UNIVERSITY OF KWAZULU-NATAL

OCULAR HEALTH OF COCOA FARMERS IN GHANA: AN ASSESSMENT AND INTERVENTION STUDY

Submitted in fulfilment for the degree of **DOCTOR OF PHILOSOPHY (Health Sciences- Optometry)** in the College of Health Sciences (Westville Campus) at the University of KwaZulu-Natal, Durban, South Africa.

SAMUEL BERT BOADI - KUSI

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By

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Submitted in fulfilment for the degree of **DOCTOR OF PHILOSOPHY (Health Sciences- Optometry)** in the College of Health Sciences (Westville Campus) at the University of KwaZulu-Natal, Durban, South Africa.

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DISCIPLINE OF OPTOMETRY, COLLEGE OF HEALTH SCIENCES

PhD IN CLINICAL, ENVIRONMENTAL AND OCCUPATIONAL OPTOMETRY

2014

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I, Samuel Bert Boadi-Kusi, hereby declare that the dissertation entitled **"Ocular health of cocoa farmers in Ghana: an assessment and intervention study"** is a result of my own investigation and research and that this work has not been submitted in part or in full for any other degree or to any other university. Where use was made of the work of others, the work used is duly acknowledged in the text.

Student: Samuel Bert Boadi-Kusi Signature:________________________

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Co-Supervisor: KP Mashige Signature:_________________________

DEDICATION

To my wife and children

ABSTRACT

Background: Cocoa farmers are known to face a lot of ocular health hazards such as chemicals, ultraviolet radiations, farm equipment, plants, dust and allergens among others in the field of work. This study sought to examine and understand the factors that affect the ocular health of cocoa farmers in Ghana in order to improve their knowledge and awareness on ocular health and safety practices through a training intervention.

Methods: The study employed two quantitative approaches: a cross-sectional survey and a quasi- experimental pre-post-test study design. The cross-sectional study involved administration of a questionnaire and conducting a comprehensive eye examination among participants, while the pre-post-test study used a structured questionnaire to gather baseline knowledge and post training knowledge on ocular health and safety practices among the participants to establish a change. A multistage random sampling approach was used to select participants from four cocoa growing districts of Ghana.

Results: Five hundred and fifty-six, out of the 576, who were recruited for the first phase of the study, met the inclusion criteria, giving an eligibility rate of 96.5%. The participants consisted of 359 (64.6%) males and 197 (35.4%) females with a mean age of 54.9 years (± 11.2). Educational attainment among the participants was low, with 142 (25.5%) having had no formal education. Participants spent an average of 33.3 (±13.4) hours per week on the farm, with

males spending more time 35.3 (±13.9) than females 29.6 (± 11.8) ($p<0.001$) and also spent more hours on the farm than females ($p<0.001$).

Participants reported poor distance and near vision, itching/redness, pain and tearing as major complaints. Anterior eye conditions recorded included pterygium 23.7% (CI: 20.3-27.5), allergic conjunctivitis 9.7% (CI: 7.4 - 12.5) and corneal scar/opacity 6.1% (CI: 4.3 - 8.4). Other conditions included cataract 25.5% (CI: 22.0-29.3), glaucoma 15.8 (CI: 12.9 - 19.1) and macular disorders 4.9% (CI: 3.2 - 7.0). Posterior segment conditions and uncorrected refractive errors (67.6%) were the major causes of moderate and severe visual impairment (MSVI) (16.7%) and legal blindness (4.9%) among the population studied. Presbyopia was present in 83.1% (CI: 79.7 - 86.1) of the participants.

The rate of ocular injuries was 143/12 854.5 worker years or 11.3/1 000 worker years (95% CI: 9.4 - 31.0), which led to a lost work time injuries of 137 injuries/ 12 854.5 worker years or 37.3/1000 worker years (95% CI: 34.1- 40.8) and were predominantly in males. Blunt injuries from plants/branches and chemical injuries were mostly reported. Only 34 (6.1%) reported using ocular protection. Barriers to use of ocular protection included non availability of the equipment, lack of funds and ignorance or lack of training. More than half of the participants (52.4%) had never seen an eye care practitioner, while 25% reported seeking eye care within the last one year preceding the study. Those who were registered with the National Health Insurance Scheme were more likely to attend

a hospital/clinic for eye care services (OR = 3.93, 1.40 - 11.06, p = 0.009). Barriers to utilization of eye facilities included lack of funds, long distance to facility and long waiting time at eye facilities.

Two hundred participants enrolled for the quasi-experimented pre-post-tested study, and had varied opinions on ocular health and safety practices on the farm. They demonstrated a good knowledge on the ocular hazards they face at work, although most were unaware of the effect of some of the hazards on the eye. Farmers also had a poor knowledge on ocular protection but a fair knowledge on first aid for ocular emergencies. Participants improved their knowledge scores (overall 40 points) on ocular health and safety practices from a pre- median score of 172 (IQR: 164 - 177.5) to 212 (IQR: 206 - 219.5) following the pre- and post-evaluation of the training intervention.

Conclusions: Eye disorders are prevalent among cocoa farmers in Ghana. Farmers are engaged in improper ocular health and safety practices on the farm. They also make insufficient use of appropriate protective eye devices and health services. The study demonstrated that, with an ocular health intervention, cocoa farmers can improve on their knowledge and awareness level on ocular health and safety practices which may be of benefit to the farmer, employers and the national economy.

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
AfDB	African Development Bank
BCVA	Best Corrected Visual Acuity
BoG	Bank of Ghana
CBPM	Community-Based Prevention Marketing
CBPR	Community-Based Participatory Research
CDC	Centre for Disease Control
ChE	Cholinesterase
CHWs	Community Health Workers
COCOBOD	Cocoa Board
CRIG	Cocoa Research Institute of Ghana
CTD	Cumulative Trauma Disorder
ENWHP	European Network for Workplace Health Promotion
FAO	Food and Agricultural Organization
GDP	Gross Domestic Product
GoG	Government of Ghana
GSS	Ghana Statistical Service
ICCO	International Cocoa Conference Organization
ILO	International Labour Organization
LHPs	Lay Health Promoters
MOFA	Ministry of Food and Agriculture
MSVI	Moderate to Severe Visual Impairment
NHIS	National Health Insurance Scheme
OECD	Organization for Economic Cooperation and Development
OHS	Occupational Health and Safety
OP	Organophosphorous
OSH	Occupational Safety and Health
PEW	Protective Eye Wear
PPE	Personal Protective Equipment

PVC	Polyvinyl chloride
SMEs	Small Scale Enterprises
SVI	Severe Visual Impairment
SRID	Scientific Research and Information Directorate
UNDP	United Nation Development Programme
UNECA	United Nations Economic Commission for Africa
UVA	Ultraviolet A rays
UVB	Ultraviolet B rays
UVC	Ultraviolet C rays
UVR	Ultraviolet Radiation
UVV	Ultraviolet V rays
VA	Visual Acuity
WHA	World Health Assembly
WHO	World Health Organization
WHP	Workplace Health Practice

CHAPTER 1: INTRODUCTION

1.1 Introduction

The ocular health of a working population is affected by their work environment and it can influence the level of productivity at the workplace. Farmers are known to face many ocular health hazards in the field of work, which predisposes them to numerous eye symptoms, diseases and injuries. In spite of these ocular hazards, they are known to underutilize protective eye wear and to make insufficient use of ocular health services. While the cocoa production industry employs approximately 800 000 farmers in Ghana, and contributes an average of USD 1.9 billion annually to the Ghanaian economy (3.4% of the gross domestic product), their ocular conditions have not been documented. Similarly, little is known about the factors that influence the occurrence of ocular injuries and the ocular safety practices adopted on cocoa farms, the ocular health seeking behaviour and barriers to seeking eyecare, as well as the knowledge, perceptions and risk beliefs on eye health and safety among these farmers.

The role of eye care professionals, particularly optometrists engaged in environmental and occupational studies in documenting this information is crucial for public health and advocacy purposes. This research study was therefore conducted to document these issues through a cross sectional survey. The study also sought to increase the knowledge and awareness of participants on the factors mentioned above through an ocular health education (intervention) and to document any change in knowledge score following the training intervention.

1.2 Background to the study

In several parts of the world, agricultural injuries have been estimated to be higher than in other industries (Verma et al, 2011; McCall et al, 2009). Impairment from injuries limits a farmer's ability to perform specific tasks which leads to loss of productivity (Myers et al, 2009). Agricultural injury is defined as unintentional physical injury or poisoning which occurs during an agricultural activity and requires medical attention or results in at least one-half day of restricted activities (Chen et al, 2007; McGwin et al, 2000; Lyman, et al, 1999). The numerous dangers inherent in agriculture; falls, burns, poisonings, machinery and environmental hazards, renders agriculture as one of the industries with the highest rates of fatal injury (Maltais, 2007).

Several factors influence the occurrence of injury on farms, including seasonal time pressure, an inadequate workforce, stress from unpredictable weather conditions and rural urban competition for farmland. Agricultural hazards in developing countries differ from those in industrialized countries due to the high involvement of manual labour (Shashikala et al, 2013; McCall et al, 2009). Although the limited agricultural mechanization in developing countries may seem to reduce the risk of injuries, high injury rates exist among farmers (Shen et al, 2013).

Occupational eye injury may be defined as any damage occurring to the eye and/or adnexa that occur in the workplace, and require medical attention or results in loss work time or restricted activities (Thompson and Mollan, 2009; Chen et al, 2007; MucCurdy and Carroll, 2000; McGwin et al, 2000; Lyman et al, 1999). Farm workers have been reported to experience ocular injuries and illnesses due to exposure to several environmental and harsh working conditions (Verma et al, 2011; Lacey et al, 2007). For example, the rate of eye injuries among agricultural workers have been reported to be 8.7/10,000 workers compared to the general workplace of 3.8/10,000 workers in the United States (Quandt et al, 2012). Similarly, in another study conducted in the United States, 3.3% of eye injuries were reported to have lead to lost work hours among farmers in 1995 (NIOSH, 1995). This presents a motivation to occupational health and the eye care professional to find solutions to reduce or eliminate ocular injuries in agriculture.

