) indicated that

consumers use unrefined salt (common salt) due to non-availability of iodized salt on the market. The results in Buxton and Baguune (2012) study also reported the high cost of iodized salt as an influential factor to the use of iodized salt. In the study an example was sited that about 500g of unrefined salt will cost about 35 Ghana pesewas and the refine (Annapurna) salt of exact quantity will cost 70 Ghana pesewas.

The UNICEF Dip-Stick baseline report on universal salt iodization in 2012 also revealed that 33% of all salt producers surveyed sold iodized salt at a different price from the non-iodized salt. The difference in the cost was accrued to milling, equipment used, packaging and iodine cost. The baseline study also looked at consumers' preference for iodized salt on the basis of previous and current usage including the extent of application to a variety of meals as well as the underlying reasons provided by respondents on the use of iodized salt. In general, the findings revealed that the usage of iodized salt among consumer groups and households is high, that is about 88% on the average with 2% indicating that they had used this salt (iodized salt) once, with 10% saying they have never used iodized salt. The result in the study also indicated that the availability of raw (unrefined) non iodized salt accounted for its high usage in the Central and some parts of the Greater Accra regions particularly in the regions that had salt producing towns (Charterhouse, 2012). The baseline report also found that out of 70 salt producers surveyed, only one (a small scale producer) claimed to be producing only iodized salt. Every other producer was found to produce raw unrefined and un-iodized salt and some only produced iodized salt based on demand by customers (Charterhouse, 2012).

In the UNICEF (2011) study, coarse (unrefined) salt was identified as the favorite

grade of salt across both urban and rural locations in salt producing areas and to a lesser degree in non- salt areas. The study also reflected that traders in salt producing localities sold coarse (unrefined) salt as compared to those in none salt producing locations. 60% of market traders in the Greater Accra region sold coarse (Unrefined) salt followed by 71% of market traders in the Volta region.

The study also indicated that a focus group discussion among traders in the Western region (Takoradi) pointed out that traders preferred the sales of non-branded coarse (unrefined) salt because they had the quickest turnover (money) (UNICEF, 2011).

2.10 Stability of Iodine and Proper Display of Salt at Point Of Sales

According to Diosady et al. (1997) on the stability of iodine in iodized salt used for correction of iodine deficiency disorders, stated that the amount of iodine in iodized salt can vary at the consumer level as results of the following reasons;

1. Variability in the amount of iodine added due to the iodization process.
2. Uneven distribution of iodine in the iodized salt within batches and bags
3. The extent of loss of iodine due to salt impurities, packaging and environmental conditions during storage and distribution
4. Loss of iodine due to food-processing, washing and cooking processes in the household.

Diosady et al. (1997) in their study concluded moisture has a critical role in the stability of iodine especially when iodized salt is stored in temperatures similar to that of developing countries. The result also showed that moisture absorbed by hydroscopic impurities contributed to the rapid loss of iodine in salt. The study therefore recommended the packaging of salt with effective moisture barriers such as low density

polyethylene bags can significantly reduce iodine loss in salt. The result indicated that with solid low density polyethylene packaging the loss of iodine from salt that has been stored for six months will be kept within 10% to 15% (Diosady et al., 1997).

Waszkowiak and Szymandera-Buszka (2008) studied the effect of storage conditions on iodine in salt and collagen preparation. Their study showed that the level of iodine in salt will decrease under high humidity and unlimited access to air. This finding shows that if iodized salt is not stored adequately in the salt value chain, the chances that the level of iodine will drop significantly before it reaches the market and the consumer is very high. Waszkowiak and Szymandera-Buszka also concluded that the introduction of collagen preparations as carrier of potassium iodate during iodization reduces iodine losses and can support the retention of iodine in salt independent of storage condition (Waszkowiak & Szymandera-Buszka, 2008).

Iodine retention in salt to some extend also depends on the nature or state of the salt. According to Jayashree and Naik (2000) white crystal salt has a relatively lower iodine retention compared to powdered and brown crystal salt. The study on iodine loses in different types iodize salt following common household storage practices revealed that iodized powdered salt after 15 days of storage was able to retain about 91% of iodine level followed by iodized brown crystal salt which retained 84% of its iodine level. Crystal white salt after the storage period retained about 77% of its iodine level making it the least in the experiment (Jayashree and Naik, 2000).

Chavasit et al. (2002) investigated different cooking methods, utensils, and cooking conditions along with the addition of various food additives such as sugars, fortificants,

spices and sanitizer to evaluate their effects on iodine in the food. Chavasit et al. (2002) carried out their study using brine (salt solution) as the model in order to maintain the real food system. Titration and spectrophotometric methods were employed to analyse iodine levels based on the kind of samples prepared. Chavasit et al. (2002) concluded that cooking methods that is boiling, frying, steaming and baking at pHs 3, 6 and 9 showed no significant effect on iodine loss however Chavasit et al. (2002), indicated that metal utensils significantly affected iodine loss in their study. Chavasit et al. (2002) also revealed that the addition of either sodium metabisulfite (50–250 ppm) or ascorbic acid (0.1 and 0.5%) in the total lost of iodine in salt at a higher concentration even before cooking. High loss of iodine was found in the samples with glucose (5%) and lactose (5%) at pH 9 after cooking especially with brass utensil; the sucrose sample showed a loss of 33% at pH 3. Conversely, high losses of iodine were found in all cooking utensils, except with brass, after adding ferrous sulfate (0.05 and 0.1%). High losses were found during cooking with phosphoric acid in brass at pH 3. Color interference caused inaccurate results for acetic acid at pH 9 in all cooking utensils, and for citric acid in brass utensil in all trials at all pH values. Garlic, fresh chili, pepper, and green curry paste caused high loss of iodine (Chavasit et al., 2002).

Longvah et al. (2012), also studied the stability of added iodine in different Indian cooking processes and investigated the retention of iodine from iodised salt when added to the most commonly used Indian recipes. Longvah et al. (2012) concluded that the retention of iodine is minimum in shallow frying with oil (52 ± 23%) and a maximum in pressure cooking (82.2 ± 6.2%).

UNICEF (2011) study also looked at the proportion of traders who sold salt under the right conditions (that is not exposing the salt to the sun and package properly) and concluded that generally traders made efforts to stock salt properly and not exposes it to the sun but about 37% of them according to the report still had their salt exposed to the sun and open air.

Based on the above the retention of iodine in the salt value chain could largely depend on the nature of the salt, storage condition as well as packaging from production to consumer level.

2.11 Misconceptions about the Use of Iodized Salt

Cultural believes and misconceptions can influence the use of iodized salt. Should this happen a lot of efforts will be required to change the perception of consumers. A study on tracking progress towards the elimination of iodine deficiency disorders in Jharkhand in India, Patro et al. (2008) indicated that misconceptions about iodized salt was noted among all groups in their study area. All participants in their study was said to have the common belief that iodized salt was equivalent to refine package salt that is further equal to expensive salt. Their study also disclosed that most of the participants were aware of health benefit of iodized salt but very few could relate the relationship between iodine and brain development (Patro et al., 2008).

Kissi (2012), in the study of the utilization of iodized salt among households in the Danfa community concluded that perception and beliefs were key determinants in the use of iodized salts. The participants in Kissi (2012) study generally believed that the use of iodized salt was associated with disease conditions such as diabetes, hypertension and

stroke and also stated that many affluent people were suffering from the above condition as a result of the use of what they described as “table salt” which contained high level iodine.

Adjei (2002) in the study on the determinant of iodated salt consumption in households in the Kintampo sub district also looked at some of the factors for the non used of iodized salt. Her results revealed that some salt consumers did not use iodized salt because they feel the taste of iodized salt was too sharp and also it was generally expensive as compared to crystal unrefined salt.

The UNICEF Dip-Stick baseline report on universal salt iodization in 2012, examine the factors accounting for the non-usage of iodized salt. The report outlines the following as some of the reasons for the non-usage of iodized salt (Charterhouse, 2012):

1. Iodized salt changes the color and taste of food and facilitate food to go bad quicker
2. Iodized salt consumption leads to high blood pressure
3. There is rumor that the consumption of iodized salt is bad
4. Iodine is a non-edible chemical and not good for consumption
5. The use of non iodized salt is our tradition

The UNICEF (2011) also revealed a number of issues regarding misconceptions concerning iodized salt production and consumption. The results indicated that low formal education among small scale salt producers translated into lower technical knowledge about salt iodization and also derived the misconception that “non iodized

salt provides all the required nutrients for human consumption". The study also stated that low literacy in rural areas also accounted for poorer knowledge and misconceptions about iodized salt, misconceptions such as "all salt are salt and this is what we have used from ages and we haven't had any problem" were drives from low literacy among consumers. The study also discovered that misconception exist among large scale producers that positive tests for iodization with RTKs is the maximum required quality control measure and not the Ghana Standards Boards (GSB) requirement to have iodine between 30 and 50 part per million (ppm).

2.12 Current Trend in Ghanaian Household Consuming Adequately Iodized Salt

WHO has recommended that 90% of all households in any country implementing the Universal Salt Iodization (USI) program should be consuming adequately iodized salt. Ghana in the last ten years has made some small gains in increasing the proportion of households consuming adequately iodized salt from 28% in 2003 to 39% in 2014. However, this gains are not too impressive as this is still far from the WHO recommended 90% target (GDHS, 2014).

The Multiple Indicators Clusters Survey (MICS) (2006) reported that 32% of Ghanaian households were consuming adequately iodized salt, indicating a 4% increase from the figure obtained in 2003 by the GDHS (2003) report. This figure further went up to 35% in 2011 of households consuming adequately iodized salt (MICS, 2011). In 2014 the Ghana Statistical Service reported that 39% of Ghanaian households were consuming adequately iodized salt representing another 4% increase from 35% (GDHS, 2014). GDHS (2014) also indicated that households in urban areas were consuming more

iodized salt than those living in the rural areas. Fifty percent (50%) of the households in urban areas were said to be consuming adequately iodized salt against 26% of rural inhabitants (GDHS, 2014).

In 2011, the Ghana Health Service (GHS) Nutrition Department in collaboration with the USAID Food and Nutrition Technical Assistances (FANTA) project together with UNICEF conducted a profile analysis on micronutrients deficiencies in Ghana. The report indicated that 3% of all babies born to iodine-deficient mothers will have cretinism, 10% will be severely mentally disabled, and 87% will present some degree of intellectual deficit. Using the projected birth rates for the period 2011–2020, if investment in nutrition is not made, almost 1.5 million children will be affected by mild to severe irreversible brain damage due to iodine deficiency (Ghana Nutrition Profile, 2011).

Economically the report also stipulated that between 2011 and 2020, 955 million cedis (USD 668 million) will be lost due to mental impairment from iodine deficiency. The 2011 Nutrition profiles report concluded that undernutrition is preventable and if adequate investment is made and proven effective nutrition interventions are implemented and scaled up, the next 10 years will see a boost in economic productivity, saved lives, and improve the well-being of Ghanaians, particularly women and children. Ghana also will make a saving of 433 million Ghana cedis from 2011 to 2020 if adequate investments in proven effective interventions are made to reduce iodine deficiency in Ghana (Ghana Nutrition Profile, 2011).

2.13 Behavioral Change Communication Theories

Socio-economic factors such as education, culture, economy and access to goods has an influence on the way people behave and the way they respond to behavior change. The behavior of people is interwoven with their environment and communities (Kauppi, 2015). The Behavior change theories explained below can help the understanding of why salt producers and traders act the way they do and why behaviors change is require in addressing factors accounting low universal salt iodization. These theories can also be helpful in guiding program design toward achieving universal salt iodization and help relevant institution and agencies focus on what or who to address in their programs (CommGAP, n.d.).

Social Cognitive Theory

Bandura's (1986) social Cognitive theory proposes that people are driven not by inner forces, but by external factors (CommGAP, n.d.). This model suggests that human functioning can be explained by a triadic interaction of behavior, personal and environmental factors. This is often known as reciprocal determinism. Environmental factors represent situational influences and environment in which behavior is performed while personal factors include instincts, drives, traits, and other individual motivational forces. Several constructs underlie the process of human learning and behavior change. These variables may also intervene in the process of behavior change (CommGAP, n.d.). Understanding and influencing factors in the salt production environment based on the social cognitive theory have the tendency to drive salt producers and traders to ensure adequate salt iodization. Salt producers and traders will adhere to salt production

practices on iodization if there is adequate enforcement of the USI law in the salt production environment, particularly in the salt producing districts (UNICEF, 2011).

How can the social cognitive theory inform practices?

- To increase levels of self-efficacy it may be important to provide resources and support to raise individual confidence. The government of Ghana in order to ensure universal salt iodization should be in the position to create an enabling environment by providing the require support in term of training, logistics and technical support to major actors in the iodized salt value chain (Charterhouse, 2012). Others have suggested that to raise self-efficacy behavior change should be approached as a series of small steps (CommGAP, n.d.).
- Bandura (1986) writes that even when individuals have a strong sense of efficacy they may not perform the behavior if they have no incentive. This seems to suggest that if we are interested in getting others to enact behavior change it may be important to provide incentives and rewards for the behaviors. The theory suggest that for Ghana to further its cause in achieving universal salt iodization there may be the need for some incentive for the major actors in the salt value chain such as producers and traders.
- Shaping the environment may encourage behavior change. This may include providing opportunities for behavioral change, assisting with those changes, and offering social support. It is important to recognize environmental constraints that might deter behavior change (Bandura, 1986). If the relevant authorities are able to support the salt industry with adequate supply of salt iodization inputs including education on the need for iodization, producers and traders may be encourage to adhere to recommended practices.

Health Belief Model

The Health Belief Model (HBM) of change proposes that people will most likely change their behavior based on (1) perceived susceptibility; the like hood of becoming a victim of a disease or circumstance (2)Perceived Severity; the seriousness or consequences of contracting a particular disease or being in a particular circumstance. (3) Perceived Barriers; the impediments of adapting the positive behavior (4) perceived benefits; the possible gains of not contracting a particular disease or condition (Glanz et al., 2008).

The HBM signifies that people are mostly likely going to change their ways if they perceived a threat to their social and physical wellbeing (Glanz et al., 2008).

How can this inform practice?

The behavior of individuals will be influence by fear of contracting a disease or condition whose effect could affect their social and physical wellbeing (Glanz et al., 2008). For example salt producers are most likely to adopt the positive behavior of universal salt iodization if they are exposed to information on the consequences of consuming non-iodized salt. Similarly salt trader will demand from their suppliers to provide them with only iodized salt if they know the consequences and the detrimental effect of iodine deficiency disorders. Exposure and knowledge of the consequences of iodine deficiencies by salt producers and traders are seen as important variables that may influence their practice of iodization and sales of iodized salt as we related to the HBM of behavior change.