Farm workers are mainly engaged in manual labour in the fields, and risk eye diseases and injuries from several hazardous elements in the physical farm environment (Quandt et al, 2012), which include chemicals such as pesticides, growth enhancers and fertilizers; farm tools; and machines (Quandt et al, 2008). Other harmful elements to eye health on farms includes ultraviolet radiations, airborne soil and particulates, dust, pollen, plant components and unstable intensity of humidity, all of which may lead to several diseases and injury of the eye (Quandt et al, 2008). Equally, insufficient education and training, poor safety precautions, geographical and cultural segregation could increase the risk for work-related ocular injuries and illnesses among farm workers (Liebman and Augustave, 2010). Furthermore, farm workers are known to have difficulties in accessing health care as a result of their inability to purchase health insurance due to its high cost (Quandt et al, 2012; Liebman and Augustave, 2010). In spite of the intrinsic risk of farm work, and farmworkers' vulnerability to ocular hazards, policies on safety and health, and labour edicts for agriculture offer minimal security compared to other industrial workers (Liebman and Augustave, 2010).

Several studies have highlighted the varied causes and rates of eye injury among farm workers. A study among migrant farm workers in North Carolina by Quandt et al (2012) reported 5.6% ocular injuries that resulted in loss work time. According to the study, penetrating or open wounds injuries, resulting from branches and foreign objects, were mainly reported by the farmers. Other causes of ocular injuries in the study were chemicals, pesticides, farm machinery and stones. These injuries were not reported to the employer and even if treatment was sought at the clinics, it was done late. Late reports of injury cases to the clinics remains a major challenge that needs to be addressed, as in most cases vision could be restored or impairment avoided/reduced if medical attention was sought promptly after injury. The reported incidence rate of lost work-time injuries of 23.8/10 000 worker years (95% CI = I7.5-55.9) due to ocular injuries exceeded the 2009 national incidence rate (6.9/10 000) worker years in the United States, making eye injury in agriculture a major health challenge.

Sprince et al (2008), also reported a crude prevalence of 8.4% ocular injury among a group of Iowa farmers. In this group of farmers, foreign body in the eye (80%, n = 32) was the major cause of injury mostly from metallic objects. Other causes, such as grinding or cutting metal, accounted for 27.5% (n = 11), welding accounted for 7.5% (n = 3) and drilling for 5.0% (n = 2) of eye injuries. Injuries from chemical and other activities resulted in farmers losing 1 to 5 days of work.

Furthermore, Islam et al (2000), reported that compensable work-related eye injuries among agricultural workers was the highest for all the industrial sector in West Virginia, while Cooper et al (2006) reported chemical injuries among migrant farm workers in Texas. In a case control study to determine the effectiveness of preventing eye injury using ocular protection, Chatterjee et al (2012) reported 0.73% (n = 4) and 11.3% (n = 61) ocular injuries in control and case groups respectively in India. Corneal ulcer due to ocular injury was a major challenge in this group. These research studies have highlighted the numerous ocular health challenges farmers face in undertaking their tasks on the farm.

Within Africa, studies have stated that 65% of all ocular injuries reported to the Grarbet Hospital in Ethiopia between 2009-2010 were farm or agricultural related (Addisu, 2011). A recent baseline report by Muilerman (2013) indicates that about 81% of cocoa farmers surveyed in Ghana reported some form of eye injury and irritation. However, combining both eye injuries and eye irritations, which is a symptom, creates a distortion as to the contribution of each to the reported prevalence although the report recommends further studies in this area, particularly as regards chemical use. A retrospective study of reported cases of eye injuries to a hospital in the Upper East Region of Ghana revealed a figure of 19.6% for farm related eye injury (Gyasi et al, 2007) compared to the 65% reported by Addisu (2011) in Ethiopia. All the injuries reported in the above studies had varied causes, such as chemicals, branches, projectiles, foreign bodies, metallic substances, grinding, hand tools, machinery, projectiles, stones and sand, and in some cases, insects were reported as causes (Muilerman, 2013; Quandt et al, 2012; Verma et al, 2011; Addisu, 2011; Verma, 2010, Sprince et al 2008; Quandt et al, 2008).

Several studies have been conducted on the ocular health among agricultural workers in developed countries and several training modules on eye health for agricultural workers do exist (Quandt et al, 2012, Monaghan et al, 2011; Marin et al, 2009; Quandt et al, 2008, Sprince et al, 2008; Luque et al, 2007; Forst et al, 2004). These studies also documented eye symptoms such as itching, pain, eye irritations, poor vision and redness among farm workers. Although eye symptoms are mostly reported, only few eye disease conditions such as conjunctivitis, pterygium and corneal ulcers or abrasions have been reported (Chatterjee et al, 2012; Quandt et al, 2008). Work-related eye diseases and other eye diseases that afflict these workers in general remain largely unreported as the focus has been on eye injury within the literature. A possible reason for this is that these studies are mostly based on self-reports from farmers or hospital records from health clinics that do not necessarily focus on eye care.

Population based studies among farmers that combines self reports of ocular symptoms through surveys and a clinical assessment are limited in the literature. For example, although farm workers frequently report poor vision, Verma et al (2011) asserts that studies that document refractive errors and visual impairment among farmers are scarce. No single study has completely covered issues on eye injuries and safety practices, eye diseases, visual impairment, refractive errors and the perceptions, risk behaviour and health seeking behaviour of a single farming population. Most of the studies focused on specific aspects of the ocular health among farmers due to the apparent broad nature of issues that tend to affect the ocular health (Quandt et al; 2012, Verma et al, 2011; Sprince et al, 2008; Forst et al, 2006).

In Africa, information on eye diseases, visual impairment and refractive errors, the perceptions and risk behaviour, as well as, the health seeking behaviour of farming populations are limited and in some countries, does not exist. A few studies have reported high levels of eye injuries and irritation among farmers (Muilerman, 2013, Addisu, 2011; Gyasi et al, 2007; Anim-Kwapong and Frimpong, 2004). However, Isar et al (1982), reported a low prevalence of ocular injuries (1.5%) among farmers in Malawi. In some instances, these reports lack a clear definition for ocular injury or they do not conform to international standards and eye disease conditions are mostly not reported. Similarly, information on the use of ocular protective equipment is limited in the literature on African farmers. Where they are available, factors that influence the use of such devices are not clearly understood in the literature among agricultural workers in an African population.

Although occupational health services form part of the healthcare system in most developing countries, there are no structured occupational health services rendered to take care of the needs of specific working populations. In Ghana, these services are mostly provided by multinational companies for their workers (Amponsah-Tawiah and Dartey-Baah, 2011), leaving individuals who suffer occupational health challenges to the general health care system, where specialized occupational health services are virtually non-existent.

Similarly, while several training modules on eye health exist in developed economies, no single training module or eye care training manual has been developed for agricultural workers within an African population. There are, however, training modules for agricultural farmers that concentrate on the general health and safety among agricultural workers (with particular emphasis on chemical use that usually lacks details on eye health). This underpins the need to develop a training manual that concentrates on ensuring eye health and safety among agricultural workers who are known to face many ocular hazards in the field of work in an African context.

The World Health Organization (WHO) and its occupational health partners recommend that all workers should have access to occupational health services to meet their health needs (Rantanen, 1994). This is particularly important due to the important role that workers play in developing the economies of nations, necessitating governments to protect and ensure the physical, mental and social wellbeing of their workers. This includes the ocular health of these workers, as the provision of effective eye health measures contribute to a healthy and secure place of work which enhances the general output of workers (COA, 2012; Pitts and Kleinstein, 1993).

The eye, a sense organ for sight, is essential for task performance among workers. It is therefore important that workers maintain good ocular health at all times, as any level of impairment due to injury or disease poses a challenge to task performance. However, the eye care needs of farm workers are often not met, especially in developing countries, where there may be inadequate eye care facilities and services (Trabelsi, 2006). This highlights the need for a concerted effort to assess the ocular health status of workers to help guide and design interventions that may be required (Naidoo et al, 2011; Allingham, 2008).

While acknowledging that there is potential for eye injury and predisposition to ocular diseases in many occupations, authors have reported that agricultural workers are at greater risk of injury (Jawa et al, 2013; Verma, 2010; Quandt et al, 2001). For example, in 1980, agriculture had a fatality rate of 61 per 100

000 workers compared to 13 per 100 000 workers for all other occupations combined in the United States (Simpson, 1984). In spite of improvements in occupational safety and health over three decades, in 2010, the fatality rate for agriculture was still high, at 27.9 per 100 000 compared with 3.6 workers for all other industries in the USA (BLS, 2012). While other industries, such as mining and construction, have made progress in injury prevention, agriculture holds one of the highest occupational fatality rates (Jawa et al, 2013), making agricultural work one of the most hazardous careers for eye health (Quandt et al, 2012; Liebman and Augustave, 2010; Forst et al, 2006). Notwithstanding this knowledge, there has been very little detailed documentation on the ocular health of these workers in many countries, including Ghana, although the economy of Ghana has depended largely on agriculture for many years (Tutu, 2011).

With the limited number of eye care professionals in Ghana (Ilechie et al, 2013), a concerted effort by eye care professionals, principally by the optometrist who focuses on primary eye care, is needed to document the ocular health of identified groups such as farmers (Naidoo et al, 2011). Information gathered could serve as a source of knowledge in designing interventions and policies to promote eye health among such groups of workers.

1.2.1. Overview of Ghana's Agriculture Sector

Ghana is situated at the west coast of Africa with a population of approximately 24.6 million (GSS, 2010). There are ten administrative regions with a total land area of 238 533 km^2 of which about 57% are agricultural lands (Quaye et al, 2010). There are six agro-ecological demarcations based on climatic conditions and soil type: the High Rain Forest, Deciduous Forest, Transitional Zone, Coastal Savanna, Guinea Savanna and Sudan Savanna (MOFA/SRID, 2011; Sagoe, 2006). Between August and September, the average annual temperature in the country ranges from 26–29^{o}C, while it ranges from 31–33^{o}C between February and March. It has an average annual rainfall range of 800 mm to 2,200 mm in the Coastal Savannah and in the Rain Forest region, (Quaye et al, 2010; FAO, 2005) which is conducive for cocoa production. Within the Sudan and Guinea Savannah Zones, the rainfall pattern is uni-modal, while it is bi-modal in all the other zones (FAO, 2005; MOFA, 2003).

Agriculture is one of the main economic activities in the country and is the backbone of the Ghanaian economy (Quiñones et al, 2011; McKay and Aryeetey, 2004). It contributes to the socioeconomic growth of the country by ensuring food security and providing raw materials for local businesses. Agriculture also generates foreign exchange and provides work and income for many people, particularly those in the rural areas, which promotes economic growth and subsequently leads to poverty reduction (Quiñones and Diao, 2011; Quiñones et al, 2011; Breisinger et al, 2008). Available statistics indicate that more than half (55.8%) of the labour force of the working-age group of about 12.26 million in Ghana are employed in the agricultural sector (GSS, 2010; Otoo et al, 2009). This sector is mainly rural and informal. It provides jobs for about three quarters (75.3%) of the rural workforce, as well as, for about one-fifth of people in the urban areas (Anang, 2011; Otoo et al, 2009).