2.14 Summary

The chapter reviewed literature on iodine deficiency and universal salt iodization both globally and in Ghana. The chapter has provided much information about the detrimental effect of iodine deficiency which includes both severe and mild mental retardation, dwarfism, goiter, increased risked of miscarriages and still births, congenital abnormalities and physical deformities (Zimmermann, 2008). The magnitude of iodine deficiency in Ghana has also been discussed, 39% of Ghanaian households are currently consuming adequately iodized salt (GDHS, 2014) and if appropriate interventions are not put in place, almost 1.5 million children will be affected by mild to severe irreversible brain damage due to iodine deficiency in Ghana between 2011 and 2020 (Ghana Nutrition Profile, 2011).

Universal Salt Iodization has been concluded as an effective strategy for preventing iodine deficiency globally. Zimmermann (2012) studied the effect of iodine deficiency on pregnant women and infants and concluded that iodine supplementation before and during pregnant reduces new cases of IDD and improves development scores of children from 10 to 20%. Andersson, Benoist and Rogers (2010) also concluded that Universal salt iodization (USI) and iodine supplementation were effective strategies for preventing and controlling iodine deficiency. WHO (2014) also published that many countries worldwide have successfully eliminated iodine deficiency disorders or made substantial progress in their control, largely as a result of salt iodization.

Aside the fact that universal salt iodization help the prevention IDDs, the salt sectors in Ghana can also be a source of revenue that can contribute significantly to GDP (Ghana

USI Strategy III, 2015) and create jobs for thousands of people living in these areas (Yaboah, 2011).

This chapter also reviewed materials on the awareness of the USI law in Ghana. The study conducted by Chirewurah et al. (2015) in assessing the use of iodized salt in rural northern Ghana concluded that as much as 97 percent of rural inhabitants were not aware of the law on salt iodization. Noncompliance by both salt producers and traders to the law on iodization accounted for low utilization at the household level (Chirewurah et al., 2015). According to the Health Belief Model (HBM) of behavior change communication, knowledge of the USI law and the consequences of iodine deficiency could influence behavior change among producers and traders. Similarly the Social Cognitive Theory of behavior change by Bandura (1986) also talks about shaping the environment and providing opportunities for behavior change.

Adequate knowledge of the consequences of iodine deficiency could lead to adequate practices by salt producers and traders as suggested by the HBM of behavior change (Glanz et al., 2008). But the evidence provided in this literature review also suggests that awareness and knowledge of iodine deficiency and the USI law may not necessarily bring about a change among salt producers and traders to ensure salt is adequately iodized before it gets to the consumer. Buxton and Baguune (2012) concluded that, in the Bia district of Ghana knowledge of IDDs was high, about 90% but this only translated to only 65% of households using adequately iodized salt. Charterhouse (2012) also concluded awareness of iodize salt was high among salt producers and traders in Ghana, that is about 80% and 72% respectively. The GDHS, (2014) reported that only 39% of Ghanaians are currently consuming adequately iodized salt.

Following the Social Cognitive Theory of Bandura (1986) there may be some factors or variables in the salt production environment influencing the current trend of universal salt iodization in Ghana rather than the knowledge and awareness of salt producers and traders. Murdoch et al. (1999) studies on the persistence of iodine deficiency in Khumbu in Nepal pointed out the preference of consumers toward crystal white raw salt. Crystal white raw salt even when iodized have relatively low iodine retention as compared to powdered and crystal brown salt (Jayashree and Naik, 2000). In Ghana most of these salt are most likely not adequately iodized and mostly are not properly packaged and labeled to preserve the iodine content in them (UNICEF, 2011). Cultural believes and misconceptions can also influence salt iodization (Patro et al., 2008). Murdoch et al. (1999) among other recommendations indicated the need to conduct a needs assessment of key players in the salt industry to ensure adequate iodization of salt before it reaches consumers. There is the need to research which of these factors as discussed in this literature review is applicable to the Ghana universal salt iodization program.

This chapter has provided the base for this study to assess the knowledge and practices of salt producers and traders on universal salt iodization in Ghana's major salt producing district. At the end of the study, further literature will be generated to enrich current literature in Ghana on universal salt iodization with recommendations that may help improve universal salt iodization in Ghana.

CHAPTER THREE
METHODOLOGY

3.0 Introduction

This chapter describes the study methodology. The chapter contains the study design, the study setting, which include the 10 salt producing districts that were purposely selected for this study. The study population is also presented in this chapter as well as the variables involved in the study. The sampling techniques, data collection method and tools are also described in this chapter. How the study data was processed and data analysis is also described in this chapter as well as the quality control methods and ethical considerations. The study limitations are also presented.

3.1 Study Design

The study is a descriptive cross-sectional study. Both qualitative and quantitative information was generated to describe how the knowledge and practices of salt producers and traders in the major salt producing districts of Ghana on universal salt iodization affect the prevalence of households in Ghana consuming adequately iodized salt.

3.2 Study Setting

The study area encompasses 10 districts that is Komenda Edina Eguafo Abrem (KEEA), Awutu Senya, Ketu, Ahanta West, Ga South, Gomoa East, Gomoa West, Ada East, Ningo Prampram, and Effutu. These districts are located along the coastal regions of Ghana and noted for the production of salt. An overview of the location of each district, demographic characteristics, literacy rate, and economics activities is provided below;

Komenda Edina Eguafo Abrem (KEEA)

The Komenda Edina Eguafo Abrem (KEEA) Municipality is made of four traditional areas which have been put together to constitute a political district. The Komenda Edina Eguafo Abirem District was carved out of the Cape Coast Municipal Council in 1988. The Municipality has Elmina as its municipal capital, which was the first point of contact with the early Europeans to Ghana. This town therefore witnessed a lot of western civilization and influence as well as other economic activities over the centuries (Ghana Statistical Service (a), 2014). The Komenda Edina Eguafo Abirem Municipality is bounded on the south by the Atlantic Ocean (Gulf of Guinea), to the east by the Cape Coast Municipality, the north by the Twifo Hemang-Lower Denkyira district and the west by the Mpohor – Wassa East district in the Western Region. The Municipality is perched between longitude 1° 20’ West and 1 40’ West and latitude 5° 05’ North and 15° North. The Municipality covers an area of 452.5square kilometers giving the municipality a population density of 319.8 persons per sq. km (Ghana Statistical Service (a), 2014).

Along the coastal zone is a series of lagoons and wetlands, the largest of which include the Benya, Brenu, Susu, Abrobi and Ankwanda Lagoons. The municipality experiences a lower level of rainfall in the region compared with the interior locations. Temperatures are generally high. And so the variability in climate and vegetation is influenced more by rainfall than temperature. With double maxima rainfall, annual rainfall totals in coastal locations rages between 750mm and 1,000mm while in the hinterland, it ranges between 1200mm and 1500mm (Ghana Statistical Service (a), 2014).

The population of Komenda Edna Eguafo Abrem Municipal according to the 2010 Population and Housing Census is 144,705 representing 6.6 percent of the region's total population. In terms of literacy, of the population 11 years and above, 63.7 percent are literate and 36.3 percent are non-literate (Ghana Statistical Service (a), 2014).

About 67.6 percent of the population aged 15 years and older are economically active while 32.4 per cent are economically not active. Small scale mining activities also take place in Elmina in an informal manner and can be classified as illegal or what is popularly referred to as "Galamsey" mostly by the inhabitants of the town. Salt mining and winning is identified to be one of the main commercial ventures in Elmina, but this activity cannot be said to be on a very large scale now. Currently there is some amount of salt winning activity in the township of Elmina. Benya Lagoon is one of the known and significant sites for salt winning in the town. Other minor salt winning sites of little or no commercial values can however, be located within the town (Ghana Statistical Service (a), 2014).

Awutu Senya District

The Administrative Capital of the Awutu-Senya District is Awutu Bereku. Until Awutu Senya East Municipal was carved out in 2012, the District was described as the Gateway to the Central Region from the Greater Accra Region. The District Assembly was established by LI 1376 of 2007 and inaugurated on 29th February, 2008 (Ghana Statistical Service (b), 2014).

The Awutu-Senya District is located in the Central Region of Ghana. It covers a surface area of 244.473sq.km. The Gomoa East District has dotted enclaves within the district. The Southern part of the district is bounded by the Gulf of Guinea, to the East by Awutu

Senya Municipal, to the West by Gomoa East and Agona East Districts, and the North-Eastern part by West Akim District (Ghana Statistical Service (b), 2014).

The District has mean annual minimum and maximum temperatures of 22°C and 38°C respectively. It experiences two main seasons, rainy and dry seasons. There is a major rainy season from April to July and a minor season from August to November. The dry season starts from November and ends in March. The annual rainfall figures of the district are quite low (40cm-50cm) along the coast but are higher in the hinterland (50cm-70cm) (Ghana Statistical Service (b), 2014).

The population of Awutu Senya District, according to the 2010 Population and Housing Census (Ghana Statistical Service (b), 2014) is 86,884 representing 3.9 percent of the region's total population. Almost half (48.3%) of the population 11 years and older in the district is literate.

About 75.1 % of the population aged 15 years and older are economically active while 24.9 % are economically not active. The District is a hub for agriculture and its related activities and it employs approximately 54% of households in the district. Agricultural activities include crop farming, tree planting, livestock rearing and fish farming. Other economic industrial activities within the district include mining, quarrying, manufacturing and construction (Ghana Statistical Service (b), 2014).

Ketu District

The Ketu South Municipality is one of the 18 administrative districts in the Volta Region and is located at the south-eastern corner of Ghana with Denu as its capital. The Municipality is strategically described as the eastern gateway to Ghana and it is the only

district that shares boundary with the capital of another country, Lome in the Republic of Togo (Ghana Statistical Service (c), 2014).

The Ketu South Municipality was formerly created by an Act of Parliament in 2007 through the Legislative Instrument (LI 1897 of 2007) which split the then Ketu District into the Ketu North and Ketu South Districts (Ghana Statistical Service (c), 2014). In 2012, the Ketu South District was elevated to a municipal status through LI 2055 of 2012(Ghana Statistical Service (c), 2014).

The Ketu South Municipality lies within latitudes 6° 03 north and 6° 10 north, and longitude 1° 6 east and 1° 11'east. It shares border with the Republic of Togo on the east, the Keta Municipality on the west, the north with Ketu North District and the Gulf of Guinea to the south. The District has a total land size of approximately 779 square kilometres representing 3.8% of the regional land area (Ghana Statistical Service (c), 2014).

The municipality experiences an average monthly temperatures varying between 24℃ and 30℃. The mean annual rainfall ranges from 850mm along the coast to 1,000mm inland (Ghana Statistical Service (c), 2014).

The population of Ketu South Municipal, according to the 2010 Population and Housing Census is 160,756 representing 7.6% of the total population of the Volta Region. Of the population 11 years and older, 72.0 percent are literate.

Seventy-one percent (71%) of the population aged 15 years and older are economically active while 22.9% are economically not active (Ghana Statistical Service (c), 2014).

Industrial activities within the Municipality are at a relatively low level. The only heavy industry found in the Municipality is the Diamond Cement Factory in Aflao. In addition,

some of the people are into small scale manufacturing, construction and mining. The salt mining activity is a major economic activity for the people in Adina, Tascorner and its environs. Another important traditional industry which employs quite a number people is "Kente" weaving. One remarkable observation about these industrial activities is that they are carried out with traditional technology thus, affecting the end product and market for members (Ghana Statistical Service (c), 2014).

Ahanta West

The Ahanta West District was formerly under the jurisdiction of the Sekondi-Takoradi Metropolitan Authority (S-T.M.A.). It was carved out of the then Sekondi-Takoradi Metropolitan Authority in 1988, now the Sekondi-Takoradi Metropolitan Assembly (STMA) and became an autonomous District under Legislative Instrument LI 1395 (Ghana Statistical Service (d), 2014).

Ahanta West District is located at the southernmost point of the country and the entire West African Sub-Region with its capital at Agona Nkwanta (Agona Ahanta). It is bounded to the East by the Sekondi-Takoradi Metropolitan Assembly (STMA), the West by the Nzema East Municipal, and to the North by Mpohor Wassa East District and Tarkwa-Nsuaem Municipal and the Gulf of Guinea to the South. The district has a total land area of 554 square kilometers representing about 2.3% of the surface area of the Western Region. The district is about 15 minutes' drive from the commercial capital of the Western Region, Takoradi and about 25 minutes' drive from the administrative capital, Sekondi. Its proximity to the Central Business District of Takoradi enhances business and trading activities (Ghana Statistical Service (d), 2014).

The district falls within the south-western equatorial climatic zone of Ghana. The highest mean temperature is 34ºC which is recorded between March and April, while the lowest mean temperature of 20ºC is experienced in August. It experiences a double maxima rainfall of over 1,700 millimeters (Ghana Statistical Service (d), 2014).

The population of Ahanta West District is 106,215 representing 4.5% of the region's total population. Considering the population 11 years and above, 73.4% are literate and 26.6% are non-literate. About 75.3% of the populations aged 15 years and older are economically active while 24.7% are economically not active (Ghana Statistical Service (d), 2014).

The following are the large scale industries in the district: Norpalm Ghana Limited and GREL. These two industrial establishments produce edible/industrial oil palm and industrial rubber respectively. A number of small scale industries for agro processing can also be found in most parts of the district. Specific locations include Azani, Freboho, Aketenchie, Himakrom and Ewusiejoe among others. Cassava which is the largest tuber crop produced and consumed in the district is processed on small scale into "gari" and starch. "Akpeteshie", (a local gin) distillation is also an important agro based activity in the district (Ghana Statistical Service (d), 2014).

Ga South

The Ga South Municipal was carved out from the Ga West District in November 2007 and was established by Legislative Instrument 2134 in July 2012 with Weija being the Municipal capital. The Ga South Municipal lies at the South Western part of Accra and shares boundaries with the Accra Metropolitan Area and Ga Central to the South-East, Akwapim South to the North East,Ga West to the East, West Akim to the North, Awutu-

Senya to the West, Awutu-Senya East to the South-East, Gomoa to the South-West and the Gulf of Guinea to the South. It occupies a total land area of about 341.838 square kilometers with about 95 settlements (Ghana Statistical Service (e), 2014).

The Municipality lies in the dry equatorial climatic zone with two rainfall seasons. The mean annual rainfall varies between 790mm along the coast to about 1270mm in the extreme north. The annual average temperatures range between 25.1ºC in August and 28.4ºC in February and March, the hottest months (Ghana Statistical Service (e), 2014).

The population of Ga South Municipality, according to the 2010 Population and Housing Census is 411,377 representing about a tenth (10.3%) of the region's total population. Of the population 11 years and above, 87.9% are literate and 12.1% are non-literate (Ghana Statistical Service (e), 2014).