The main agricultural exports of the country are cocoa, timber, horticultural products, fish and sea foods, game and wildlife (MOFA/SRID, 2011). Agriculture has been the leading Gross Domestic Product (GDP) contributor to the country for decades, contributing over 55% of GDP until recently when it was overtaken by the services sector with 50.2%, and the manufacturing sector (industry) with 25.9%, while agriculture declined to 25.6.3% (GSS, 2012). Within the agricultural sector, crops and cocoa farming stands as the main sub-sectors, while crops like sorghum, millet, rice, maize, cassava, yam, cocoyam and plantain are primarily used as staple food. Cocoa is mainly exported and is the country's major foreign exchange earner. The Bank of Ghana reports that Ghana's cocoa sub-sector accounted for over 9% of agricultural GDP, which contributed about USD 1.9 billion to the Ghanaian economy and represented nearly 21% of total merchandise exports in 2010 (AfDB, OECD, UNDP & UNECA, 2012; MOFA/SRID, 2011; BoG, 2011, World Bank, 2011). Currently, Ghana is second in global cocoa production (World Bank, 2011) and as a result, the cocoa sector employs a large percentage of the Ghanaian population, especially in rural areas (Breisinger et al, 2008).

1.2.2. Cocoa production in Ghana

Cocoa cultivation in Ghana can be traced to the early 19th century when the Dutch missionaries came to the Gold Coast. It is reported that they were the first to plant cocoa in the coastal areas of Ghana in 1815, and the Basel missionaries planted cocoa at Aburi in 1857 (COCOBOD, 2002). However, commercial cocoa growing in Ghana did not start until Tetteh Quarshie, a native of Osu in Accra, who had travelled to Fernando Po and worked there as a blacksmith, returned with Amelonado cocoa pods in 1879. He established a farm at Akwuapim Mampong, from where farmers' purchased pods to plant, and resulted in the spread of cocoa cultivation to other parts of the country (Adjinah and Opoku, 2010; Anim-Kwapong and Frimpong, 2004; Grossman-Greene and Bayer, 2009). Since its introduction, trade in cocoa beans has been a major foreign exchange earners for Ghana's economy.

Cocoa is an annual crop, with its production year starting in October and ending in September in Ghana. Cocoa fields usually have an economic life of approximately 25-30 years and it is mostly grown under extensive management system by smallholders (Grossman-Greene and Bayer, 2009). Ghana is second to her neighbouring country, Cote D'Ivoire, in the global production of cocoa (Anang, 2011; Vigneri, 2007; Vigneri and Santos, 2007) contributing an average of 21 percent of global production of about 3.9 million metric tonnes (World Bank, 2011).

Cocoa is Ghana's most important crop and dominates the agricultural sector, providing employment for more than 800,000 smallholder farm households and others industries engaged in related activities such as transportation and processing (World Bank, 2011; Asuming-Brempong et al, 2006). Cocoa farms are usually small in size, ranging from 0.4 to 4.0 hectares with an approximate overall farm land area of almost 1.45 million hectares (Anim-Kwapong and

Frimpong, 2004, COCOBOD, 2002). It provides employment for about 50 percent of the agricultural work force and is the major source of income and livelihood for workers in the rural areas (Anang, 2011; Asuming-Brempong et al, 2006; Seini, 2002).

The cocoa industry remains the biggest sector in Ghanaian agriculture and plays a vital role in the Ghanaian economy (Tutu, 2011; Dormon et al, 2004), contributing greatly to Ghana’s foreign exchange earnings. It provides approximately 70-100 per cent of the annual income of cocoa farmers as well as for stakeholders such as licensed cocoa buyers (LCB's) (Asamoah and Baah, 2003). Therefore, any negative factors that affect the general and ocular health of this workforce will adversely affect the production of cocoa in Ghana.

Cocoa production increased from 395 000 metric tonnes in 2000 to 740 000 metric tonnes in 2005, with a corresponding rise in agricultural GDP from 13.7% in 2000 - 2004 to 18.9% in 2005 - 2006 (Breisinger et al, 2008). Cocoa production increased by 14% in 2009/10 due to an increase in cocoa production from 640, 000 metric tonnes to 1 million metric tons, and by 5.4% in 2011 (GSS, 2012, AfDB, OECD, UNDP & UNECA, 2012; GCB, 2011; MOFEP, 2011). Although various government ministries have put measures in place to ensure high cocoa production to boost Ghana’s economy, very little has been done to assess the visual needs of these workers. This is evident in the fact that there is no single eye health policy that targets these workers.

1.2.3. Reasons for the high prevalence of eye conditions among farmers

Agricultural workers suffer more from eye disorders compared to other industrial workers due to the hazardous elements in the environment within which they work and in some instances, due to poor or no use of ocular protection (Verma et al, 2011; Verma, 2010; Taylor et al, 2006a). Environmental conditions that predispose farmers to ocular disorders may include airborne soil particles that result from farming practices, as well as, allergens such as pollen, which has the potential to cause an allergic response or abrasions to the eyes (Lacey et al, 2007; Brison and Pickett, 1991). Other ocular disorders, such as irritation, could also arise due to exposure during mixing, loading and applying pesticides, as well as, due to pesticide residue on plants (Lacey et al, 2007). There is also an opportunity for continuous exposure to pesticides for farmers who usually live in houses located near the farms or on farms sprayed with pesticides (Quandt et al, 2004; Lucas and Gilles, 2003).

Farmers also spend a considerable number of hours working in the sun, thereby exposing themselves to extreme ultraviolet radiations which have implications for ocular health (Quandt et al, 2008; Threlfall and English, 1999). For example, eye irritation and eye sensitivity have been associated with short-term exposure to intense ultraviolet light, while conditions such as cataract, retinal damage, and development of pterygium have been associated with long term exposure (Carson, 2009; Taylor et al, 2006a). Foreign bodies invading the eye due to the use of old equipment or trauma from these tools could cause corneal abrasions or injuries which could impair the vision of farmers. Abrasions to the eye could also be caused by pricks from thorns, stalks, vines, and bushes (Verma, 2010; Quandt et al, 2008, Lacey et al, 2007). Furthermore, the prevalence of eye abrasions may be high among farmers due to the failure to use ocular protection (Verma, 2010).

1.2.4. Cocoa farming and risk factors for eye conditions

Land preparation for cocoa production normally starts with clearing of weeds, cutting down trees, drying and burning of the bushes, as well as, removal of remains of trees after burning. These strenuous activities have the potential to cause eye injuries and are mostly undertaken by men (Asuming-Brempong et al, 2006). Cocoa beans are planted directly or as seedlings after preparation of the land. Weeding of the farm is normally carried out about three times in a year when the plants are still young and insecticides are sprayed (could be harmful to the eye if appropriate protection is not worn) about four times per year to manage pest and diseases that affect the plants. Occasionally, the plants are pruned to allow for proper growth and movement within the farm. Harvesting (plucking) of cocoa beans is carried out when pods mature, usually with a harvesting hook and the beans prepared for sale (Asuming-Brempong et al, 2006). These activities predispose cocoa farmers to several occupational diseases and injuries, highlighting the need for occupational vision and ocular health assessment for such farmers in Ghana. Other vision related diseases and injuries among cocoa farmers may result from infections, contact with vector and parasites, the use and exposure to organophosphate and carbamate insecticides and pesticides, as well as, accidental injuries. Poorly maintained equipment, improper use of farm machinery and tools, failure to understand and observe safety instructions and poor supervision are key factors which may result in accidents which could affect the eye (Lucas and Gilles, 2003).

Cocoa farmers are also at risk of traumatic eye injuries caused by plants that may result in fungal keratitis, while other infections may also lead to various forms of anterior segment eye diseases such as conjunctivitis (Kanski, 2009; Carson, 2009). According to Wood and Lass (1985) cocoa is best cultivated under temperatures ranging between 30-32^{o}C mean maximum and 18-21^{o}C mean minimum and absolute minimum of 10^{o}C. Exposure to ultraviolet radiation by virtue of the nature of the work of cocoa farmers may lead to the development of several eye conditions (Carson, 2009; Quandt et al, 2001). Such diseases and injuries contribute to a loss in productivity as workers spend time seeking care either through orthodox or modern methods of health care.

While some of the cocoa farming related ocular problems may be addressed in instructions to farmers by agricultural extension officers as part of general trainings, there are a number that go unmentioned and probably undetected because there is no comprehensive system for identifying and educating farmers on eye care in Ghana. Furthermore, the nature and responses to such diseases may be related to socio-economic, cultural and environmental conditions in which farmers work and live (Lucas and Gilles, 2003). These factors may also affect their ocular health seeking behaviour. It is therefore important to study some of these inter-relationships which affect the visual status of cocoa farmers.

1.3 Problem Statement

There is little documentation on the eye health of agricultural workers including cocoa farmers in Ghana. The few studies that have been conducted, reported broad perspectives on eye irritations, undefined eye injuries and use of personal protective equipment; and often have been part of some general studies (Muilerman, 2013, Gyasi et al, 2007; Anim-Kwapong and Frimpong, 2004). Unlike in developed economies where some data exists on the subject matter, studies on farmers in Ghana, has been limited in scope, and therefore provide little evidence on the nature and extent of visual problems faced by farmers. As a result, the magnitude and characteristics of eye diseases, eye injuries, ocular safety practices, ocular health seeking behaviour, as well as, the perceptions and risk beliefs on eye health and safety among cocoa farmers are not known. There is no comprehensive training programme on eye care for such farmers. In addition, no occupation health policies have been developed for farm workers, specifically cocoa farmers, and the extent to which they know about and practice good eye care is unknown. The absence of this information makes it difficult to develop training interventions that address their specific needs, and to therefore improve their knowledge about eye health and safety.

1.4 Aim and objectives

The study aimed to examine and understand the factors that affect the ocular health of cocoa farmers in Ghana in order to improve their knowledge and awareness on ocular health and safety practices through a training intervention.