About seventy percent of the population 15 years and older are economically active while 28.9% are economically not active. The structure of the local economy is predominantly agriculture, followed by the industrial and the services sectors. The economic activities in the Municipality include cassava production for industrial starch, fishing at the Weija Lake, large scale quarrying activities in the north-eastern part, shopping mall, constructional works, financial institutions and telecommunication services (Ghana Statistical Service (e), 2014).

Gomoa East

Gomoa East District is one of the seventeen (17) districts in the Central Region of Ghana. The district was carved out of the then Gomoa District in 2008 by the Legislative Instrument 1883 and became operational on 29th February, 2008. It occupies an area of

539.69 square kilometres with a total population of 207,071 comprising 47.5% males and 52.7% females (2010 PHC) (Ghana Statistical Service (f), 2014).

The district is situated between latitudes 5°14' north and 5°35' north and longitude 0022' west, and 00°54' west. It is located in the south-eastern part of the Central Region. It is bordered by a number of districts, to the north-east by Agona East, south-west by Gomoa West, east by Awutu Senya and Ga south in the Greater Accra region and to the south by Effutu. The Atlantic Ocean borders the south-eastern part of the district (Ghana Statistical Service (f), 2014).

The mean annual rainfall ranges between 70mm and 90mm in the southern coastal belt and between 90mm and 110mm in the north-western semi- deciduous forest areas. The district's mean annual temperature is around 29ºC which occurs in February to March and August respectively (Ghana Statistical Service (f), 2014).

The population of Gomoa East District, according to the 2010 Population and Housing Census is 207,071 representing 9.4% of the region's total population. Of the population 11 years and older, 81.5% are literate and 18.5% are non-literate (Ghana Statistical Service (f), 2014).

About 69% of the population aged 15 years and older is economically active while 31.0% are economically not active. The agricultural sector constitutes the major economic activity of the people in the district. The ecology of the district encourages the cultivation of crops such as cassava, maize, sugar cane, pineapple, rice, pawpaw, vegetable, citrus; yam and plantain. In addition, non-traditional crops such as the Asian Vegetables, chilly and bird eye pepper and pineapple are cultivated. The fishing sector includes marine and fish farming with the former employing about 8,000 men and 3,000 females. There are

however, very few small scale aqua-cultures in area around Okyereko, Nsuem and Adzentem (Ghana Statistical Service (f), 2014).

Gomoa West

Gomoa West District was established in July, 2008 by Legislative Instrument (LI) 1896 following the division of the former Gomoa district into two, Gomoa West and Gomoa East Districts. Apam is its District capital. Gomoa West district stretches from Gomoa Antseadze in the west to Gomoa Bewadze in the east. It shares boundaries to the west with Ekumfi district, North-West by Ajumako-Enyan Essiam district, North by Agona East and Gomoa East districts and East by Effutu Municipal, as well as the Atlantic Ocean in the south. The district covers a total land area of 458.5 square kilometres. Apam the district capital is 68 km from Cape Coast the regional capital and 69 km from Accra the National Capital (Ghana Statistical Service (g), 2014).

The district lies within the semi-wet equatorial region with mean annual rainfall between 1500mm to about 2000mm. The district on the average experiences an annual temperature of 29° Celsius (Ghana Statistical Service (g), 2014).

The population of Gomoa West District, according to the 2010 Population and Housing Census is 135,189 representing 6.1% of the region's total population. Of the population 11 years and above, 66.7% are literate and 33.3% are non-literate. About 69.6% of the populations aged 15 years and older are economically active while 30.4% are economically not active. The main economic activities of the people are farming that is crops and livestock, fishing, mining and quarrying, tourism, commerce and services, manufacturing and agro-processing (Ghana Statistical Service (g), 2014).

Ada East

The Ada East district was formerly Dangme East District and was created in 1989 by Local Government Instrument, L. I. 1491. By subsection (one) of section 3 of the Local Government Act, 1993 (Act 462), a new district (Ada West) was carved out of Dangme East with a new Local Government Legal Instrument (L.I 2130) and new a district was also established and known as Ada East in March, 2012 with twenty seven electoral areas (Ghana Statistical Service (h), 2014).

The Ada East District is situated in the Eastern part of the Greater Accra Region. The total land area of the District is 289.783 square km. The District shares common boundaries with the Central Tongu District to the North, South Tongu District and Ada West to the East and West respectively. It is bounded to the south by the Gulf of Guinea, which stretches over 18 kilometers from Kewunor to Totope. It is also bounded by the Volta River South–Eastwards extending to the Gulf of Guinea southwards thereby forming an Estuary, about 2 kilometers away from the District capital, Ada-Foah (Ghana Statistical Service (h), 2014).

The Ada East District temperatures are high throughout the year and ranges between 23°C and 28°C. A maximum temperature of 33°C is normally attainable during the very hot seasons. Rainfall is generally heavy during the major seasons between March and September. The average rainfall is about 750 millimeters (Ghana Statistical Service (h), 2014).

The population of Ada East district according to the 2010 Population and Housing Census is 71,671 representing 1.8 percent of the region's total population. Of the population 11 years and above, 72.8% are literate and 27.2% are non-literate. Seventy

percent of the populations aged 15 years and older are economically active while 30.0% are economically not active. Of the economically active population, 95.0% are employed while 5.0% are unemployed. The district is predominantly an agrarian economy. The district was producing salt in commercial quantities when it was formerly Dangme East, however the salt mining industry found itself in the geographical jurisdiction of the new district (Ada West) the Songor lagoon area at Pute was discovered as having the potential of producing salt in commercial quantities thus paving way for the establishment of salt industry in the area (Ghana Statistical Service (h), 2014).

Ningo Prampram

The Ningo-Prampram district was carved out of the then Dangme West district in to Shai Osudoku and Ningo-Prampram districts by the LI 2132 in 2012 and the Local Government Act of 1993(Act 462). The Local Government Act of 1993, (ACT 462) and the National Development Planning System Act of 1994 (ACT 480) (Ghana Statistical Service (i), 2014).

Ningo-Prampram district covers a total land area of about 622.2 square kilometers. The district is located about 15 km to the east of Tema and about 40 km from Accra, the capital of Ghana. The district is bounded in the north by Shai-Osudoku district, south by the Gulf of Guinea, in the east by the Ada East district and to the west by Kpone-Katamanso district (Ghana Statistical Service (i), 2014).

Temperatures are appreciably high for most parts of the year with the highest during the main dry season (November – March) and lowest during the short dry season (July – August). The maximum temperature is 40°C. Rainfall is generally very low with most of the rains being very erratic between September and November. The mean annual rainfall

increases from 762.5 mm in the coast to 1,220 mm in the northern parts of the district (Ghana Statistical Service (i), 2014).

The population of Ningo-Prampram District, according to the 2010 Population and Housing

Census is 70,923 representing 1.8 percent of the region's total population. Of the population 11 years and above, 71.2% are literate and 28.8% are non-Literate. About 66.8% of the populations aged 15 years and older are economically active while 33.2% are economically not active. The Ningo-Prampram district is largely rural. The predominance of rural population reflects in the occupational distribution with agriculture as the dominant occupation. About 90% of the total land area is arable land and about 25% is mainly savannah grassland suitable for livestock farming. The major crops grown in the district are cassava, maize, mango, banana, vegetables (e.g. tomato, okro, pepper) and rice. The district's proximity to Tema and Accra makes it easy for community members to have access to many social facilities and infrastructure, such as, good roads, water, hospitals and electricity. The district also serves as a dormitory for workers in many industries in Tema and Accra metropolis (Ghana Statistical Service (i), 2014).

Effutu

Before 1988, the Municipality was part of the then Gomoa-Awutu-Effutu-Senya District Council. In 1988, the then Awutu-Effutu-Senya district was carved out of the Gomoa-Awutu-Effutu-Senya District Council with the establishment of the PND Law 207 of 1988 which demarcated the country into 110 administrative districts from 65. Following the creation of new districts in 2007, the Effutu Municipal Assembly was carved from the

then Awutu-Effutu-Senya District Assembly and was established by L.I 1860 with Winneba as its administrative capital (Ghana Statistical Service (j), 2014).

The Effutu Municipality is one of the 20 administrative districts in the Central region of Ghana. It is situated between latitudes 5°16' and 20.18"N and longitudes 0°32' and 48.32''W of the eastern part of Central region (Ghana Statistical Service (j), 2014).

The Municipality lies between the Gomoa East District to western, northern and eastern flanks. On the southern flank is the Gulf of Guinea. The administrative capital is Winneba, a town renowned for its specialized major institutions of higher learning. It covers a total land area of 95 square kilometers (Ghana Statistical Service (j), 2014). Data from the 2010 Population and Housing Census indicates that the Municipality has a population of 68,597 which represents 3.1 percent of the population of the Central region. The municipality has fourteen settlements which are clustered around the Municipal capital Winneba.

The Municipality lies within the dry-equatorial climatic zone characterized by low rainfall and long dry season of five months. The annual rainfall ranges from 400 mm to 500 mm. Mean temperatures range from 22ºC to 28 ºC (Ghana Statistical Service (j), 2014).

The Municipality has a household population of 60,891 with a total number of 17,121 households. More than three quarters (80.7%) of the population aged 11 years and older in the

Municipality is literate. Half (56.2%) of the population aged 15 years and older in the Effutu Municipality are economically active. The major economic activities in the municipality are fishing, wholesale/retail trade, services, manufacturing, salt mining, crop

farming and agro-processing. Fishing, farming and related work are the leading economic activities in the municipality. These are followed by services with salt mining along the coast of Winneba and Warabeba. The fishing industry is very prominent in the coastal communities of Winneba, Akosua Village and Warabeba within the municipality (Ghana Statistical Service (j), 2014).

3.3 Study Population

The study population consisted of salt Traders and Producers in the 10 salt producing districts.

3.4 Dependent and Independent Variables

The dependant variables in this study include (1) the knowledge of salt producers and traders on universal salt iodization, that is the knowledge of the USI law, knowledge of the benefits of USI, and knowledge of standard practices to prevent iodine loose. And (2) practices of salt producers and traders to ensure adequately iodised salt reached salt consumers, that is salt iodization and quality control practices by salt producers as well as salt handling and packaging by salt traders.

The variation in Knowledge and Practices of Producers and Traders on USI may or may not result in the adequately iodized salt at the household level. This research assessed knowledge and practices as dependent variables.

The independent variables consisted of socio demographic characteristics such as, age of respondents, educational status, religion and marital status.

3.5 Sampling Strategy

The Lot Quality Assurance Sampling (LQAS) methodology was used in this study. This is because the study area is very broad and this method is relatively rapid and an inexpensive method to data collection. This was adapted due to its relative cost effectiveness and statistical precision.

3.6 Sampling Size Determination

Sample size was determined using the LQAS decision rule table (annex) with pre calculated sample sizes "n" for each district with corresponding coverages and decision rules "d".

The sample sizes are derived from the binomial formula;

$$P_a = \frac{n!}{a!\,(n-a)!}\; p^a \, x \, q^{n-a}$$

Where;

Pa = the probability of selecting "a" successes (e.g. rapid diagnostic tests) in a sample of "n" elements

p = the benchmark for quality (% coverages in the LQAS table)

q = the expected proportion of failures (q = 1-p)

n = the sample size

a = the exact number of 'successes' in the sample (i.e. the acceptable performance)

n-a = the number of 'failures' in the sample (i.e. the unacceptable performance; in LQAS this

Expression is referred to as "d", the "decision rule")

This formula calculates the probability of a certain number of failures from populations regarding a particular indicator for which certain proportions (%) are successful.

In the LQAS decision rule table the sample size "n" is selected to ensure an apha (α) and betta (β) error of ≤ 10%.

With reference to the LQAS decision rule table, nineteen (19) is the minimum sample size that provides an alpha and betta error of ≤ 10% which is an acceptable level for making management decisions; at least 92% of the time. Samples size larger than 19 have practically the same statistical precision as 19 (Valadez et al., 2003; Hedt et al., 2008).

Based on this a sample size of 19 was taken from each salt producing district in the study catchment area. Therefore for the 10 salt producing districts under study a total sample size of 190 was required to calculate coverages in the catchment areas. These coverages are represented by "p" in the binomial formula which represents the benchmark of quality and corresponds to a decision rule number "d" in the LQAS decision rule table. The decision rule number "d" is the benchmark below which are failures and above which are successes.

3.7 Sampling Techniques

The study area comprised of 10 salt producing districts. In each of the district's the major markets noted for salt trade in the district was selected for data collection. Nineteen (19) salt traders were interviewed in each market for each district. First a list of salt traders in each market was generated and a random number table was used to select the first salt trader as starting point for interviewing. The salt sold by each respondent (Salt Trader)

was also tested for it iodine level using the MBI iodine rapid test kits. In total 190 salt traders were interviewed across the 10 salt producing districts.

Table 3.1: *Number of Salt Traders interviewed in each district.*

No.	District	Name of Market	Number of Traders interviewed
1	Komenda Edina Eguafo Abrem (KEEA)	Bantama Market	19
2	Awutu Senya	Bawjiase Market	19
3	Ketu	Denu Market	19
4	Ahanta West	Agona Nkwanta Market	19
5	Ga South	Weija Market	19
6	Gomoa East	Nyanyano Kakraba Market	19
7	Gomoa West	Apam Market	19
8	Ada East	Kesseh Market	19
9	Ningo Prampram	Prampram Market	19
10	Effutu	Wineba Market	19
	Total		190

Two salt producers were also interviewed in each district using a semi structured interview guide to collect qualitative information on salt production and iodization. This arrangement was made by the District Assembly focal person for USI in each district.

Salt samples from these sites were also tested with the MBI iodine rapid test kits to ascertain iodine levels.

3.8 Data Collection Methods

Three main data collection methods were employed in this study. These methods included;

Questionnaire administration, Semi- structured Interview guide and Salt Testing.

Survey Questionnaire: A questionnaire was used consisting of a series of both closed and open-ended questions and other prompts for the purpose of gathering information from respondents who were mainly salt traders. The questionnaire was designed in a manner to bring out respondents ideas, perceptions, practices and attitude towards the Ghana USI program. In each of the 10 salt producing districts, 19 salt traders were interviewed. With the assistance of the district focal person for USI at the District Assembly a list of salt traders was compiled in each of the markets selected for the study. A random number table was then use to select a starting point for interviewing. A total of 190 salt traders were surveyed with the survey questionnaires in all the 10 salt producing districts within the study catchment area.

Semi-structured Interview Guide: Semi-structured interviews were employed to collect qualitative information from respondents who were mainly salt producers. This guide was designed to include questions and topics that must be covered at the end of each interview. Some of the topics included; salt production practices, salt iodization practices, awareness of the USI law, knowledge of the benefits of iodized salt among others. The discretion of respondents about the order in which questions were asked was carefully considered during the data collection process whiles still ensuring that standardized

questions and probes were made to ensure that this study covers and able to draw the requisite information from respondents. The process ensured flexibility in how and in what sequence questions were asked making sure detailed information was obtained in a style that is conversational. English and occasionally "twi" was the main language used and each interview lasted approximately 40 minutes. The district focal persons for USI at each District Assembly in the selected district had already acquired clearance from two salt producers to be interviewed in each district. Semi-structured interviews were conducted with 20 salt producers in the study catchment area. Two salt producers were interviewed in each district.

Iodine Testing: MBI iodine rapid test kits (RTK) was used in this study to ascertain the level of iodine in salt at production sites and salt that was sold on the market by traders. The RTK consist of three solutions, two test solution and one recheck solution. During the testing a few drops of reagents was introduced on about 5gram salt sampled from respondents (salt traders and producers). The intensity of the color varies with the amount of iodine in the salt and by matching it with the colour chart in the RTK, the range of iodine was ascertained between 0ppm to over 15ppm.

Salt samples was taken from both salt production sites and traders in the study catchment area and tested to ascertain the level of iodine in them. A total of 210 salt samples were tested.

3.9 Source of Data

Both primary and secondary data was collected in this study. Primary data was collected from respondents through questionnaire administration and semi-structured interviews.

Iodine levels were also determined in salt that was sampled from respondents using the MBI iodine rapid test kits. Secondary data was also obtained through the review of various research publications, reports of the Ghana Statistical Service (2010 Population and Housing Census) that had detail information and profile of the districts under the study area.

3.10 Quality Control

Two interviewers were recruited and taken through training on the sampling techniques and survey tools. Both interviewers could speak Twi and Fante that is the most common languages spoken in the study area. The questionnaire and interview guides were pre tested in the Makola market involving 19 salt trader during the training of interviewers to ensure that the interviewers were familiar with the survey questionnaires and could adequately administer it in the local language if the need arise. Iodine RTKs were obtained from the Ghana Health Services and checked to ensure they were not expired. Interviewers were also taken through training on how to test salt samples for iodine. Close monitoring and supervision of data collection was carried out throughout the data collection process by the principal researcher, spot checking was also done during field interviews and data of completed interviews were cross-checked before entry for further analysis.

3.11 Data Storage and Analysis

Data entry screen was developed and completed survey questionnaires were entered and analyzed using data processing software Statistical Package for the Social Sciences (SPSS) and Microsoft Exel. Univariate analysis was carried out to obtain the frequencies

and total number of correct responses of the study variables such as the number of traders and producers in the salt producing districts who are aware of the law on universal salt iodization, the number of salt traders who sell adequately iodized salt and properly display salt at the point of sale. The total number of correct responses (numerator) for the 10 districts (study catchment area) was divided by the total number of responses (sample size or denominator) for each variable to get the coverage proportion for each variable in the study catchment area.

A decision rule was selected from the LQAS Table by using the respective coverage proportions obtained for each variable as stipulated in the study objectives as the performance standard. Priority districts were then identified by those districts which fell below the decision rule number for any given variable. The results were discussed and conclusions were drawn upon with some recommendations.

3.12 Ethical Consideration

The study was discussed with the Ministry of Local Government and Rural Development, Ghana Health Service and other MMDA's in the salt sector who are represented on the National Salt Iodization Committee for support before the study began. Community entry was carefully planned and executed. The study proposal was reviewed and approved by the School of Allied Health Sciences and clearance and approval was given to conduct the study. In addition, permission was sought from all relevant authorities and study participants. The rational for the study was thoroughly explained to all participants and participants had the right to decline their participation. Both salt Producers and Traders were assured of the privacy and confidentiality of their information. They reserved the right to refuse responding to questions they do not

feel conformable to answer. They were assured that the information collected was intended to aid program designing, policies and interventions with respect to the Ghana USI initiative to address iodine deficiency among vulnerable groups in the country

3.13 Limitation

- The sample size of 19 for each salt producing district in the study catchment area is too small to estimate coverage for each district. The coverage's calculated represent the entire study catchment area (The 10 salt producing districts). The total number of correct responses for each variable in each district only provides data for the identification of priority areas using the LQAS decision rule table.
- Salt producers were pre selected by district focal persons for USI which may have some bias
- The use of MBI iodine test kit only provided qualitative data on where salt sample tested were above or below 15 parts per million (ppm) and not the exact levels of the samples tested.
- The research could not ascertain the exact level of iodine in the salt samples tested at salt production site to see whether they meet the 50ppm recommended by the FDA and MoTI due to the Use of the MBI iodine rapid test kit. Generally the research could not tell the exact levels of iodine in all the salt samples tested but rather to classify them as either above or below 15 ppm.

CHAPTER FOUR

RESULTS

4.0 Introduction

This chapter presents the results from the study analysis. The socio-demographic characteristics of the respondents is presented in this chapter, others include the qualitative result on the salt production practices with respect to iodization in the 10 salt producing districts, awareness of the USI law among salt producers and traders, proportion of producers and traders who know the benefits of iodized salt, proportion of traders who sell adequately iodized salt and the type of salt sold by traders whether refined or unrefined salt. The chapter also covers analysis on the proportion of traders who properly display salt at the point of sales and results on the misconceptions about the use of iodized salt. A total of one hundred and ninety (190) Salt Traders and 20 salt producers constituted the respondents in this study. All responses were analyzed and the frequencies, trends and graphs generated in accordance with the study objectives.

4.1 Socio-demographic characteristics

Table 4.1 Provide details on the socio-demographic characteristics of the salt producers and traders in the 10 salt producing districts. Most of the respondents fell within the age range of 26 to 35 years representing 37.1 % of the total respondents in the study area. Majority of the respondents in salt producing districts also had low education that is either primary or junior high education (67.1%). The study area was dominated by Christian representing 80% of the respondent population. About sixty-four percent (64%) of the respondents were married and 15.2% were co-habitating.

Table 4.1: *Socio-demographic characteristics of salt producers and traders in 10 salt producing districts*

Variable	KEEA	Awutu Senya	Ketu	Ahanta West	Ga South	Gomoa East	Gomoa West	Ada East	Ningo Prampram	Efutu	Total	Percentage (%)
Number of Respondent	21	21	21	21	21	21	21	21	21	21	210	100
Age of Respondent												
15-25	2	5	4	7	6	4	5	6	5	2	46	21.9
26-35	9	7	11	4	7	10	5	10	8	7	78	37.1
36-45	5	5	5	9	4	4	8	4	5	8	57	27.1
46-55	5	4	1	1	4	3	3	1	3	4	29	13.8
Educational status											0	0.0
None	3	1	2	2	5	3	3	4	3	0	26	12.4
Low (Primary and JSS)	13	14	14	16	10	17	13	13	14	17	141	67.1
High (SHS and above)	5	6	5	3	6	1	5	4	4	4	43	20.5
Religion											0	0.0
Muslim	5	3	3	2	3	4	4	1	2	4	31	14.8
Christian	14	18	15	17	18	17	17	16	19	17	168	80.0
Traditional	2	0	3	2	0	0	0	4	0	0	11	5.2
Marital Status											0	0.0
Married	13	17	19	13	10	12	14	12	9	15	134	63.8
Single	6	2	2	4	6	7	4	5	6	2	44	21.0
Co habitating	2	2	0	4	5	2	3	4	6	4	32	15.2

4.2 Production Practices With Respect To Iodization of Salt in the Ten Districts

The solar evaporation method is the main method used in the mining of salt in the 10 salt producing districts. Huge pans are dredged and brine from lagoons or underground is pumped to fill them, crystallization of the salt takes place by natural means through solar evaporation. The crystallized salt in all the 10 salt producing districts was harvested by hand labor and transferred through a series of conveyors to a dumping site for further

storage. In the case of the large scale production, mechanized equipment's were used to scrub the salt; this was observed in Ketu district and Ga south district.

Iodization of salt for both human and animal consumption is mandated by law in Ghana. All salt at production sites must be iodize to 50ppm according to food and Drug Authority (FDA) in the country. The results showed that iodization method by all the producers in the area under study was by spraying except in the Ada East District where a method that could not be identified was used by some producers. At the production site iodization was done manually by spraying the potassium iodate solution on the harvested salt. It was reported that a tea spoon full of potassium iodate is mixed with 12litres of water in a knapsack to attain the recommended dosage of 50ppm.The spraying is carried out on the harvested salt and mixing is done manually with a shovel.

The results revealed that producers use 12litres of potassium iodate to iodizing 12tons of salt. In the Ada East situation, the Producers introduced the potassium iodate into the salt pans so that crystalised salt in pan will be automatically iodized. The producers could not inform the study where that method was adapted from or thought.

In all the 10 salt producing districts, Rapid Test Kits (RTKs) were used as quality control measures to check whether the salt is adequately iodized. The RTKs tells the producer that the iodine in the salt meet recommended household consumption level of 15ppm but not the exact level of iodine in the salt. The results also showed that producers do not have the equipment to check the actual level of iodine after the salt goes through iodization.

Most of the producers in the 10 districts produce the salt for export and also for the local market. The salt they produce is mostly unrefined salt which is sold directly to salt traders who retail it in the open market. The result also revealed that some of the crude salt is sold to the refinery and repackage for the open market. Some of the salt is also exported to neighboring countries like Togo, Burkina, Mali, Benin and Niger. Packaging of the salt was mostly done on site. The salt is packed into 75kg to 100kg jute bags at production sites. Only one salt producer had their salt branded as was observed during the study.

The study results also revealed Producers lacked modern machinery or equipments to explore other salt mining methods which affect the expansion of the salt industry and adherence to both local and international standards. The study also observed poor storage of harvested salt at various production sites in the study areas. Salt harvest in most cases is heaped in open space and exposed to all weather conditions.

The results also showed that salt producer do not have formal training on iodization of salt. The results revealed that all the Producers lacked access to potassium iodate solution due to high cost. In Ketu district the Producers complained that, in 2011, the cost of 1kg of potassium iodate was GHc 50.00 but currently it is being sold at 300.00 per kilogram of potassium iodate. This has affected the cost of production and hence the price of iodized salt on the market. Lack of modern machines for iodization was also identified as a challenge to salt iodization by the producers. As a result, most of the traders/producers advocated for low interest credit facilities to improve both production and iodization.

4.3 Awareness of USI Law among Salt Producers and Traders

All the salt producers interviewed in the 10 districts were aware of the USI law (100%). On the other hand, 45% of the salt traders were aware of the USI law in the 10 districts as shown in the figure 1.3. This reflects a huge gap in the awareness of the law between producers and traders in the study area.

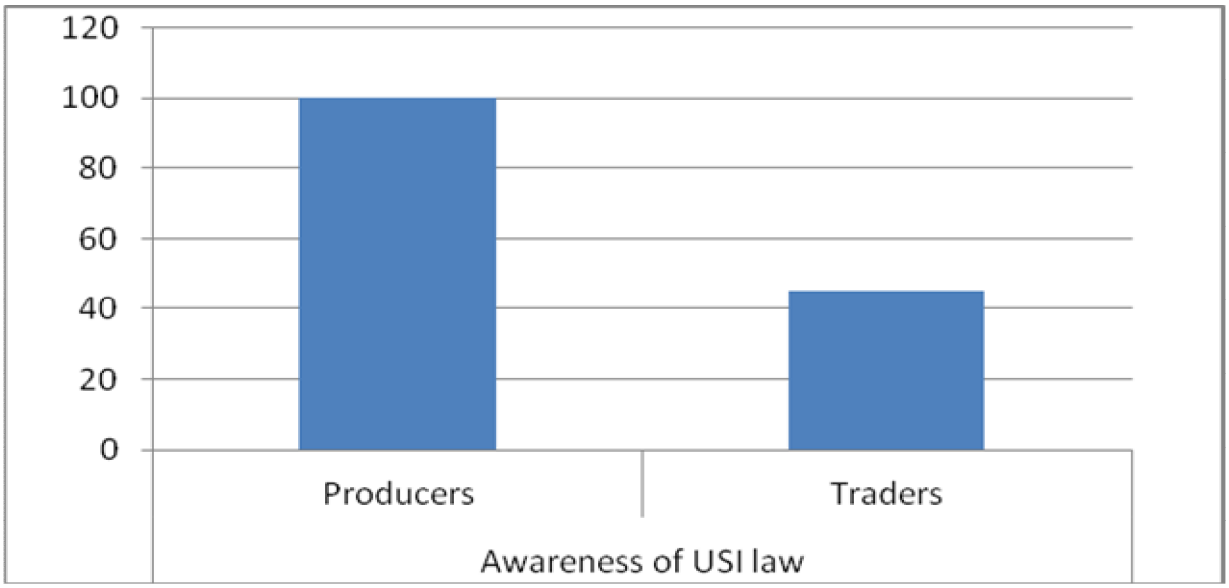


Figure 4.1: *Proportion of salt producers and traders who are aware of USI law in the 10 salt producing districts*

Source: *Field survey*

Using the LQAS decision rules table to identify salt producing districts with lower awareness of the USI law among traders, the coverage of 45% corresponds to six (6) correct responses that is the average total number of positive response (Yes) for awareness to be at 45% in each district. From Table 4.2, Awutu Senya, Ningo prampram and Ada East districts had 0, 5 and 4 traders respectively indicating they were aware of the USI law. This means that the proportion of traders who are aware of the USI law in

these districts is less than 45% which signified low awareness in relation to the other districts.