The objectives of this study were to:

1. determine the prevalence of ocular conditions, refractive error and visual impairment among cocoa farmers in Ghana by means of an ocular examination.
2. establish the prevalence of ocular injuries among cocoa farmers in Ghana by means of an interviewer-administered questionnaire.
3. examine the use of protective eyewear among cocoa farmers using an interviewer-administered questionnaire.
4. determine the eye care seeking behaviour among cocoa farmers in Ghana by means of an interviewer-administered questionnaire.
5. investigate the cocoa farmer’s knowledge, perceptions, and beliefs on ocular health and safety practices using a pre-training questionnaire.
6. develop an education training intervention to improve the cocoa farmers' knowledge on ocular health and safety practices.
7. implement a training intervention to improve the cocoa farmers' knowledge on ocular health and safety practices.
8. establish changes in the cocoa farmers' knowledge, perceptions and beliefs on ocular health and safety practices using a post training questionnaire.

9. finalise the ocular health and safety practices training manual for cocoa farmers.

1.5 Hypothesis

The hypothsis to be tested for Phase 2 of the study is,

$H_{o:}$ There is no difference in knowledge scores of participants before and after the training intervention on ocular health and safety practices in the farm.

1.6 Type of study and methods

The study used two quantitative methods, a cross-sectional survey and a training intervention. The cross-sectional study involved undertaking ocular examination and administering a structured questionnaire among cocoa farmers selected from four cocoa growing districts in Ghana through a multistage random sampling approach. A quasi-experimental pre-post-test study design was adopted for the interventional study to compare the pre and post knowledge scores of 200 participants following an ocular health education programme. This was assessed using a 5 point Likert - scale questionnaire adapted from previous studies (Verma et al, 2011; Forst et al, 2006; Forst et al, 2004). The knowledge, perceptions and risk beliefs on ocular health and safety practices among farmers were assessed using the pre-training questionnaire.

1.7 Study outcomes

This study sought to understand issues on the ocular health of cocoa farmers in Ghana and therefore documented the ocular health status (refractive errors, visual impairment and eye diseases) among cocoa farmers, as well as, the visual hazards on cocoa farms. It sought to provide data on ocular injury, use of ocular protection and barrier to its use, the eye health seeking behaviour and barriers to seeking eye care among participants. The knowledge, perceptions, risk beliefs on ocular health and ocular safety practices among the farmers have also been documented. The intention was to develop and test an ocular health and safety training manual for cocoa farmers that could be adopted for training to improve the knowledge and awareness of good ocular health and safety practices among cocoa farmers in Ghana.

1.8 Definition of terms

The terminologies used in this study are defined below.

Ocular condition: This refers to any ocular pathology identified in the study population (e.g. pterygium, corneal ulcer, conjunctivitis, cataract, retinopathies, etc).

Refractive errors (myopia, hyperopia and astigmatism): In this study myopia was defined as the spherical power in the better eye of −0.50D or worse and hyperopia as the spherical power in the better eye of +1.00D or more. Astigmatism was defined as −0.50D cylinder or worse in the better eye (Otutu et al, 2012).

Ocular (eye) injury: This was defined as any injury occurring to the eye and/or adnexa that in the workplace, and that requires medical attention (orthodox or traditional) or results in at least one-half day of restricted activities (Thompson and Mollan, 2009; Chen et al, 2007; McCurdy and Carroll, 2000; McGwin et al, 2000).

Protective eye wear: Any device worn over the eye with the intention of preventing injury or exposure to ocular hazards.

Barriers: Any reason cited as a hindrance to positive health behaviour such as using protective eye wear or seeking eye care.

Health seeking behaviour: This refers to any mode of seeking health by participants either through hospitals or clinics, as well as, alternatives such as local chemical shops or its equivalent, and the use herbal medicine or visiting traditional/native doctors.

Ocular (Eye) health: A state of well being of the eye.

Safety practices: Measures adopted to prevent or reduce injuries and diseases, as well as, their management where injury or disease occurs.

Risk beliefs: Beliefs associated with risk taken behaviour as regards the ocular health practices on the farm.

Cocoa farmer: A cocoa farmer is defined as an individual whose major occupation is cocoa farming and/or works on a cocoa farm for a living throughout the year or for major periods of the year (COCOBOD, 2002). In this regard, cocoa farmer and cocoa farm workers mean the same in this study as there is a thin line between the two due to the dominance of small scale cocoa farming with most farmers working on their own farms.

Visual impairment: Visual acuity of < 6/18 (0.5logMAR) to 6/60 (1.0 logMAR) was classified as visual impairment (moderate visual impairment-MVI) using presenting visual acuity while visual acuity of <6/60 to 3/60 was classified as Severe Visual Impairment (SVI). Blindness in this study refers to a visual acuity of <3/60 (1.3 logMAR) in the better eye (Pascolini and Marriotti, 2010; WHO, 2010a).

1.9 Chapter Organization

The thesis has been organized into eight chapters. Chapter one deals with the introduction to the study, which covers the background, the research problem, objectives and the rationale for the study of ocular health of cocoa farmers in Ghana: an assessment and intervention study.

Chapter 2. OCULAR HEALTH AND SAFETY AMONG AGRICULTURAL WORKERS: the evolution of environmental and occupational optometry and screening methods used among workers are discussed, as well as, the ocular effects of major hazards faced by farmers in their daily activities. The chapter also reviews common ocular complaints and diseases that have been reported among agricultural workers, as well as, factors influencing the occurrence of injuries, use of ocular protection and barriers to use of ocular protection among agricultural workers.

Chapter 3. THEORETICAL FRAMEWORK: OCCUPATIONAL HEALTH AND SAFETY: discusses perspectives on occupational health and safety, and how they relate to the ocular health of farmers. The theoretical concepts underlining the study are also presented. Issues such as global burden of occupational health and diseases; evaluation of potential ocular hazards in agriculture; work and personal health practices; work; physical safety and health influencing the health of workers have also been reviewed to enhance an understanding of the study background.

Chapter 4. OCULAR HEALTH AND SAFETY EDUCATION: focuses on safety and health education among farmers. A brief overview of theoretical concepts that underpins health education in the literature is presented. The chapter also reviews eye and vision health education including strategies and methods that have been adopted to implement successful eye safety training programmes, as well as, barriers to accepting training programmes among farmers. A review of the knowledge, perceptions and risk beliefs on ocular practices among farmers is presented.

Chapter 5. METHODOLOGY: presents the methodological aspects of the study. A brief background of the study areas is provided in addition to the research design and sampling procedure used for the study. Instruments used for the data collection are explained, as well as, the data collection process, analysis and field experience.

Chapter 6. RESULTS: the results are presented and include the demographic characteristics of respondents from the survey, such as the farm characteristics, years spent in farming and number of cocoa bags produced. The results also include self-reported vision and visual status of farmers, as well as, the health seeking behaviour of farmers. Reported cases of injury and use of ocular protection, as well as, eye conditions identified during the examination procedures are also presented. Results on the efficacy of safety training among the participants are also reported on.

Chapter 7. DISCUSSION: focuses on the discussion of the results presented in the previous chapter. Issues arising out of the results have been situated in their context and compared to available literature to enhance an understanding of the findings of the study.

Chapter 8. CONCLUSIONS AND RECOMMENDATIONS: includes a summary of the main findings, conclusions and recommendations. Essential issues in the study have been summarised and conclusions have been drawn pertaining to the ocular health of cocoa framers in Ghana. This chapter also provides recommendations for stakeholders in the health and agricultural industry on identified challenges.

CHAPTER 2: OCULAR HEALTH AND SAFETY AMONG AGRICULTURAL WORKERS

2.1 Introduction

This chapter begins by tracing the evolution of environmental and occupational optometry. It goes on to discuss the various types of vision screening that may be conducted among workers and the procedures that may be followed. The ocular effects of major hazards faced by farmers in their daily activities such as constant exposure to ultraviolet radiations and pesticides among others are also discussed. A brief overview of the influences of social drugs that are usually abused in society which is common among farmers with implications for vision and injury outcomes is included. The chapter also reviews common ocular complaints and diseases that have been reported among agricultural workers.

In the latter part of the chapter, the factors influencing agricultural injuries among agricultural workers, classification of ocular injuries, issues on use of ocular protection and barriers to utilisation of such devices are discussed. In addition, ocular health seeking behaviour and barriers to seeking eye care among farmers are discussed. The chapter concludes by touching on the seemingly lack of interest by researchers and academics in Africa in the ocular health and safety of farmers and suggests possible ways of bridging the gaps in the paucity of information on the ocular health and safety of farmers in Africa and that of the developed economies.

2.2 Environmental and occupational vision

"Environmental vision is the branch of optometry that broadly considers the relationship of people's eyes and vision to all aspects of their environments including home, school, work, recreation, transport, underwater or outer space" (Pitts and Kleinstein, 1993:4). It encompasses a wide range of services such as evaluating and resolving challenges that arise through the interactions of workers with their environments, designing optimal visual environments for workers' needs and improving visual performance of workers through environmental assessments (Good, 2001).

Occupational optometry also deals with all facets of the interrelationship that exists between "work and vision, visual performance, eye safety and health" (Good, 2001: 1; Pitts and Kleinstein, 1993: 4). This multi-faceted relationship includes the "worker's eye and visual system, as well as the worker and the workplace environments" (Good, 2001:4). Occupational optometry therefore, places much emphasis on high quality care of workers with two major priorities: prevention of work related eye diseases, injuries, and vision disorders, and enhanced performance of workers on the job including disease prevention and health promotion. This is important because "occupational eye disease is one of the greatest under in the world; under recognized, under reported, under compensated, under studied and under prevented" (Pitts and Kleinstein, 1993: 4).

Good (2001:1) summarized the above two priorities as "that which is concerned with the efficient and safe visual functioning of an individual within the work environment which encompasses more than just the prevention of occupational eye injuries". It also includes the "assessment of the vision of workers, with emphasis on their specific visual requirements and the demand these requirements place on them" (Ovenseri-Ogbomo et al, 2012: 39), the detection of possible dangers or risks to the eye and formulating policy to help decrease or eradicate such risks. These assertions underscore the relevance of the concept of environmental and occupational vision to individual workers, employees and organizations, as well as, governments since at the core of every industry, are man whose productivity is greatly linked to health functioning of his visual system. Pitts and Kleinstein (1993: 387) asserts that, "how well we see and what we see are determining factors in how efficiently and safely we perform at our occupations". It is therefore important to work towards integrating occupational vision assessments in all workplace settings to enhance the ocular health of workers, as well as, productivity particularly for those whose jobs require critical visual needs.

2.3 Evolution of environmental and occupational optometry

While some are of the view that optometry started at the time of creation with the pronunciation of "let there be light" (Genesis 1:3), a much more accepted belief is that optometry developed during the early 20th century to cater for the eye and vision care needs of individuals. Eye protection which is key in the evolution history dates back thousands of years with the use of face shields with eye holes by a variety of people, who used various materials with eye slits for protection from the ultraviolet radiation in sunlight (Pitts and Kleinstein, 1993). The first protective spectacles for foundry workers were made in 1870 and were known as “melter’s glasses” (Pitts and Kleinstein, 1993). Protective eyewear today ranges from plano safety spectacles to gold-coated sun shields used by the astronauts (Carson, 2009). In the 1940s and 1950s, the specialty of industrial optometry developed with major emphasis on eye safety and injury prevention but with minimal attention to improve performance on the job (Pitts and Kleinstein, 1993).

According to Pitts and Kleinstein (1993), interest in the specialty practice of both industrial optometry and industrial medicine was highest following World War II. Thereafter, there was a long period when there was little interest in this area. In recent times, the interest in occupational optometry appears to be increasing and being rejuvenated as occupational medicine has been. “The clinical discipline of occupational medicine which was largely understudied, untaught, and unpractised in major medical centers underwent unprecedented rejuvenation in the 1980s. In the United States, this was spurred by national regulatory programmes and requirements, widespread litigation concerning toxic injury, and altered perception of environmental risks, the demand for the services of occupational medicine, especially outside the workplace” (Cullen et al, 1990: 594).

Optometry has expanded from a profession which focuses only on spectacles to one with a broad concern about the patient’s health and well-being (WCO, 2005; Pitts and Kleinstein, 1993). In the same context, as providers of primary eye care, optometrists have advanced from restricted concerns about vision in industry to broad concerns about occupational and environmental eye and vision care. It is expected that occupational optometry will continue its progression into a major part of the health care system together with the transformation of society into the information and technology age, the aging of workforce, the increasing complexity of the workplace, and the need for higher productivity to meet international competition. There is therefore the need to maximize vision and visual performance among workers given these complex scenarios relating to work and productivity (Anshel, 2007; Anshel, 2006; Good, 2001), hence the relevance of environmental and occupational optometry studies to meet these needs.

2.4 Occupational vision assessment (screening) of workers

Several diseases affect the eye and visual system of individuals which prompts the need for ocular health assessments. These assessments are particularly important for workers who rarely have general physical examinations or for those who have had acute or chronic exposure to environmental hazards (Wilken et al, 2012). These assessments include a detailed health history including exposure to environmental hazards, physical assessment of the eye; vision screening, such as internal and external examination, and in some cases systemic screening tests such as the measurements of blood pressure and glucose levels (Naidoo et al, 2011). These examinations help elicit diseases that may put the health of workers at risk.

Vision screening is a vital component of any occupational health programme that has the intention of identifying eye and vision problems that decrease work productivity. It also aids in diagnosing eye diseases at an early stage in order to institute timely interventions that can save the individual's vision. Vision screening also assesses if workers have the minimum vision required for their specific job and establishes a baseline data for future comparisons (Good, 2001). According to Pitts and Kleinstein (1993) such screening must be selective and with much emphasis on the nature of work of the population at risk. This underscores the need to assess the visual status of cocoa farmers in the Ghanaian community since these farmers constitute a special working population with specific needs, contributing immensely to the economic development of Ghana.

There are three categories of periodic vision screening which may be conducted within the industry. The first is a basic occupational vision examination which assesses occupational vision demands of workers (Good, 2001; OVS, 1990). This examination focuses on an analysis of the visual demands of the job, work hazards and the work environment (Pitts and Keinstein, 1993). Both generalized and specialised tests may be used in this screening to identify specific abilities needed by workers with demanding vision or job requirements. These tests may include visual acuity measured at both distance and near, with the near distance assessment being at the customary job working distance; assessment of work-related oculomotor, accommodative and binocular functions at distance and near; assessment of external and internal eye health (ophthalmoscopy) with much emphasis on peripheral vision to rule out major peripheral vision defects; refraction if appropriate and colour vision (Good, 2001; Pitts and Kleinstein, 1993). These tests allow the clinician to make an appropriate determination as to whether workers can see adequately to perform their tasks, need corrective lenses at distance and or near, have adequate peripheral vision for avoiding accidents, possess adequate binocular vision to perform tasks safely and comfortably, can avoid fatigue with frequent near vision tasks, have healthy eyes and have normal colour vision. This study mainly adopted this approach with some modifications to reflect the objectives of the study as it is believed that the criteria for each screening test may vary with the job or task performed and the needs of the individual in an industry.

The second type of vision screening is specialized, normally designed as a supplementary occupational health vision examination and is therefore limited to task analysis (Good, 2001; Pitts and Kleinstein, 1993). The examination includes an analysis of the visual demands of the job and may include a review of work hazards and the job environment. Specialised tests are necessary for selected workers, depending on the tasks they perform. For example, the accommodative convergence tests and other binocular vision tests may be useful for the presbyopic worker doing a special near task.

The third category involves a comprehensive eye and vision examination conducted at regular intervals to assess eye and vision problems, to rule out suspected diseases or disorders, and to provide early identification of risk factors and health problems such as hypertension and diabetes (Good, 2001; Pitts and Kleinstein, 1993). A major purpose of this category of screening is for surveillance of the workers' vision. The early identification of workers who are developing vision problems is important, as it enables treatment to be provided before these problems interfere with productivity or contribute to accidents. This study partly covered the essence of this third type of examination.

2.5 Effects of main ocular hazards in agriculture

A hazard is defined as anything that has the potential to cause harm (Aw et al, 2007). The hazards found in the workplace may be grouped based on the authors' background and specific situation in context (WHO, 2010b; Cox, 2000; Takala and Urrutia, 2009; Pitts and Kleinstein, 1993; Zenz, 1988). For the purpose of this study, ocular hazards in agriculture are grouped into three main categories; ultraviolet (UV) radiations, pesticides and farm practices. Personal habits that tend to increase the risk of ocular injuries and diseases among farmers are also included as an ocular hazard. An understanding of these hazards is important because they have different routes of entry and different modes of causing eye problems, and many require different approaches for prevention and control (Pitts and Kleinstein, 1993).

2.5.1 Ultraviolet Radiation

Agricultural workers face outdoor solar exposure leading to several effects on the different ocular media (Quandt et al, 2008; Sprince et al, 2008). Ultraviolet radiation is divided into four categories: UVA (315 nm to 400nm), UVB (290nm to 315nm), UVC (200 nm to 290nm) and UVV (100nm to 200nm) (Naidoo et al, 2011; Kolozsva´ri et al, 2002; Threlfall and English, 1999). The ozone layer in the upper atmosphere normally filters out UVC and UVV whereas UVA and UVB are transmitted through the atmosphere to reach the earth (Naidoo et al, 2011; Kolozsva´ri et al, 2002).

Studies (Voke, 1999; Pitts and Kleinstein, 1993) have shown that following a latency period (6 to 12 hours) after excessive exposure to UV radiations, the anterior aspects of the eye, the eyelid, and the adnexa surrounding the eye may become reddened. This may lead to a sensation of an ocular foreign body or gritty sensation, photophobia, excessive tearing and blepharospasms to help reduce pain (Voke, 1999). These are usually acute symptoms but could lead to inflammation of the eye if the intensity is high or sustained for a longer period (Pitts and Kleinstein, 1993).

Other reports also indicate that excessive exposure to UVB (207-310nm) affects the bulbar conjunctiva which leads to the formation of pterygia and pingueculae (Voke, 1999). According to Voke (1999), the characteristic position of a pterygium is thought to be a direct consequence of radiation entering from the temporal side at a specific angle, owing to the shape of the outer eye. Evidence from cytological reports have indicated that there is direct damage to the organelles of the conjunctival cells and the presence of a localized immune response which are consistent with pathologic changes observed in pterygia and pingueculae due to UV exposure (Voke, 1999; Villarejo and Baron, 1999; Pitts and Kleinstein, 1993). Other conditions associated with excessive exposure to UV radiations include conjunctival injection, chemosis and basal cell carcinoma (Villarejo and Baron, 1999; Pitts and Kleinstein, 1993).

Most of the damage from UV radiation on the eye affects the cornea (Carson, 2009). For example extended exposure of the cornea to UVB can result in the development of epithelial debris in the precorneal tear film, formation of granules in the columnar cell layer of the corneal epithelium and in the wing cell layers due to a breakdown of the primary lysosome membrane, which release hydrolytic enzymes that form secondary lysosomes (Kolozsva´ri et al, 2002). Continuous exposure to UV radiation leads to permanent damage to the corneal endothelium and is manifested by an increased thickness of the cornea and the appearance of flare and cells in the aqueous (Mansy, 2013; Kolozsva´ri et al, 2002). Other conditions that may affect the cornea as a result of exposure to UV radiation are photokeratitis and several keratopathies (i.e. acute UVB keratopathy, band keratopathy and climatic keratopathy) which occur due to deposition of proteins in the superficial cornea between the epithelium and Bowman's membrane, leading to opacification (Kolozsva´ri et al, 2002; Pitts and Kleinstein, 1993; Taylor et al, 1989; Moran and Hollows, 1984; Gronvold and Ringvold, 1982).

The uvea has also been reported to be involved in damage from UVB (295-310nm). The resulting conditions may include secondary anterior uveitis due to an inflammation of the posterior limiting layer (Descemets' membrane) and the corneal endothelium. This may manifest as localized redness of the lateral cornea and or aqueous flare which may be self-limiting (Voke,1999;

Pitts and Kleinstein, 1993).

Excessive exposure to UV radiation (295-320nm) from the sun as well as daily absorption (as in the case of cocoa farmers) has been reported to be partly responsible for the premature development of brown or “sunshine” cataracts, as well as, an early development of age-related cataracts (Mahmoud et al, 2010; Tessem et al, 2005; Johnson, 2004; Voke, 1999). This begins with the formation of small, discrete, white dot appearing in the anterior epithelium of the lens which gradually changes into permanent opacities. As these opacities become larger, they disappear into the anterior stromal haze and spread laterally from the anterior suture line appearing as stromal vacuoles over the anterior subcapsular surface of the lens, this later becomes permanent lenticular opacities, impairing vision (Pitts and Kleinstein, 1993). It is only in the aphakic and pseudophakic eyes that UV radiations has been reported to produce retinal damage by causing both functional and morphological changes to the retina (Zulclich and Blankenstein, 1984). Such conditions may be less common in the farmers involved in this study.