Table 4.2: *Awareness of USI Law: LQAS decision rule for sample size of 19 for classifying district's with coverages below 45%*

Districts/ Response	KEEA	Awutu Senya	Ketu South	Ahanta West	Ga South	Gomoa East	Gomoa West	Ada East	Ningo Prampram	Efutu	Total	LQAS-Decision number Rule(45%)
Traders (Yes)	15	0	7	11	14	7	7	5	4	16	86	6
Traders (No)	4	19	12	8	5	12	12	14	15	3	104	6
Total	19	19	19	19	19	19	19	19	19	19	190	6

Source: *Field Survey, 2016*

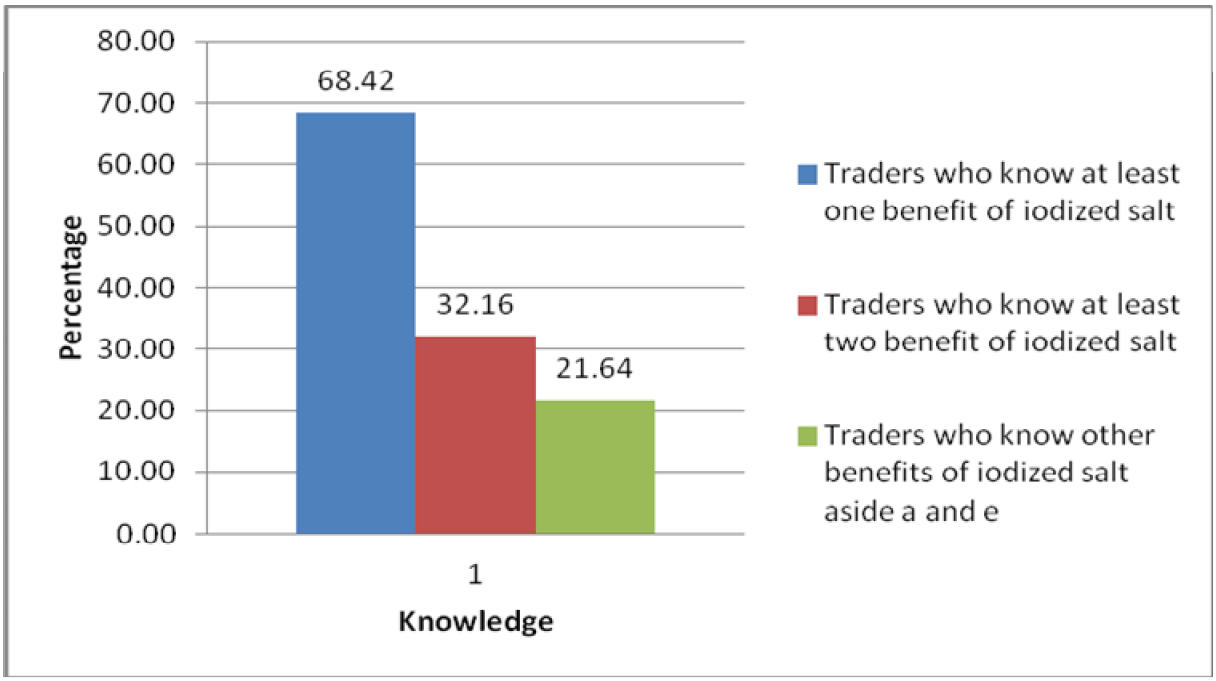
4.4 Proportion of Producers and Traders Who Know the Benefits of Iodised Salt

All the salt producers could mention at least one benefit of iodized salt. The most known benefit of iodize salt among the producers was the prevention of goiter, that is 90% of the salt producers mentioned the prevention of goiter as a benefit of iodized salt. Other benefit mentioned included; improvement of child intelligence that is 55% representing 11 producers. None of the producers mentioned the improvement in pregnancy outcome as a benefit of iodised salt.

Sixty eight percent (68%) of the one hundred and ninety (190) traders surveyed across the ten districts knew at least one benefit of iodized salt.

Thirty-two percent (32%) knew at least two (2) benefits of iodised salt. The results showed that most respondents mention the prevention of goiter (a) and improvement in general health (e) as a benefit of iodised salt. In the figure 11 above, the study estimated

the proportion of traders who knew other benefit aside these two most common responses, indicated as "aside 'a' and 'e' in figure 1.4. About 22% of the traders were able to indicate other benefits aside "a and e". Prevention of goiter still stands out as the most known benefit of iodised salt in the study areas.



*a=prevention of goiter, *e=improvement in general health

Figure 4.2: *Percentage of traders who know the benefit of iodized salt*

About 43% of traders mentioned the prevention of goiter as a benefit of iodised salt in the study area, this was followed by about 20% of them mentioning the improvement in child intelligence/school performance as a benefit. Most of the traders also indicated an improvement in general health (37.43%) as a benefit. Relating iodised salt to improving pregnancy outcome and child health was less known to the traders in the study area representing 4.68% and 5.85% respectively.

The LQAS decision rule base on estimated coverage for each known benefit of iodize salt in the study area classified priority districts where interventions need to be strengthen the most to improve knowledge on each benefit of using iodise salt. This is indicated by the shaded districts in table 4.3.

The result indicates that even though about 43% of traders know that the consumption of iodized salt prevents goiter, three (3) districts in the study area, that is Ketu, Ahanta West and Ningo Prampram have coverage's below the 43%.

Similarly, with respect to knowledge of traders on improvement in child intelligence/school performance as a benefit of iodize salt consumption in the study area; Awutu Senya, Ningo Prampram and Effutu districts had coverages below 20.47%.

The results also showed that few traders know the relationship between iodized salt and improving pregnancy outcomes and child health. Because the coverage's are too small the LQAS methodology is not sensitive to classify the districts, this means that general action or intervention is required to improve the knowledge of traders on improving pregnancy outcome and child's health as a benefit of consuming iodized salt.

Table 4.3: *LQAS decision rule table highlighting priority districts with coverages below the established coverage of each known benefit of iodised salt.*

Benefit of Iodised Salt	KEEA	Awutu Senya	Ketu	Ahanta West	Ga South	Gomoa East	Gomoa West	Ada East	Ningo Prampram	Efutu	Total Correct	Total Coverage (%)	LQAS Decision Rule
Prevents goitre	9	7	5	5	11	9	10	7	4	7	74	43.3	6
Improves child intelligence/school performance	4	1	6	4	2	7	6	3	1	1	35	20.5	2
Improves pregnancy outcomes	0	0	3	1	0	0	3	1	0	0	8	4.7	na
Improves child health	0	1	3	0	1	1	2	1	0	1	10	5.9	na
Improves health in other groups	10	9	1	5	13	4	7	3	6	6	64	37.4	5

Source: *Field Survey 2016*

4.5 Proportion of Traders Who Sell Adequately Iodize Salt in the Ten Regions

A total of 190 salt samples were tested with RTK's in all the ten selected districts. These samples were taken from the 190 traders that we interviewed during the study. Twenty salt samples were also tested from production sites to see whether iodine levels met recommended household levels. Sample from seventeen (17) producers tested above 15ppm representing 85%, two (2) samples were less than 15 ppm and only one (1) sample had no iodine in it at all. This means that at the production level, about 95% of salt have some level of iodine in it with 10% being not iodised.

About 51% of the salt samples from traders tested above 15ppm, 14.7% tested below 15ppm and 34.7% showed no evidence of iodization. Figure 1.5 is a graphical representation of the level of iodised salt on the market.

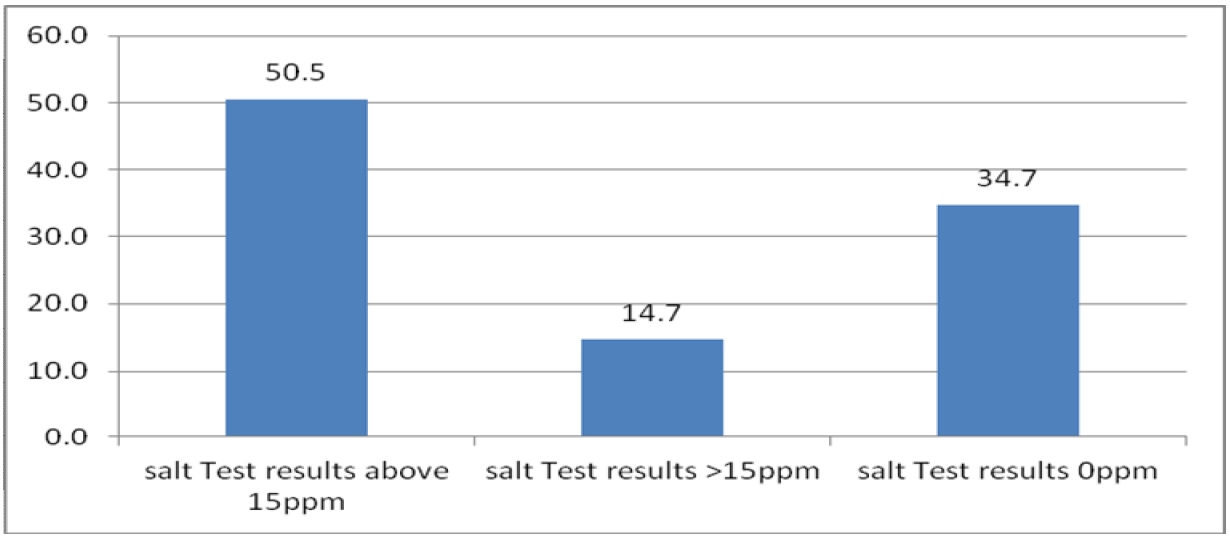


Figure 4.3: *Proportion of traders who sell adequately iodised salt*

The results showed that about 51% of the salt on the market in the selected districts are adequately iodized. Looking at the LQAS table in table 4.4, traders in Ketu, Gomoa West and Ada East have most of their salt below 15ppm.

Table 4.4: *LQAS decision rule highlighting districts traders with the least adequately iodised salt below the survey coverages*

Salt Sample Test Results	KEEA	Awutu Senya	Ketu	Ahanta West	Ga South	Gomoa East	Gomoa West	Ada East	Ningo Prampram	Efutu	Total Correct	Total Coverage (%)	LQAS Decision Rule
salt Test results above 15ppm	10	9	6	11	14	14	6	5	12	9	96	50.5	8
salt Test results less than 15ppm	3	3	2	5	1	2	5	3	1	3	28	14.7	na
salt Test results 0ppm	6	7	11	3	4	3	8	11	6	7	66	34.7	4

Source: *Field survey, 2016*

4.6 Preference between the Sale of Refined and Un-Refined Salt among Traders in the 10 Selected Districts

The preference of consumers or customer's wills most likely affect the choice of traders in the sale of both refined and unrefined salt. The results disclosed that 53.7% of traders sold both refined and unrefined salt, 20.5% sold only refined salt and 25.8% sold only unrefined salt. Figure 4.4 shows the proportion of type of salt sold by traders in the 10 districts.

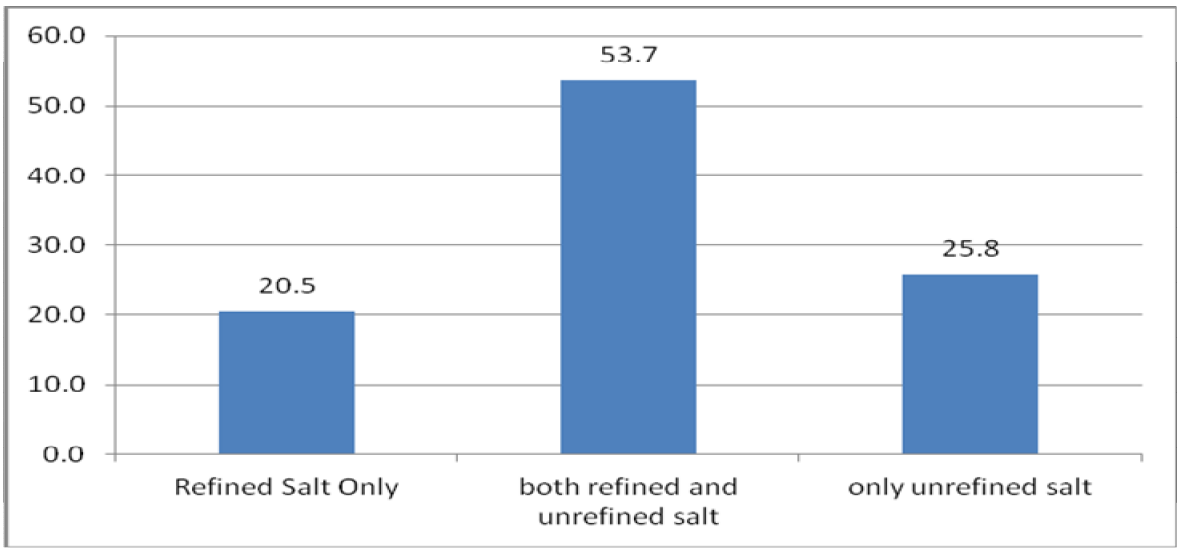


Figure 4.4: *Proportion of traders who sold either refine or unrefined salt*

Ga South district recorded the highest number of traders selling only refined salt that is 7 out of 19 traders. The sale of only unrefined salt was recorded the most in the Ketu district that is 10 out of 19 traders. Gomoa West on the other hand, had the highest number of traders who sold both refined and unrefined salt that is 13 out of 19 of the traders surveyed. Table 4.5 below shows traders in each district selling either refined or unrefined salt.

Table 4.5: *Table showing the number of traders in districts selling either refined or unrefined salt.*

Type of salt that was being sold	KEEA	Awutu Senya	Ketu	Ahanta West	Ga South	Gomoa East	Gomoa West	Ada East	Ningo Prampram	Efutu	TOTAL	Coverage (%)
Refined Salt Only	5	6	0	6	7	3	4	2	2	4	39	20.5
both refined and unrefined salt	11	8	9	11	9	12	13	9	9	11	102	53.7
only unrefined salt	3	5	10	2	3	4	2	8	8	4	49	25.8
Total sample size	19	19	19	19	19	19	19	19	19	19	190	100.0

Source: *Field survey, 2016*

Traders indicated that most of the customers still patronize the unrefined salt. Reasons provided included the following:

- It is cheaper especially when the customer does bulk cooking. Examples given included chop bar operators, food vendors, schools and other institutions where bulk cooking is done.
- Some customers are used to cooking with unrefined salt; they claim they usually end up putting too much salt or too little salt in food when they use refined iodised salt. It is easier with unrefined crystal salt for them since that is what they are used to.
- Some customers say the use of refined salt sometimes change the colour of their corn dough. They said this was the complaints from some chop bar operators and food vendors.

4.7 Proportion of Traders Who Properly Display Salt at the Point of Sale

The handling and display of salts at the point of sale has implications for the levels of iodine in them. In the areas under study, about 63.7% of traders had their salt properly displayed. Most of the salt was tied in transparent polythene bags and displayed on tables for sale. The pie chart below (figure 4.5) shows the proportion of traders who displayed their salt properly on the market in the 10 districts.

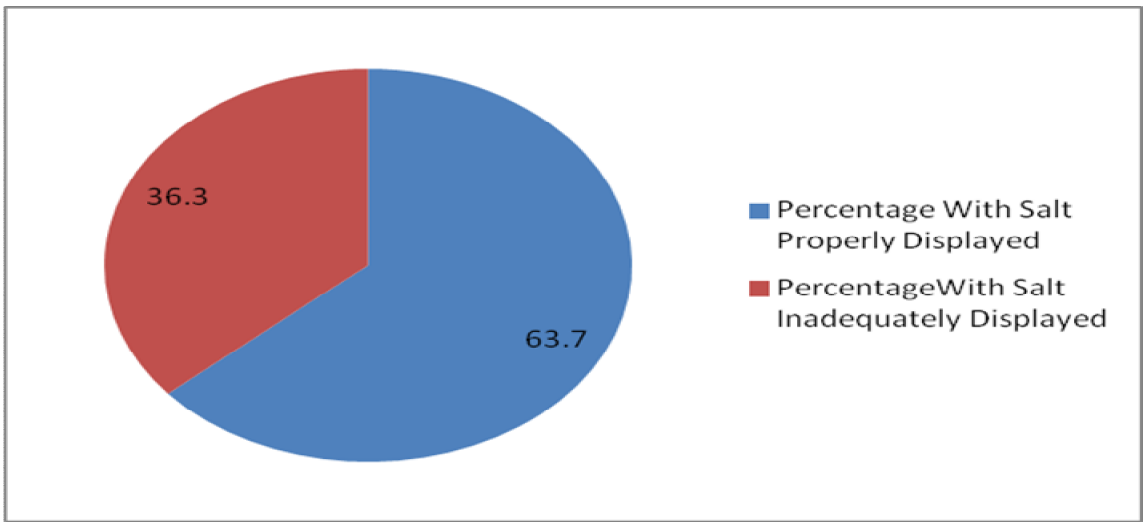


Figure 4.5: *Pie chart showing proportion of traders with salt properly displayed*

Effutu District had most of their traders properly displaying their salt at the point of sale that is about 17 out of 19 traders surveyed. Ketu district on the other hand was identified as priority district for the least number of traders who had their salt properly displayed.

Table 4.6: *LQAS Table showing* the n*umber of traders in districts who were observed and had their salt properly displayed at sales*

Districts	KEEA	Awutu Senya	Ketu	Ahanta West	Ga South	Gomoa East	Gomoa West	Ada East	Ningo Prampram	Efutu	Total	LQAS Decision Rule for 63.7%
Traders who properly displayed salt at sales (Observe)	16	10	2	13	15	13	10	9	16	17	121	6
Traders who did not properly displayed salt at sales (Observe)	3	9	17	6	4	6	9	10	3	2	69	
Total sample size	19	19	19	19	19	19	19	19	19	19	190	

Source: *Field survey, 2016*

4.8 Misconceptions about the Use of Iodised Salt

The survey of both producer and traders in the area under studied revealed a number of perceptions about the use of iodised salt. These include;

1. A way of the white man to sell his salt and making locally produced salt less competitive.
2. It is not good for one's health according to some people and traditional healers.
3. Some people say it causes infertility.
4. Not good for the preservation of fish
5. Changes the colour of corn dough.

4.9 Summary of results

In summary the result indicates that the solor evaporation method of salt mining and knap sack spraying with potassium iodate is the method employed by salt producers in the 10 districts under study. The result also show that the iodine Rapid Test Kits are used to determine whether salt is adequately iodised or not which falls short of determining whether salt at the production site is iodised up to 50ppm as recommended by policy.

There is also high awareness of the USI law among salt producers in the 10 districts (100%) and about 45% among salt traders. Awutu Senya, Ningo prampram and Ada East districts where identified as the districts with low awareness of the USI law among salt traders.

The prevention of goiter is the most known benefit of iodised salt in the districts under study and the least is improving pregnancy outcomes (4.68%). About 51% of the salt on the markets in the 10 districts were adequately iodised above 15ppm, however markets in Ketu, Gomoa West and Ada East districts relatively had most of their salt inadequately iodised.

The results showed that about half (53.7%) of traders sell both refine and unrefined salt. About 25.8% of the salt traders in the 10 districts sold only unrefined salt. Unrefined salt was sold the most in the Ketu district. About 64% of the salt in the 10 district was properly packaged and displayed on the market but Ketu district again had the least number of salt traders who properly packaged and displayed salt for sale.

CHAPTER FIVE

DISCUSSION

5.0 Introduction

This chapter presents a discussion of the study findings in relation to the literature that has been reviewed in chapter four on the various study objectives and how this finding can translate in to recommendations that may be useful for the Ghana USI program. In this chapter discussions are held on salt production and iodization in the 10 salt producing districts, awareness of the USI law and knowledge of salt producers and traders on the correct benefits of iodized salt, the prevalence of iodized salt in markets in the study area, sales of refined salt verses un-refined salt by traders in the study area as well as how salt is handled at the point of sales whether it is properly packaged and displayed or not. The chapter also discussed the misconceptions surrounding salt iodization and also the flow of iodized salt from salt production site to salt consumers in accordance with the study conceptual framework.

5.1 Salt Production and Iodisation in the Ten Salt Producing Districts

Salt production in the ten districts was sorely by solar evaporation and harvesting was done by hand labor. It was only in the Ketu district and Ga South district that some producers were located using mechanical means to harvest their salt, all the other salt producers used hand labor. The results in this study also revealed that this manual ways of salt production by most of the salt producers eventually affect the quantity of salt they produce on a daily base. Yaboah (2011) also concluded that these rudimentary technologies allow these salt producers, mostly termed as artisans to harvest about 15 bag of salt daily.

This study also concluded that salt producers lack modern machinery and equipment's to explore other mechanical ways of salt production. The lack of modern equipment's was found to have affected the expansion of the salt industry and adherence to both local and international standards. This finding could be one of the reasons why Ghana is said to be under achieving its salt production potentials (Yaboah, 2011). Yaboah (2011) also indicated that the current annual salt production in Ghana may only represent ten percent (10%) of it production potential.

The Ghana Export Promotion Council has identified the salt sector as an important one to aid the diversification of Ghana's economy and that Ghana has the potential to make salt one of its trading commodities which can contribute significantly to GDP (USI Strategy III, 2015). For Ghana to realize this potential the government should be willing to invest in the salt sector. This will include investing in machinery and equipment to facilitate the production of larger quantities of salt daily by the salt industry. It will also be important for government to make available financial or loan facilities to support cottage scale producers (artisans) who produce less than 500 metric tons per anum and own about 35% of the local market shares (UNICEF, 2011). This financial facility will aid the expansion of their enterprises and create employment for more people living in these salt producing areas. Yaboah (2011) in his study stated that the salt sector is a major source of livelihood and provides employment for thousands of people living in salt producing areas.

The results in this study revealed that salt iodization is done manually in all the 10 salt producing districts. Knapsack spraying of harvested salt with potassium iodate is the main iodization method in the study catchment area (all ten districts). The crude salt is hand mixed with a shovel before they are bagged and transported. This manual ways of

iodization of salt could be the reason why most of the salt on the market is inadequately iodized.

This study revealed that most of the salt producers produced mostly unrefined salt, which is sold directly to the local market. All the salt producers complained of the lack of access to potassium iodate and those that had access to it complained about its high price. These factors could account for the current levels of adequately iodized salt at the household level, which is 38.4% as in the GDHS 2014. In addition, the findings of this study also showed that producers lack the quality control equipment to check the adequacy of iodine level in salt after iodization. Rapid Test Kits (RTKs) are used to check whether salt is adequately iodized at production sites. The RTKs tells the producer that the iodine in the salt meet recommended household consumption level of 15ppm but not the exact level of iodine in the salt. Most of the salt producers are therefore unable to confirm the 50ppm iodine level in their salt as recommended by the Food and Drug Authority (FDA). The iodine levels in salt can only be determined by titration in a laboratory or the use of the Photometers. The Photometer is a rapid test instrument used to estimate the exact levels of micro nutrient in food substance. Some of these instruments are popularly referred to as “iCheck”. Nyumuah et al. (2012) in the review of the lessons learned in the implementation of large scale food fortification in Ghana indicated that the use of the iCheck CHROMA rapid test device for salt can help improve quality control with respect to Ghana Universal Salt Iodisation (USI) programme. Large scale salt producers mostly have an advantage because most of them are relatively better resourced and may have quality control laboratories and devices to ensure adherence to standards (UNICEF, 2011). Small scale producers on the other hand who poses up to about 35% of the

domestic market share in Ghana lack this quality control equipment's and mostly use the RTKs which does not give them actual iodine levels in their salt. This situation brings about noncompliance to iodization standards (UNICEF, 2011).

The study also revealed that salt production staff do not have any formal training on iodization of salt in the past two years. Staff attrition had also resulted in the loss of trained staff on iodization. A situation in Ada East District had a salt producer introduce potassium iodate into the salt pans so that crystalised salt in the pan will be automatically be iodized. The producers could not inform the study where that method was adapted from or thought. This situation has implication for the Ghana USI program and the adequacy of iodized salt that will eventually reach the salt consumer if the agencies in the "iodised salt producer to consumer hill" (conceptual framework) fail to control such salt.

5.2 Awareness of USI Law and Knowledge of the Correct Benefits of Iodised Salt By Salt Producers and Traders in the Study Catchment Area

It is constitutionally required that salt meant for both human and animal consumption in Ghana must be fortified with potassium iodate (USI Strategy II, 2008). The result of this study revealed that 100% of salt producers in the areas under study were aware of the USI law, however less than half that is 45% of salt traders were discovered to be aware of the USI law with Awutu Senya, Ningo Prampah and Ada East districts having less than 45% of their traders being aware of the USI law. According to Chirawurah et al. (2015) only 3% of rural inhabitants in their study area were aware of the law on iodization.

With reference to the "iodize salt producer to consumer hill" (the study conceptual framework) it is realized that awareness of the USI law diminishes as it moves towards

the consumer. The trend is reflected in the proportion of producers and traders who sell adequately iodize salt in the study results. 85% of salt at the production sites visited were adequately iodized where as 51% of the salt at the market were adequately iodized. At the household level, the prevalence of iodize salt is at 38.4% according to the GDHS 2014 report. The study conducted by Chirewurah et al. (2015) revealed that so many people especially those who sell salt in the market were not aware of the existence of the law on iodization which included them not knowing that breaking these laws could lead to their arrest. This diminishing effect could be attributed to poor sensitization and enforcement of the law by the agencies responsible in the value chain as shown in the study conceptual framework. Salt handling, packaging and transportation from salt production site to the markets where they are sold must be monitored properly to ensure that adequately iodized salt reaches the end user or beneficiaries.

Chirewurah et al. (2015) suggest that although Ghana has passed a law on USI the absence of strict enforcement of the law in addition to weak monitoring of the salt value chain could serve as a major drawback for Ghana in its quest to achieve 90% availability and utilization of iodized salt at the household level. The Health Belief Model (HBM) of social and behavioral change theories indicates that individuals are more likely to practice a particular behavior based on their perception or belief of the consequences of not practicing that behavior (Glanz et al, 2006). Based on this theory salt producers and traders are more likely to iodized and sell adequately iodized salt to consumers if they know and understand the correct benefit and consequences of iodize and non-iodize salt respectively. This could inform their willingness to adhere to iodization standards so as to prevent iodine deficiency disorders (IDD).

The study results showed that 90% of salt producers know that lack of iodine causes goiter and 43% of traders in the major markets (districts) in the study catchment area. Goiter remains the most known benefit of iodized salt in the study catchment area. Other important benefits such as improving pregnancy outcomes, improving child health and intelligence were the least known to producers and traders in the study area. These results are similar to the Ghana Health Service Family Health Division (FHD) report 2014 which also reported that 41.7% of respondent (mostly traders and salt consumers) in salt producing districts knew goiter as a consequence of iodine deficiency.

The result indicated that even though 43% of traders know the consumption of iodised salt prevents goiter, three (3) districts in the study area, that is Ketu, Ahanta West and Ningo Prampram had coverage's below the 43%. These areas are therefore classified as priority areas for any health education and SBCC activities on IDD base on the LQAS decision rule used in this study.

Based on the HBM of behavioral change theories individuals will have to belief in the consequences of iodine deficiency and perceive these consequences as health threat before they can practice and adhere to the recommendation of the USI program. Ironically Buxton et al. (2012) on the other hand concluded in their study on the knowledge and practices of people in the Bia district of Ghana with regard to the intake of iodize salt, indicated that the participants in their study were aware of the importance of consuming iodized salt and iodine deficiency disorders, that is about 90.4% but this translated to only 64.6% of households using adequately iodized salt. They therefore suggested in their study that high levels in the proportion of people who know the importance of iodized salt did not necessarily translate in to an increase in the number of

households who use adequately iodized salt. Buxton et al. (2012) therefore recommended that the enforcement of the USI law and related policies on universal salt iodization in addition to ensuring quality assurance of iodized salt throughout the salt value chain to the consumers as a solution.

5.3 The Prevalence of Iodised Salt among Salt Traders in the Ten Salt Producing Districts

The results in this study revealed that 51% of the salt samples from traders in the study area tested above 15 ppm, 14.7% tested below 15ppm and 34.7% showed no evidence of iodization. This trend is not very different from the findings of the Ghana Health Service FHD (2014) annual report on market availability of iodized salt in 13 salt producing districts using iodized salt Rapid Test Kits (RTKs).it was found out that only 48.8% of salt samples tested in selected markets were adequately iodized. Paa-Nii Quaye (2010) of the Global Alliance for Improved Nutrition, (GAIN) Africa, expressed concern in a news item that about 50% of salt on the Ghanaian market was not iodated despite 16 years of introducing iodisation of salt in the country. According to him, only about 30% of iodized salt on the market have the requisite iodine supplementation needed for the prevention of iodine related deficiency problems such as low Intelligence Quotient (IQ), still births, low birth weight and goiter (GNA, 2010).

The UNICEF Dip-Stick baseline report on universal salt iodization in 2012 also concluded that 66% of distributive traders were selling iodized salt (Charterhouse, 2012). Base on this information it is quite clear that about 50% of the salt on the market is adequately iodized. Following the “iodized salt producer to consumer hill” (the study conceptual framework) it means that half the salt on the market which is not adequately

iodized it slopping down to the consumers making them susceptible to IDDs.

In order for Ghana to achieve the WHO recommendation of 90% household availability of adequately iodized salt, there is the need to have close to 100% prevalence of adequately iodized salt on the market especially in these salt producing areas that serve as a hub for salt trade to other parts of the country.

5.4 Sales of Refined Salt Verses Un- Refined Salt In The 10 Districts

This study result showed a relatively higher number of traders selling only unrefined salt that is 25.8% to 20.5% who sold only refined salt. However, majority of the traders about half that is 53.7% sold both refined and unrefined salt. This shows that there is still high preference of unrefined salt by consumers in the study area (10 salt producing districts). This study finding agrees with the UNICEF (2011) market research study on iodized salt which identified coarse (unrefined) salt as the favorite grade of salt across both urban and rural locations in salt producing areas and to a lesser degree in non- salt producing areas. The UNICEF (2011) study also reflected that traders in salt producing localities sold coarse (unrefined) salt as compared to those in none salt producing locations and also pointed out that traders preferred the sales of non-branded coarse (unrefined) salt because they had the quickest turnover (money).

Qualitative results in this study also showed that traders in the major markets in the study area indicated that most customers still patronize the unrefined salt and the reasons provided included;

- It is cheaper especially when the customer does bulk cooking. Examples given included chop bar operators, food vendors, schools and other institutions where bulk cooking is done.

- Some customers are used to cooking with unrefined salt and they claim they usually end up putting too much salt or too little salt in food when they use refined iodized salt. It is easier with unrefined crystal salt for them since that is what they are used to.
- Some customers said the use of refined salt sometimes change the color of their corn dough. This they said was the case of some chop bar operators and food vendors.