2.5.2 Pesticides

Exposure to pesticides is one of the most common hazards faced by agricultural workers, the major groups being insecticides, herbicides, fungicides and plant growth regulators (Banjo et al, 2010). Organophosphates (OP), organochlorines and carbamate insecticides are the more widely used pesticides among agricultural workers (Kwong, 2002; Echobichon, 1996; Schenker et al, 1992; Sullivan and Blose, 1992). According to Atu (cited in

Adeogun and Agbongiarhuoyi, 2009), pesticides are toxic and can have serious health implications to human beings. Several studies have reported eye injuries from chemical causes, (Sprince et al, 2008; Saurabh et al, 2008; Retzlaff and Hopewell, 1996). The most common routes of exposure to pesticides being inhalation, ingestion, and dermal contact (Echobichon, 1996; Schenker et al, 1992; Sullivan and Blose; 1992). A less common route of entry for toxic pesticides is ocular exposure (Bradberry et al, 2004; McKeag et al, 2002). This includes direct entry into the eye tissues or from accidental contacts of the eye with chemicals that may be absorbed into the tissues and enter into systemic circulations (Bradberry et al, 2004; Lessenger, 1993).

Regular exposure to pesticides in the absence of personal protective equipment is a potential health risk, especially to unprotected eyes (Jaga and Dharmani, 2006). Handling pesticides and subsequent hand-to-eye contact increases the probability of ocular exposure in workers, which may also be caused by improper practices associated with the lack of hand washing. Aerial spraying of pesticides into the environment over farms also increases the risk of ocular exposure to workers on the ground (Jaga and Dharmani, 2006; Ciesielski et al, 1994) as does the residual effects of the chemicals which constitute health hazards (Quandt et al, 2008; Lacey et al, 2007). Studies have confirmed the transport of a carbamate insecticide from the cornea, through the aqueous humor, and vitreous humor to the retina (Budai et al, 2004). The main ocular symptoms of pesticides exposure are: irritation, burning sensation, itchiness, blurring of vision and tearing (CDC, 2005; Lu, 2005; Bradberry et al, 2004; Budai et al, 2004; Strong et al, 2004). Blurred vision and burning sensation are known ocular symptoms of organophosphate poisoning from systemic exposure as a result of inhalation, ingestion, or dermal contact (Echobichon, 1996; Schenker et al,1992; Sullivan and Blose, 1992).

Long-term ocular exposure to pesticides may also produce chronic effects in the eyes. Pesticides have toxic consequences on various structures of the eye including the conjunctiva, cornea, iris, lens, retina, and the optic nerve, including the neural pathways that extend to the brain (Schenker et al, 1992; Sullivan and Blose, 1992). For example, eyelid infections and cataracts leading to refractive errors have been reported following the carbamate pesticides exposure in the Bhopal gas tragedy (Andersson et al, 1990; Raizada, 1987).

The conjunctiva, which has a greater surface area than other parts of the eye, reacts to chemical injury, with inflammation, congestion, or edema (chemosis), (Jaga and Dharmani, 2006) and is usually observed as redness or hyperemia in exposed eyes (Bradberry et al, 2004). Bradberry et al (2004) and the CDC (2005) reported conjunctival hyperemia and other acute conjunctival reactions among agricultural workers exposed to the plant growth regulator, hydrogen cyanamide. Corneal epithelial damage caused by exposure to paraquat herbicide has also been reported by McKeag et al (2002). Other authors (Andersson et al, 1990; Raizada and Dwivedi, 1987) have reported visual impairment due to unresolved corneal opacities from chemical injuries.

Furthermore, retinal degeneration has been reported in pesticide applicators that used fungicides, as well as, among applicators that used organophosphate insecticides (Kamel et al, 2000). Dementi (1994) reported retinal diseases such as Saku disease (an optico-autonomic peripheral neuropathy associated with organophosphates exposure) in Saku, an agricultural community. Further studies on Saku disease revealed features such as myopia, astigmatism, narrowing (constriction) of visual fields, reduced visual acuity, abnormal eye movements and pupillary responses, with optic neuritis. Retinal effects of the disease included a progressive state with retinal pigmentary degeneration, papilledema of the optic disc, poor ERG responses and constriction of retinal vasculature (Dementi, 1994).

Misra et al (1985) also studied retinal changes in workers exposed to the organophosphate, fenthion. Macular changes were significantly more evident in 19% of the 79 workers compared to the controls ($p < 0.01$), with a characteristic features of irregular perifoveal pigmentation and hypopigmentation. The symptoms reported by these workers were photophobia, blurring of vision and narrowing of visual fields (Misra et al, 1985). In a related study, autopsy findings of a professional organophosphorous sprayer showed severe retinal degeneration with optic neuropathy and arteriosclerotic changes in the heart, brain, and retinal vessels (Jaga and Dharmani, 2006).

2.5.3 Farm practices

Several farm activities such as weeding, burning, pruning, harvesting, among others predispose farmers to eye injuries (Verma et al, 2011; Quandt et al, 2008). They also risk traumatic eye injuries from plants (i.e. branches, vines and thorns), dust, sand, pollen and allergens, as well as, flying objects and equipment (Quandt et al, 2008; Forst et al, 2006). These could result in eye diseases and injuries, and could increase the risk of occupational injuries, which, if untreated, could lead to visual impairment and blindness. For example, a study by Sprince et al (2008) showed that grinding or cutting metal resulted in 27.5% eye injuries, welding 7.5% and drilling accounting for 5%. It is important to note that, 25% of these injuries resulted in the farmers losing 1 to 5 days of work. A summary of the various hazards farmers face in agriculture, mechanism of injury and their possible ocular health outcomes is given in **Table 2.1**.

Table 2. 1 Hazards, injury mechanism and possible ocular health conditions in agriculture

Agent	Injury Mechanism	Outcome
Ultraviolet radiation (Sunlight)	UV light	Cataracts Pterygium Possible retinal changes
Farm chemicals (pesticides, fertilizers, gasoline, solvents, cleaning agents, antifreeze, vehicle fluids)	Chemical burn. Absorption of toxic agent through mucous membrane. Breach of barrier and introduction of infectious agent	Corneal abrasion Corneal scarring Blindness Systemic toxicity Infection Blindness
Dust, debris, metal shards, particulate (from sharpening tools, kicking up dust, working on machinery)	Foreign body Acute trauma Infection	Abrasion Laceration Pierced globe Hyphema Allergic/infected conjunctivitis Blindness
Plant debris (may be contaminated with microorganisms or farm chemicals)	Allergy Irritation Infection Chemical burn	Red eye Infection Corneal abrasion Pierced globe Corneal scarring Blindness
Brush, branches, plants	Penetrating trauma Blunt trauma	Corneal abrasion Lid laceration Pierced globe Hyphema Allergic or infectious conjunctivitis Blindness

Sources: Quandt et al, 2008: Forst et al, 2006; Retzlaff and Hopewell, 1996; Taylor et al, 2006a; Villarejo and Baron, 1999.

2.5.4 Effects of social drugs on the eye

The effect of social drugs on vision has been reported widely in the literature (Oshika, 1995; Pavan-Langston and Dunkel, 1991). Over indulgence of social drugs such as alcohol and tobacco may exacerbate the occurrence of eye conditions among workers as the eye is structurally and metabolically diverse, and is susceptible to such drugs leading to a large number of vision disorders (Oshika, 1995). Despite this knowledge, the use of such drugs has been reported to be high among manual workers such as cocoa farmers and other farmers (Muilerman, 2013; Brison and Pickett, 1991). Effects of drug use may occur in the pre-retinal structures (cornea, lens, pupil); the oculomotor systems; the vasculature; the retina; or neural structures, including the optic pathways, visual cortex, or non-visual cortex (Bartlett and Jaanus, 2001). Many of these effects can be expected to produce visual changes which are briefly described below.

a. *Alcohol.*

There is evidence that alcohol may act directly on the human retina, opening up the possibility of a wide range of visual dysfunctions (Wegner et al, 2001; Grant, 1986). These changes are separate from additional changes in cognitive function, attention, and higher visual processes. Alcohol may also exert its effect on vision function by interfering with the fine motor control of the ocular system on which proper visual function critically depends (Phipps et al, 2006; Bui et al, 2005; Bui et al, 2004; Pitts and Kleintein, 1993). This may lead to injury when taken prior to or during work, especially where there is little supervision as in the case of cocoa farmers.

The oculomotor system is also affected adversely by low to moderate effects of alcohol with accommodation, convergence, smooth pursuits and saccadic eye movement (Grant, 1997; Hill and Toffolon, 1990; Levett and Jaeger, 1980) showing significant changes. It can also result in double vision, poor tracking of moving objects, reducing visibility by inexact fixation and blurring of near objects related to compromised accommodation which could be problematic in workers requiring fine vision for task performance (Pitts and Kleinstein, 1993). These are usually acute effects of alcohol use which could significantly lead to injuries among workers.

Chronic alcohol use has been reported to cause colour vision defects with the prevalence of dyschromatopsia and the mean colour confusion index increasing with alcohol intake (Wegner et al, 2001; Pitts and Kleinstein, 1993). Alcohol amblyopia, often referred to as tobacco-alcohol amblyopia, has also been described by many (Prakash et al, 2011; Behbehani et al, 2005; Wegner et al, 2001). The condition is associated with symptoms such as “dimness of vision”, visual field changes, changes in the optic disc and colour discrimination losses. These conditions could also negatively affect safety and productivity of workers if not identified and managed early.

b. Tobacco.

Tobacco is another commonly abused social drug with profound effects on the eye. Acute inhalation of tobacco smoke affects the oculo-motor system. There is evidence that pupil size increases by at least 0.75mm during cigarette smoking (Robert and Adams,1969 cited in Pitts and Kleinstein, 1993). Tobacco abuse may lead to amblyopia with characteristics similar to that of alcohol amblyopia as these two drugs are often abused concurrently. Both are amblyopias caused by the same mechanism; the result of a deficiency of vitamin B. For this reason, tobacco-alcohol amblyopia is usually considered a single entity (Behbehani et al, 2005). The symptoms of amblyopia found in this category of people are a reflection of the vitamin B deficiency associated with the abuse and not necessarily due to the chronic abuse of the drugs. Chronic tobacco smoke exposure on the other hand, causes changes in the visual system primarily in the optic nerve. The nature of the changes is consistent with a slowing down of transmission of information and a loss of information carried in the large fibers (Behbehani et al, 2005; Fotzsch et al, 1986).