The reasons revealed for the patronage of unrefined salt in this study is not far from the finding of Chirewurah et al. (2015) and Buxton et al (2012). Cherewurah et al. (2015) in their study in northern Ghana on the use of iodized salt in rural northern Ghana indicated the high cost of refine salt as a limiting factor to the patronage of iodized salt, other reasons included that respondents were used to crystal unrefined salt. Chirewurah et al. (2015) also indicated that 27% of respondents said iodized salt (refined salt) was expensive and accounted for low usage. Buxton et al. (2012) in their study also reported the high cost of iodized salt as an influential factor to the use of iodized salt and sited an example that about 500g of unrefined salt will cost about 35 Ghana pesewas and the refine (Annapurna) salt of exact quantity will cost 70 Ghana pesewas.

The results in this study clearly showed that most consumer still have a great preference for crystal unrefined salt, based on this findings, it is important to ensure that crude salt at production site be adequately iodized, package and store properly to maintain it iodine levels. As discussed already it is important to reiterate the importance quality control throughout the salt value chain to ensure that iodized crystal unrefined salt maintains its iodine level at the household level.

5.5 Handling Of Salt at Sale Point by Traders in the 10 Districts

This study in looking at the display and packing of salt at sales point by traders in the market revealed that about 63.7% market trader properly displaying their salt. These salts were tied in transparent polythene bags and displayed on tables for sale. This implies that about 36% of iodized salt on the market had the possibility of losing iodine as a result of improper packaging. Diosady et al. (1997) concluded that moisture has a critical role in the stability of iodine especially when iodized salt is stored in temperatures similar to that of developing countries. Diosady et al. (1997) also showed that moisture absorbed by hydroscopic impurities contributes to the rapid loss of iodine in salt. The way some proportion of producer and traders handle iodized salt in the study area (10 salt producing districts) and based on Diosady et al. (1997) conclusion could signify iodine lost due to poor storage and handling through the salt value chain in the salt producing districts. This result is also in line with the UNICEF (2011) market research study which revealed that about 37% of traders had their salt exposed to the sun in the market.

This study result showed that 85% of salt at the production sites visited were adequately iodized where as 51% of the salt at the market were adequately iodized. Based on the discussions above the deference in the iodization level between the salt at production site and the market could also be attributed to the way iodized salt is handled within the salt value chain causing most of the iodine to be lost before it reaches the market.

In order to prevent iodine lost, the packaging of salt with effective moisture barriers such as low density polyethylene bags can significantly reduce iodine loss in salt.

Diosady et al. (1997) indicated that with solid low density polyethylene packaging the loss of iodine from salt that has been stored for six months will be kept within 10% to 15%.

Ketu district was identified in this study as one of the areas where traders do not properly package and display salt at the point of sales. It was also one of the districts together with Ga South district where mechanize means of salt production was observed in this study. In order for adequately iodized salt to reach the consumers in the iodized salt value chain, Ketu district should be targeted as a priority district in the study area to ensure producers and traders practice proper packaging and handling of salt to maintain its iodine levels.

5.6 Misconceptions about Iodised Salt among Salt Producers and Traders

This study revealed a number of perceptions about the use of iodised salt among salt traders and producers. These included:

1. A way of the white man to sell his salt and making locally produced salt less competitive.
2. It is not good for one's health according to some people and traditional healers.
3. Some people say it causes infertility.
4. Not good for the preservation of fish
5. Changes the color of corn dough.

These findings are in line with other misconceptions about the use of iodized salt in the Charterhouse (2012) baseline report on universal salt iodization which examined the factors accounting for the non-usage of iodized salt. Charterhouse (2012) report concluded that some misconceptions salt traders and producers have about iodized salt

have the tendency to influence the production and sales of iodized salt. Following the HBM of behavioral change communication theories which focuses on belief and perceptions of individuals in relation to their behaviors, these misconceptions about the use of iodized salt among salt producers and traders could influence their behaviors negatively in the production and sale of iodized salt.

5.7 The Flow of Iodised Salt from Production to Consumption (Iodize Salt Producer to Consumer Hill)

This sections discusses the study results in relation to the conceptual framework developed for this study. For the purpose of this discussion, the conceptual framework will also be referred to as the "iodized salt producer to consumer hill". The conceptual framework also illustrates the major actors and the government ministries and agencies working to ensure adequately iodized salt reach the consumers.

Conceptual Framework

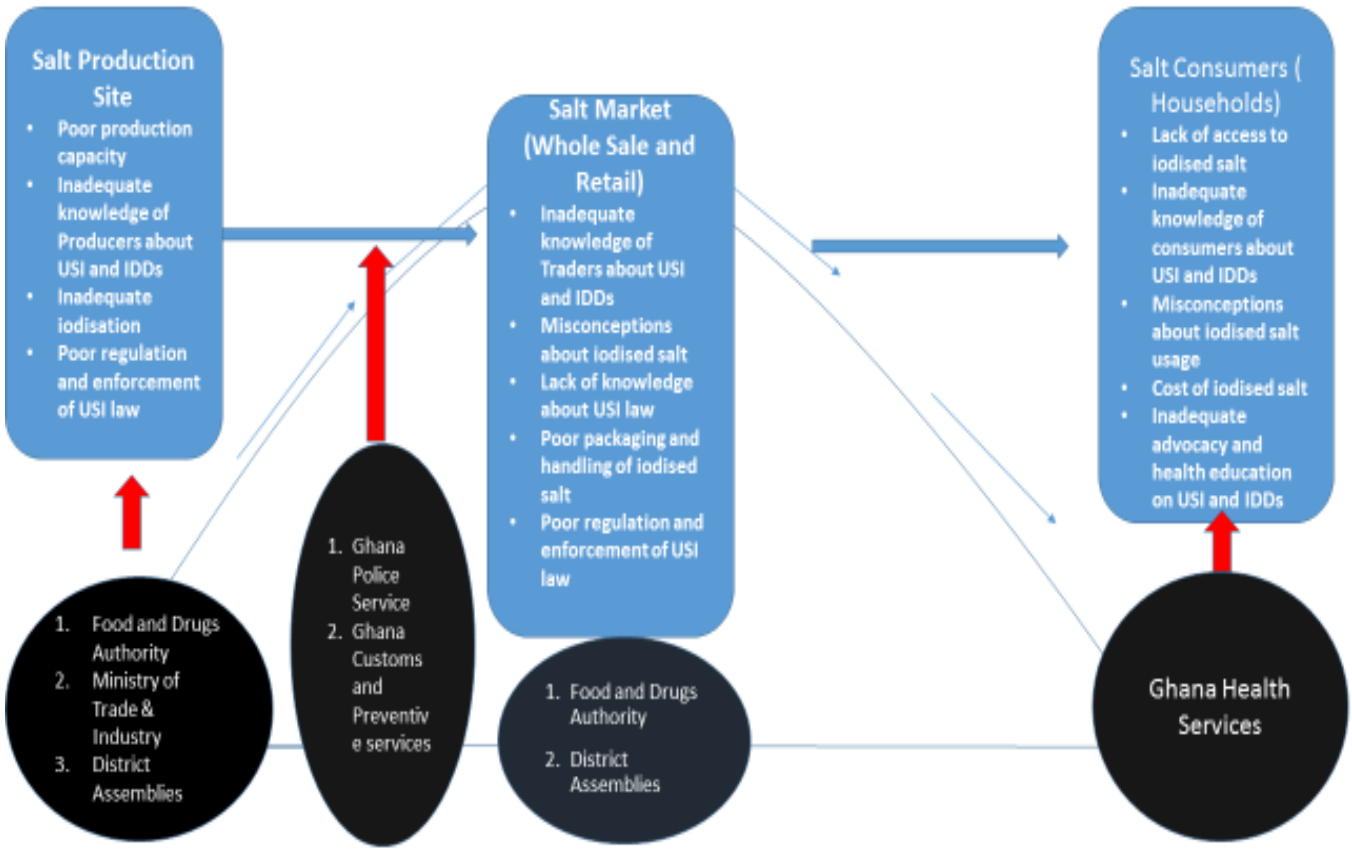


Figure 1.3: *Iodised salt producer to consumer hill*

Source: *Author*

The study designed concentrated on salt traders and salt producers because they are considered in this study as the critical groups in the salt industry that are targeted in the USI program, their activities have greater implications in the countries prowess towards achieving the 90% availability of iodized salt at the household level (consumers).

The results in this study indicated salt production is done by hand labor and non mechanical means is used to iodized salt. Knapsack spraying with potassium iodate and hand mixing by shovel is what is employed in Ghana's salt producing districts. Even though this study was limited in estimating the exact level of iodine in salt at production sites in the various districts in the study area, 85% of salt tested in the study area was above the household requirement of 15ppm. In the conceptual framework ("iodize salt producer to consumer hill"), the Ministry of Trade and Industry (MoTI), the Ghana Standards Authority (GSA) and the Food and Drugs Authority (FDA) are responsible for ensuring that salt producers adhere to the standards of production and iodization of salt (USI Strategy III, 2015). Following the flow of salt in the "iodized salt producer to consumer hill" inadequate enforcement by the various Ministries and agencies at the production site will allow the flow of non-iodized salt to the market. These agencies are required to support the salt production sectors with enhanced and mechanical ways of iodizing salt. The ability of salt producers to be able to employ quality control measures in ensuring 50ppm iodization of salt at production site is also crucial. Nyumuah et al. (2012) suggested that the use of the iCheck CHROMA rapid test device for salt can help improve quality control with respect to Ghana Universal Salt Iodisation (USI) program.

The results in this study showed that 51% of the salt in majors markets in the 10 salt producing districts has the required household level of iodine of 15ppm which is a reduction from 85% from production site. The point of interest in the conceptual framework, that is "iodize salt producer to consumer hill" is the barrier between the producers and the traders where we have the Ghana Police Service and the Ghana Customs and Preventive Services who serve as a cross checking point through the salt

transport chain to prevent non iodized salt from reaching the traders or the market. This means that even when non iodized salt is not detected at the production site the likelihood that it will be detected at the cross checking points and slide back to the production site for re-iodization is high. The cross checking points here refers to the Police and Customs check point barriers on the roads and high ways in the country. These facts may point to weak monitoring by responsible agencies that allow inadequately iodized salt to slip to the market or poor handling of adequately iodized salt on the market by traders that allows most of the iodine in the salt to be lost. In the iodized salt producer to consumer hill, the salt traders are at the peak of the hill and serve as the point where either iodized or non-iodized salt could either slide back to the producers or to the consumers. This makes them a very critical group that can determine the kind of salt that reaches the consumers.

The Ministry of Local Government and Rural Development (MLGRD) through the various District Assemblies (DA) are expected to monitor salt traders with the Food and Drugs Authority (FDA) being the lead agency (USI Strategy II, 2008). The Environmental Health Officers (EHOs) are the staff of the DA who has been charged with the day to day monitoring of salt that is being sold on the market and therefore ensure adherence to the USI law by salt traders (USI Strategy III, 2015).

The results in this study showed that households are still exposed to inadequately iodized and non iodized salt. The results also revealed that salt traders in the study catchment area sold more crystal crude salt which is mostly inadequately iodized as compared to the refined salt. This study also discovered that most of the salt in the study catchment area (the 10 salt producing districts) was not labeled to indicate whether they were iodized or

not. The salt on the market were tied in transparent polythene bags and displayed at the point of sale. The Ghana Health Service (GHS) in the conceptual framework through their service delivery contact points, that is through Out Patient Care Departments (OPD), Antenatal care (ANC) services, Post-natal care (PNC) services, Child welfare Clinics (CWC), community outreaches and home visiting services are responsible to create the demand among consumers to patronize and consume iodized salt. They also provide information on the benefit and consequences of consuming and not consuming iodized salt respectively through health education and social and behavioral change communication (SBCC) activities. The hypothesis here is that if consumers are aware of the consequences of iodine deficiency the likelihood of them adapting a positive behavior toward the use of iodized salt will improve. If salt consumers only demand iodized salt, the sales of non-iodized salt will become disincentives to traders which will in turn stimulate salt producers to produce only iodized salt.

CHAPTER SIX

STUDY CONCLUSIONS AND RECOMMENDATIONS

6.0. Introduction

This chapter outlines and summarizes the study main findings in the study catchment area (the 10 salt producing districts). The conclusions of the findings are also stated in this chapters as well as proposed recommendations to aid the universal salt iodization program in Ghana.

6.1. Main Findings

The aim of this study is to assess the knowledge and practices of salt producers and salt traders in the salt producing districts of Ghana on universal salt iodisation. The targeted group form an important part of the salt value chain and therefore play a crucial role in ensuring that adequately iodised salt reached the household level. The understanding of salt producers on standard production and iodisation has implication for the Ghana salt iodization program. Knowledge of salt traders and producers on the USI law, IDDs and how to handle salt to avoid iodine lost can facilitate the achievement of 90% iodised salt at household levels. The main findings in this study include:

- Throughout all the ten districts, all salt producers produced crude salt and solar evaporation was used as the mining method. Harvesting of salt was done by hand labor and transferred through a series of conveyors to a dumping site for further storage. Iodisation was done in all the salt producing districts by mixing potasium iodate with water in a knapsack (1 tea spoon [5g of KO3] to 12 liters of water) and sprayed directly on salt.

- Lack of access and cost of potassium iodate was mentioned as a challenge to salt iodisation by producers
- All the producers interviewed were aware of the USI law (100%). and 45% of the traders were aware of the USI law. Using the LQAS decision rule table for the coverage of 45% for traders. Awutu Senya, Ningo prampram and Ada East districts were prioritized as district with low awareness of the USI law among traders.
- All salt producers and 68% of the traders surveyed across the ten districts knew at least one benefit of iodized salt. Prevention of goiter was the most known benefit of consuming iodised salt among the other benefits stated in the study.
- About 51% of the salt samples from traders tested above 15ppm, 14.7% tested below 15ppm and 34.7% showed no evidence of iodization. Traders in Ketu, Gomoa West and Ada East had most of their salt below 15ppm.
- The study revealed that 53.7% of traders sold both refined and unrefined salt, 20.5% sold only refined salt and 25.8% sold only unrefined salt. Traders indicated that most of the customers still patronize the unrefined salt based on the following reasons:
    - It is cheaper especially when the customer does bulk cooking. Examples given included chop bar operators, food vendors, schools and other institutions where bulk cooking is done.
    - Some customers are used to cooking with unrefined salt; they claim they usually end up putting too much salt or too little salt in food when they use

refined iodised salt. It is easier with unrefined crystal salt for them since that is what they are used to.

- Some customers say the use of refined salt sometimes change the colour of their corn dough. This they said was the case of some chop bar operators and food vendors.