Finally, an association between heavy tobacco smoking and nuclear lens opacities has been documented (Cheng et al, 2000; Christen et al, 1992). An increase in smoking dose increases the risk of nuclear opacities and the severity of opacities, and quitting smoking decreases the risk (Klein et al, 1993). It has also been reported that “in many cases the severity of Leber’s optic atrophy is related to tobacco smoking which may normally lead to dimness of vision” (Pitts and Kleinstein, 1993: 397) which could adversely affect workers.

From the previous discussion on alcohol and tobacco as socially abused drugs, it can be concluded that the use of such drugs by workers may influence disease and injury outcomes among such a population from an eye examination if the abuse of such drugs are high among them. There is therefore the need for investigations to be made into the use of these drugs among the working population during eye examinations. The study therefore took into account the use of these two drugs among the study population.

2.6 Common ocular complaints and conditions among farmers

Farm workers have significant levels of vision problems and have a high risk of injury (Quandt et al, 2008). They depend both on distance and near vision for their activities such as harvesting from the top of a tree or reading chemical labels respectively (Schmid-Kubista et al, 2010; Sprince et al, 2008; Tesfaye and Bejiga, 2008; Arcury and Quandt, 2007; Quandt et al, 2001). Due to this, they are known to report several ocular complains to health facilities (Villarejo et al, 2000; Hall et al, 2000; Myers, 1997; CDCP, 1995).

Affirming the above assertion, 40% Latino farmworkers reported eye pain and redness after fieldwork in a survey (Quandt et al, 2001). Similarly, Quandt et al (2008) reported that 22% of migrant farmworkers in North Carolina had fair or poor eyesight, while 20% had difficulty seeing at distance and near. The study further reported 41% of eye pain or burning; 43% redness; 25% itching and 22% blurred vision. Furthermore, a survey among California Agricultural Workers revealed that, 23% had irritated or itchy eyes while 12% of participants reported blurred vision (Villarejo et al, 2000). In a survey of 1554 cocoa farmers in six cocoa producing districts in Ghana, an estimated 6% and

4% complained of eye irritation following the application of pesticides and fertilizer, respectively (Asuming-Brempong et al, 2006). According to Verma (2010), redness, pain, itching and blurred vision, are mostly reported by farmworkers. Due to constant outdoor work, farmers are also known to frequently report symptoms of eye sensitivity, irritation, foreign body sensation or gritty sensation (Omoti et al, 2009; Taylor et al, 2006a; Quandt et al, 2001; Threlfall and English, 1999). These complaints and symptoms provide some evidence that numerous ocular conditions may be prevalent among agricultural and farm workers in general and need to be investigated further.

Three main methods are normally used in the studies of ocular diseases and injuries; hospital based surveys, trauma registry and population-based surveys. Most population based studies on eye health focuses on ocular complaints and injuries reported by the farmers using questionnaires. For this reason, eye conditions among these workers are normally based on reports from farmers rather than from assessment and diagnosis (Quandt et al, 2008). Furthermore, data on eye conditions among such workers have mostly been documented from hospital records through review of records or reports and through the registry. For example, Retzlaff and Hopewell (1996), reported that eye infections (conjunctivitis), pterygia and diabetes-related eye problems were common among migrant farmworkers. Pterygia have been reported to be common among Latino farmers in Carlifonia and North Carolina (Quandt et al, 2008; Taylor et al, 2006a; Villarejo and Baron, 1999). Within the same population systemic conditions such as hypertension and type II diabetes which increases the risk of other vision disorders have been reported to be high (Quandt et al, 2008; Taylor et al, 2006a; Villarejo and Baron, 1999).

Verma (2010) also reported pterygia and allergic conjunctivitis as eye conditions prevalent among farmers. Other conditions such as microbial keratitis due to superficial injuries and corneal abrasions which causes visual impairment are also common among farmers in developing countries (Thylefors, 1992). Cooper et al (2006) also documented that infections to the eye among migrant farm workers in Texas are common and yet farmers self-treat or fail to go to the clinic as a result of inadequate funds.

Macular degeneration, the leading cause of central vision loss and reduced visual acuity in the elderly population in developed economies (Zampatti et al, 2014; Lim et al, 2012), has been reported to be high among agricultural chemical applicators and those exposed to chemicals in agriculture in India and North Carolina (Kirrane et al, 2005; Kamel et al, 2000). Although other known risk factors to macular degeneration include age and family history, smoking, hypertension, cardiovascular diseases, their occurrence among agricultural chemical applicators is a source of concern. Other risk factors include atherosclerosis, previous history of cataract surgery, alcohol consumption, obesity, sunlight exposure, and darker iris pigmentation (Zampatti et al, 2014; Lim et al, 2012; Kirrane et al, 2005). Some of these risk factors may be high among agricultural workers due to the nature of their work (Brison and Pickett, 1991). Though reports indicate that global visual impairment due to this disease has decreased by about 50% due to new methods of treatment, with recent improvements in the quality of life and subsequent improved life expectancy in most countries, it has been predicted that over 20% of the ageing population might still suffer from the disease (Lim et al, 2012).

Few studies have documented the level of refractive errors and visual impairment in a farming population (Verma et al, 2011; Verma, 2010). According to Verma (2010:6), "they are extremely scarce". "Visual impairment among farmers could be caused by occupation-related increases in ocular disease risk factors (e.g., sun exposure) and eye injuries (e.g., exposure to chemicals, dust, radiation, welding, agricultural products, penetration of foreign bodies)", (Davila et al, 2009: 1384). Visual impairment could also be due to refractive errors which have been reported to be common in farming populations (Retzlaff and Hopewell, 1996).

The prevalence of visual impairment among farm workers and other agricultural workers who are 65 years and above has been reported to be 11.4% (4.7 - 18.1), however, the general prevalence for farm operators and managers was 15.4% (Davila et al, 2009). Another study by Verma (2010) also measured the vision of farmers using a Snellen Tumbling E chart among migrant farmers in North Carolina and reported a 1.4% (n = 4) prevalence of visual impairment and 0.3% (n = 1) legal blindness among the farmers in both eyes. Distance visual impairment, using presenting visual acuity in the right eye, was 2.4% (n = 7) with 1.0% (n = 3) legal blindness while visual impairment in the left eye was 2.1% (n = 6) with 1.0% (n = 3) being legally blind in the same population. In addition, near visual impairment was reported at 6.6% (n = 19) among the farmers. Other reports on agricultural farmers indicate that impairment from near vision are about three folds high among agricultural workers than the general population (Quandt et al, 2012, Verma, 2010). In spite of these reportedly high prevalence of visual impairment from refractive errors, spectacle use among this population is low. For instance, Quandt et al (2008), indicated that only 5.1% of agricultural workers used spectacle in North Carolina.

It is important to note that, eye conditions among farmers in developing countries especially in Africa is very rare in the literature. This suggests a pattern of neglect by researchers and academics as asserted by Pitts and Kleinstein (1993). There is therefore a need for much more attention to be paid to agricultural health studies which focuses on the vision of farmers since the economies of most developing countries (especially in Africa) depends on agriculture in which the farmers play a critical role.

2.7 Factors affecting injury in agriculture

Work-related eye injuries or trauma is a major cause of visual morbidity and blindness (Shashikala et al, 2013; Thompson and Mollan, 2009; Xiang et al, 2005). This is a major source of concern not only to individual workers, but also to employees and governments as well. Research studies in this area have sought to understand the occurrence of such injuries and helped direct measures and policies to control their occurrence. In this regard, several factors have been linked to the occurrence of injuries in agriculture some of which are highlighted below although the direct association between some of the factors and ocular injuries has not been established and was therefore explored in this study.

2.7.1 Gender

There has been mixed reports on gender differences in injury levels in the literature. Some studies indicate that the men are at a higher risk of farm-related injury compared to women (Chae et al, 2014; Shashikala et al, 2013; Shen et al, 2013; McCall et al, 2009; Xiang et al, 2005; 1999: Ferguson et al, 2005; Hagel et al, 2004; Stallones and Beseler, 2003; Virtanen et al, 2003; Hwang et al, 2001; McCurdy and Carroll, 2000; Pickett et al, 1999). The high rates of injury among men is attributed to the fact that they dominate the commercial crop industry which are relatively riskier (McCall et al, 2009; Koehler, 2001), and are more exposed to farm hazards (Miller et al, 2004; McCurdy and Carroll, 2000).

2.7.2 Age

Age has been shown to influence the occurrence of injury as it predicts a number of factors such as "general health status, cumulative experience, tendency to take risks, reflex speed, visual acuity and hearing" (Maltais, 2007: 5). For example, an increase in age reduces reflex speed and could make older farmers more vulnerable to injury (Chae et al, 2014; Etherton et al, 1991). Many farmers perform tasks beyond the age limits permissible to undertake such activities safely because there are "no mandatory retirement age in farming and the intergenerational transfer of farms tends to extend over a number of years" (Maltais, 2007: 3). This may heighten the rate of injury among elderly farmers. There are contrasting findings in the literature regarding the influence of age on injury. Studies among farm workers report that both the young and old age groups have equal chances of sustaining injuries (Hagel et al, 2004; Sprince et al, 2002, 2003a, 2003b, 2003c; Lewis et al, 1998; Lyman et al, 1999). However, risk of falls are higher among older producers (Hagel et al, 2004; Sprince et al, 2003c), whereas machinery-related injuries are common in the younger age groups (Hagel et al, 2004; Sprince et al, 2002). Others have argued that the older population are at a much higher risk of sustaining injury (Chae et al, 2014; Shen et al, 2013).

2.7.3 Education

There is evidence in literature regarding the level of education and predisposition of farmers to injury (Shen et al, 2013). It has been reported that educated people are more likely to be able to read instructions on chemicals and instructions on proper use of farm machinery leading to a reduction in the number of injuries (Adeogun and Agbongiarhuoyi, 2009). Other studies have found an association between education and injury (Sprince et al, 2008; Chen et al 2007) indicating that higher educational attainment reduces the occurrence of injuries.

2.7.4 Duration of work on the farm

"The number of hours worked on the farm may be a proxy datum for factors such as risk exposure, fatigue and experience" (Maltais, 2007:6), which has been shown to influence injury outcomes among workers. Studies have indicated that agricultural workers working full time or spending more hours in the farm are at a higher risk of sustaining injuries (Chae et al, 2014; Shen et al, 2013; Ferguson et al, 2005; Sprince et al, 2002; McCurdy and Carroll, 2000; Lewis et al, 1998). This may be due to increases exposure to risk and fatigue (Sprince et al, 2002; Sprince et al, 2003a; 2003b). For example, a study by Chae et al (2014) reported that injury rate was higher for farmers who worked 10 months (4.1% ± 0.01) compared to those who worked 7–9 months (3.0% ± 0.01) and less than 7 months (1.5% ± 0.00) per year on the farm. Similarly, the injury rate was the highest among those who worked more than10 hours per day (4.7% ± 0.00), decreased to (3.5% ± 0.01) for those who worked 5-9 hours, and was (1.7% ± 0.00) for those who worked for less than 5 hours per day.