- About 63.7% of traders had their salt properly packaged and displayed on the market. Most of the salt was tied in transparent polythene bags and displayed on tables for sale. Ketu district had the least number of traders who had their salt properly packaged and displayed on the market (2 out of 19 traders surveyed).
- The results also showed that some misconceptions still exist among salt producer and traders about iodized salt. These included;
    - A way of the white man to sell his salt and making locally produced salt less competitive.
    - It is not good for one's health according to some people and traditional healers.
    - Some people say it causes infertility.
    - Not good for the preservation of fish
    - Changes the colour of corn dough.

6.2. Conclusions

- This study has concluded that the solar evaporation method is the major salt mining technology being used in Ghana and salt is still being harvested through

hand labor. The salt industry in Ghana also lack modern machinery for salt production and iodization.

- Salt iodization still remains a challenge for the Ghana salt industry. This study has concluded that salt artisans and most medium scale producers of salt still lack adequate knowledge of salt iodization techniques; they are also limited by the lack of access to salt iodization machine and salt iodization input.

- Quality control and ensuring that all salt produced is iodize to 50ppm at production site is still a challenge in the ten districts. The commonly used testing tool in the salt industry for quality control is the iodized salt Rapid Test Kits (RTKs). RTKs can only provide qualitative information by classifying salt in to above 15ppm and below and cannot provide exact measurement of the levels of iodine in the salt. The RTK is also being used by regulatory and enforcement agencies which make them unable to determine the exact levels of iodine in salt during the course of their duty.

- Awareness of the USI law among the study population is high among salt producers (100%) and relatively low among salt traders (45%). The study results also suggest that awareness of the USI law is directly related to the prevalence of iodize salt at both production site and the market. About 85% of salt tested at production sites was iodize above 15ppm and 51% of the salt tested from the markets was above 15ppm following the pattern of awareness of the USI law among salt producers and salt traders respectively.

- Ninety percent (90%) of salt producers are aware of at least one benefit of iodized salt and 68% of traders in the study population. The prevention of goiter is the

common known benefit of iodized salt. Other important benefits such as (1) improving child intelligence and school performance (2) improving pregnancy outcomes and (3) improving child health were less popular among traders. Awutu Senya, Ningo Prampram and Effutu districts are noted as priority areas using the LQAS decision rule for low knowledge of traders on the benefits of iodized salt.

- This study concluded that only 51% of the salt on the markets in the 10 salt producing districts are adequately iodized. Using the LQAS decision rule table, markets in Ketu, Gomoa West and Ada East have most of their salt below 15ppm compared with the other districts in the study area.
- More traders in the study area sold more crystal crude unrefined salt than refined salt even though majority of traders sold both refined and unrefined salt. Some of the reasons for the patronage of unrefined salt included; it is cheaper as compared to refined salt and also the fact that some consumers are used to crystal crude unrefined salt. Other traders also reported some customers claim it changes the color of the corn dough they us to prepare food.
- About 36% of the salt in the area under study was not properly packaged and displayed for sale. Iodine lost can therefore be attributed to the way salt is handled and package by traders at the point of sale in the study area. This study also concluded that Ketu district has the highest number of traders who do not practice proper packaging and display of salt at the point of sales.
- Misconceptions about the use of iodized salt among salt producers and salt traders may still account for non production and sales of iodized salt in the salt producing districts. Some of the study population thinks iodization is the white

man's way of selling his salt and making locally produced salt less competitive. Some other misconceptions included; iodized salt causes infertility and bad when use in the preservation of fish.

6.3. Recommendations

- For Ghana to ensure universal salt iodization and also benefit from the salt sector, the government (MoTI and FDA) should be willing to invest in the salt sector. There is the need for sustainable supply of potassium iodate (KIO3) to salt producers and building the capacity of salt producers especially both medium scale salt producers and artisan on appropriate salt iodization techniques. Investing in machinery and equipment's to facilitate the production of larger quantities of salt daily by the salt industry is also recommended as the salt sectors have the potential of contributing to GDP.

- It is recommended that MoTI and FDA should build the capacity of salt producers, regulatory and enforcement agencies on quality control and support them with tools or devices that can provide adequate measurement and give exact figures of iodine in salt. The use of iodine photometer rapid test device for salt can help improve quality control and provide adequate measurement of iodine level in salt.

- This study showed that high awareness of the USI law among traders may results in higher prevalence of iodized salt on the market, it is therefore recommended for the MLGRD, GHS and the various District Assemblies to strengthen advocacy on the regulation on salt among traders and strengthen monitoring of the salt value chain in order to ensure that salt moving from the

market to the households are adequately iodized. This can be achieved through various communication channels that have been proven to be effective ranging from interpersonal to mass media.

- Since most traders sell unrefined crystal salt, it is recommended that enforcement by FDA and Districts Assemblies should be geared toward ensuring adequate iodization, packaging and labeling of these salt to ensure consumers are able to identify those that are adequately iodize. Packaging of salt with effective moisture barriers such as low density polyethylene bags by traders to prevent iodine lost is also recommended.
- It is highly recommended that social and behavioral change communication programs and messages be developed by relevant agencies such as the Ghana Health Service and District Assemblies in the salt producing districts to address misconceptions about the use of iodized salt as they act as potential barriers to the production and sales of iodized salt by both salt producers and traders in the ten districts.

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APENDIX

Apendix 1.LQAS decision rule table.

LQA	le: Decision Rules for Sample Sizes of 12-30 and Coverage Targets/Average of 10%-95%																	
Sam Size	Average Coverage (Baselines) / Annual Coverage Target (Monitoring and Evaluation)																	
	%*	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
12	/A	N/A	1	1	2	2	3	4	5	5	6	7	7	8	8	9	10	11
13	/A	N/A	1	1	2	3	3	4	5	6	6	7	8	8	9	10	11	11
14	/A	N/A	1	1	2	3	4	4	5	6	7	8	8	9	10	11	11	12
15	/A	N/A	1	2	2	3	4	5	6	6	7	8	9	10	10	11	12	13
16	/A	N/A	1	2	2	3	4	5	6	7	8	9	9	10	11	12	13	14
17	/A	N/A	1	2	2	3	4	5	6	7	8	9	10	11	12	13	14	15
18	/A	N/A	1	2	2	3	5	6	7	8	9	10	11	11	12	13	14	16
19	/A	N/A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
20	/A	N/A	1	2	3	4	5	6	7	8	9	11	12	13	14	15	16	17
21	/A	N/A	1	2	3	4	5	6	8	9	10	11	12	13	14	16	17	18
22	/A	N/A	1	2	3	4	5	7	8	9	10	12	13	14	15	16	18	19
23	/A	N/A	1	2	3	4	6	7	8	10	11	12	13	14	16	17	18	20
24	/A	N/A	1	2	3	4	6	7	9	10	11	13	14	15	16	18	19	21
25	/A	1	2	2	4	5	6	8	9	10	12	13	14	16	17	18	20	21
26	/A	1	2	3	4	5	6	8	9	11	12	14	15	16	18	19	21	22
27	/A	1	2	3	4	5	7	8	10	11	13	14	15	17	18	20	21	23
28	/A	1	2	3	4	5	7	8	10	12	13	15	16	18	19	21	22	24
29	N/A	1	2	3	4	5	7	9	10	12	13	15	17	18	20	21	23	25
30	N/A	1	2	3	4	5	7	9	11	12	14	16	17	19	20	22	24	26

N/A: *Not Applicable*, meaning LQAS can not be used in this assessment because the coverage is either too low or too high to assess an SA. This table assumes the lower threshold is 30 percentage points below the upper threshold.

: light-shaded cells indicate where *alpha* or *beta* errors are greater than or equal to 10%.

: dark-shaded cells indicate where *alpha* or *beta* errors are greater than15%.

Apendix 2: Questionnaire For Salt Traders

UNIVERSITY FOR DEVELOPMENT STUDIES, TAMALE

THE GRADUATE SCHOOL

THE DEPARTMENT OF PUBLIC HEALTH, SCHOOL OF ALLIED HEALTH SCIENCES

TOPIC: Assessing The Universal Salt Iodization Program Among Salt Producers And Trader In Ten Salt Producing Districts In Ghana

QUESTIONNAIRE FOR SALT TRADERS

Principal investigator: Abdul-Kahad Amadu

Contact: 0244885577/027530080

Informed Consent

Hello. My name is……. I am working for Mr. Abdul-Kahad Amadu, a master's student at the University for Development Studies. He is conducting a survey on universal salt iodization in salt producing. This is in partial fulfillment of the requirement for the award of master's degree in Community Health and Development. You have been selected to take part in the study by responding to some questions which will take about 30 minutes to of your time.

Any information you will give will be treated confidential and will not be shared with anyone else except members of the survey team. All information given will only be used for the purpose of this study and nothing else.

Your participation in the study is purely voluntary and so you are at liberty to opt out. We would however be grateful if you agree to participate since your views are important to the researcher and for the success of the study.

I certify that the purpose of this study has been read/explained to me and my participation is based on my own voluntary decision to be part of the study as a respondent.

Signature /thumbprint of respondent……. Date……..

SECTION A: IDENTIFICATION

A1. Date of interview ____/ ____/2016 A2. Questionnaire ID ……..

A3. Interviewer's name: ……. A4. District Name ……

SECTION B: SOCIODEMOGRAPHIC CHARACTERISTICS

1. Age of respondant……(years)
   a. 15-25
   b. 25-35
   c. 35-45
   d. 45-55
   e. Above 55 years
2. What is your religion?
   a. Christian
   b. Islam
   c. Others (specify):
3. Marital status
   a. Single
   b. Married
   c. Cohabitating
4. What level did you stop schooling?
   a. None
   b. Primary
   c. Middle/JHS
   d. SHS/Vocational training
   e. Tertiary
   f. Others (specify)

SECTION C: UNIVERSAL SALT IODIZATION

1) What type of salt do you sell?
a) Coarse salt
b) Refined powdered salt
c) Both

2) Which type of salt is mostly patronized by consumers?
a) Coarse salt
b) Refined powdered salt

3) Check whether salt is displayed correctly
a) Yes (covered or tired in plastic bags)
b) No (not covered and exposed)

4) Can I have some of the salt you are selling for testing?
a) 0ppm
b) Less than 15ppm
c) Above 15 ppm

5) Have you ever heard of iodised salt
a) Yes
b) No

6) If YES where did you hear about it?
a) Radio
b) TV
c) Health facilities
d) Mobile Van
e) Market place
f) Others

7) Do you think iodised salt is good?
a) Yes
b) No

8) If NO why?
9) What are the benefits of consuming iodised salt?
a) Prevention of goiter
b) Improves intelligence/school performance
c) Improves pregnancy outcomes
d) Improves child growth
e) Improves brain development
f) Prevent goiter
g) Others

10) Have you ever heard any bad news about consuming iodised salt?
a) Yes
b) No

11) If Yes What did you hear?

12) Have any of the following people ever interacted with you on iodised salt?
a) Health Worker
b) Environmental health officers
c) Friends or family members
d) Market queens

13) Do you know that selling un-iodised salt for human consumption is unlawful?
a) Yes
b) No

14) What do you think can be done to ensure that all salt for consumption is iodised?

Appendix 3: Semi-Structured Interview Guide For Salt Producers

UNIVERSITY FOR DEVELOPMENT STUDIES, TAMALE

THE GRADUATE SCHOOL

THE DEPARTMENT OF PUBLIC HEALTH, SCHOOL OF ALLIED HEALTH SCIENCES

TOPIC: Assessing The Universal Salt Iodization Program Among Salt Producers And Trader In Ten Salt Producing Districts In Ghana

SEMI STRUCTURED INTERVIEW GUIDE FOR SALT PRODUCERS

Principal investigator: Abdul-Kahad Amadu

Contact: 0244885577/027530080

Informed Consent

Hello. My name is……. I am working for Mr. Abdul-Kahad Amadu, a master's student at the University for Development Studies. He is conducting a survey on universal salt iodization in salt producing. This is in partial fulfillment of the requirement for the award of master's degree in Community Health and Development. You have been selected to take part in the study by responding to some questions which will take about 30 minutes to of your time.

Any information you will give will be treated confidential and will not be shared with anyone else except members of the survey team. All information given will only be used for the purpose of this study and nothing else.

Your participation in the study is purely voluntary and so you are at liberty to opt out. We would however be grateful if you agree to participate since your views are important to the researcher and for the success of the study.

I certify that the purpose of this study has been read/explained to me and my participation is based on my own voluntary decision to be part of the study as a respondent.

Signature /thumbprint of respondent……. Date……..

SECTION A: IDENTIFICATION

A1. Date of interview ____/ ____/2016 A2. Questionnaire ID ……..

A3. Interviewer's name: ……. A4. District Name ……

SECTION B: SOCIODEMOGRAPHIC CHARACTERISTICS

5. Age of respondant……(years)
   f. 15-25
   g. 25-35
   h. 35-45
   i. 45-55
   j. Above 55 years
6. What is your religion?
   d. Christian
   e. Islam
   f. Others (specify):
7. Marital status
   d. Single
   e. Married
   f. Cohabitating
8. What level did you stop schooling?
   a. None
   b. Primary
   c. Middle/JHS
   d. SHS/Vocational training
   e. Tertiary
   f. Others (specify)

SECTION C: UNIVERSAL SALT IODIZATION

1. Can you describe to me how you mine your salt?

Record notes in field notebook

2. Do you do iodization of your salt?
   b) Yes
   c) No
3. If NO WHY?

Record notes in field notebook

4. If YES can you describe to me how you do iodisation?

5. What type of salt do you sell or produce?
    a. Coarse salt
    b. Refined powdered salt
    c. Both

6. Which type of salt is mostly patronized by CUSTOMERS?
    a. Coarse salt
    b. Refined powdered salt

7. Check whether salt is displayed correctly
    a. Yes (covered or tired in plastic bags)
    b. No (not covered and exposed)

8. Can I have some of the salt you are selling for testing?
    a. 0ppm
    b. Less than 15ppm
    c. Above 15 ppm

9. Have you ever heard of iodised salt
    a. Yes
    b. No

10. If YES where did you hear about it?
    a. Radio
    b. TV
    c. Health facilities
    d. Mobile Van
    e. Market place
    f. Others

11. Do you think iodised salt is good?
    a. Yes
    b. No

12. If NO why?

13. What are the benefits of consuming iodised salt?
    a. Prevention of goiter
    b. Improves intelligence/school performance
    c. Improves pregnancy outcomes
    d. Improves child growth
    e. Improves brain development
    f. Prevent goiter
    g. Others

14. Have you ever heard any bad news about consuming iodised salt?
    a. Yes
    b. No

15. If Yes What did you hear?

16. Have any of the following people ever interacted with you on iodised salt?
    a. Health Worker
    b. Environmental health officers
    c. FDA Officer
    d. GSA Officer
    e. Friends or family members
    f. Market queens

17. Do you know that selling un-iodised salt for human consumption is unlawful?
    a. Yes
    b. No

18. What do you think can be done to ensure that all salt for consumption is iodised?