2.7.5 Farm size

According to McCurdy and Carroll (2000), the rates of injury may be higher among farmers woorking on large farms as compared to smaller farms. This assertion may hold ture if there is increased workload leading to fatigue and increased exposure to hazards, due to inadequate farmworkers. This has been supported by both Virtanen et al (2003) and Hoskin et al (1988), who reported that injury rates were higher among farmers working on farms with more than 49 cultivable acres.

2.7.6 Other factors

Other risk factors for injury on the farm may include off farm work, alcohol consumption, use of medication, lack of training, use of farm machinery and hand tools among others (Simpson et al, 2004; Sprince et al., 2003b and 2002; Browning et al, 1998; Zwerling et al, 1995; Zhou and Roseman, 1994).

2.8 Classification of ocular injuries

Ocular injuries are broadly divided into two main categories; open globe and closed globe injuries (Kanski, 2009: Kuhn et al, 1996; Kanski, 2003). An open globe injury involves a full thickness wound (an injury penetrating into the globe) of the corneoscleral wall which may result from penetrating or blunt eye trauma. Open globe injuries include lacerations which may be divided into penetrating injuries, perforating injuries and intraocular foreign bodies (Peate, 2007; Kuhn et al, 1996).

Closed globe injuries are mainly due to blunt trauma whereby the corneoscleral wall of the globe remains intact (a partial thickness corneal wound), however, intraocular damage may be present. They are divided into burns, blunt trauma/contusions and lamellar lacerations. Ruptures are caused by blunt objects with the actual wound being produced by an inside-out mechanism (Kuhn et al, 1996). If the inflicting object is blunt, it can result in either a contusion or a rupture (open globe) (Juthani and Bruce, 2007; Schrader, 2004).

2.8.1 Open globe injury

"A laceration is a full thickness wound of the eye wall, usually caused by a sharp object. The wound occurs at the impact site by an outside-in mechanism. The classification is based on whether an intraocular foreign body or an exit wound is also present" (Kuhn et al, 1996: 399). Occasionally, an exit wound may be created by the object while remaining partially intraocular (Kuhn et al, 1996).

2.8.2 Penetrating and perforating injury

A penetrating trauma is a single full thickness wound laceration caused by a sharp object without an exit wound whereas a perforating injury has two full thickness lacerations, an entrance and exit wound caused by the same agent (Kanski, 2003). They may be associated with prolapse of the internal contents of the eye (MacGwin et al, 2005). The extent of damage depends on the site of ocular penetration and the speed of the object that caused the injury (Kanski, 2003; MacGwin et al, 2005). Such injuries may occur among agricultural workers.

2.8.3 Intraocular foreign body

An intra-ocular foreign body (IOFB) is a retained foreign object that enters the eye and may be superficial or deeply embedded causing an entrance laceration. An IOFB injury is technically a penetrating injury, but due to different clinical implications it is categorized differently because of the treatment modality, timing and rate of endophthalmitis. The size, shape and speed of the object at the time of impact, as well as the site of ocular penetration may determine the final resting place and extent of damage caused by an IOFB. Once in the eye, the foreign body may lodge in any of the structures it encounters and may be located anywhere from the anterior chamber to the retina (Kanski, 2003; Imrie et al, 2008).

2.8.4 Globe rupture

Globe rupture is a full-thickness wound of the eye due to contusion or penetrating trauma on the orbit. It results in compression of the globe along the anterior-posterior axis resulting in an increase of intraocular pressure to an extent that the sclera tears. Ruptures from blunt trauma can occur at the thinnest site of the sclera where the intraocular muscles insert, at the limbus, at the site of previous intraocular surgery and occasionally occurs around the optic nerve. Direct perforation of the globe may be due to sharp objects or those travelling at high velocity. Small foreign bodies may remain within the globe after penetration (Patockova et al, 2010; Doyle, 2009; McGowan et al, 2006).

2.8.5 Closed globe injury

Closed globe injuries also occur in everyday life and may be caused by a variety of objects in the environment. However, the outcomes and the standard of management following a severe closed globe injury has not been well established especially when associated with vitreous hemorrhages, hence pose a threat to vision in later stages of injury especially with blunt traumas (Kanski, 2003). Closed globe injuries often experienced by agricultural workers may be from projectiles, stones and knocks to the eye from pods at heights during harvesting among others.

2.8.6 Burns

Burns to the eye are mostly due to exposure to, or contact with strong acids or alkalis which are amongst the most urgent of ocular emergencies and have been reported to be common among pesticide applicators in farms. They are grouped based on the causative agents involved as either chemical injuries i.e. acid or alkali or radiant energy injuries which may be classified as either thermal or ultraviolet. "In particular, the severity of a chemical burn relates to the solution pH, contact duration, solution penetrability and solution quantity" (Kanski, 2003: 678). Chemical injuries range in severity from trivial to potentially blinding (Kanski, 2003; Coakes and Sellers, 1995). Injuries from radiant energy that usually occur from contact with hot gases, hot liquids, or molten metals are classified as thermal burns (Kanski, 2003; Peate, 2007; Coakes and Sellers, 1995).

2.8.7 Blunt trauma/injury

Blunt trauma refers to a direct blow or a type of physical trauma to the eye and surrounding tissues caused by the impact of an object (Carson, 2009). This type of injury may also be common among farmworkers who are involved in harvesting of pods from high tree crops. Damage may occur to anterior segment structures including the eyelid, conjunctiva, sclera, cornea, iris and lens; and posterior segment structures including the retina and optic nerve resulting in significant visual loss (Viestenz and Küchle, 2005). It includes contusions and lamellar lacerations of the globe. A contusional injury has no (full thickness) wound and the injury is either due to choroidal rupture or angle recession. A partial thickness wound to the eye may also be caused by a sharp object, referred to as Lamellar laceration. Both structural and functional damage to the eye can occur from blunt trauma (Viestenz and Küchle, 2005).

2.9 Ocular protection

The relevance of ocular protection to the working population has been highlighted in the literature by several authors (Quandt et al, 2012; Verma et al 2011; Verma, 2010; Quandt et al, 2008). It is recommended that anyone exposed to hazardous conditions at work, that could cause an eye injury, must wear ocular protection. This is because protective eyewear has proved to be efficient in preventing 90% of eye injuries (Peate, 2007; Forst et al, 2006). In spite of this knowledge, the majority of eye injuries still occur at the workplace because workers do not wear eye protection or they wear the wrong kind of eye protection (Quandt et al, 2008). As a result, several measures have been proposed to help workers adopt the culture of using ocular protection at work. For this reason most workplaces have been designated as "eye protection mandatory".

2.9.1 Approaches to ocular protection

Recognizing the hazards workers face, four major approaches for reducing or minimizing eye and vision hazards in industry or work settings have been proposed. These are engineering, administrative, redesign and personal protective. These approaches include the entire element in an organization: tasks, environments, machinery and workers (Good, 2001; Pitts and Kleinstein, 1993).

a. Engineering approach

The engineering approach is usually the best because it builds into the task or process safety materials or devices that protects the worker from hazards or eliminates them. A typical example is using a thermoplastic shield in front of machine tools, grinding equipment and other metal forming tools (Pitts and Kleinstein, 1993).

b. Administrative or task oriented approach

This approach of reducing hazards is based on limiting exposure; it also involve training, safe work practices, house-keeping and similar practices (Pitts and Kleinstein, 1993). Workers doing tasks in hazardous areas can have their risks reduced by reducing their total exposure through proper scheduling with enforcement of maximum exposure durations to reduce risks. For example, farmers can schedule chemical spraying in such a way that one person does not do it all the time. This may require an increase in the number of pesticide applicators. Equally, the direction of the wind could be monitored before undertaking a spraying activity to help reduce exposure.

c. Redesign or environment - oriented approach

This requires the redesign of the manufacturing process or the substitution of alternative procedures in order to eliminate or reduce risks and hazards (Good 2001, Pitts and Kleinstein, 1993). However, during the initial design of a workplace, consultations could be held with clinicians to help reduce risks and hazards. The process is, however, very expensive and usually less preferred due to engineering costs.

d. Personal Protective Equipment (PPE)

Due to its cost-effectiveness, PPE is the most common approach to reducing hazardous exposure (Lipscomb, 2010; Good, 2001, Pitts and Kleinstein, 1993) and is readily available and offers protection for all types ocular injuries (Chatterjee et al, 2012). It does not require engineering costs or the increase in the number of employees that the administrative approach may require. These are usually used when there is no alternative solution (Pitts and Kleinstein, 1993; Geigle, 2000). For example, no engineering or administrative approach can protect a farm supervisor who must inspect or be on the farm during spraying. However, the supervisor may protect himself if the appropriate eye equipment is used by adhering to the guidelines for selection of protective materials. For example, when working with chemicals, personal protective devices such as goggles, eye cup and cover types are recommended (Bateman, 2010; Carson, 2009; Good 2001, Pitts and Kleinstein, 1993).

2.9.2 Protective eye devices

Protective devices/equipment offer protection to the wearer's face, and eyes, from a several hazards such as particles, projectiles, stones, light, heat, wind blast, sea or some type of ball or puck used in sports (Carson, 2009; Good, 2001; Geigle, 2000; Wyman, 2000). They may be classified as primary or secondary. “A primary protector is a device which may be worn in conjunction with a secondary protector or alone e.g. goggles, they may be used in conjunction with the other protectors or used alone and ii) a secondary protector is a device which shall be worn or used only in conjunction with a primary protector" (Wyman, 2000: 271; Good, 2001: 9). Secondary protectors include face shields, side shield, helmets and visors (Carson, 2009, Peate, 2007; Good, 2001).

a. Standards of protective devices

Efficient protective eyewear must meet the following requirements:

(i) tailored to specific purposes (different designs),

(ii) resistant against major impact as well as scratching,

(iii) held by a proper frame that does not break,

(iv) offer side, as well as, frontal protection without interfering with the field of view,

(v) designed to prevent fogging,

(vi) readily available and affordable (Carson, 2009; Kuhn, 2008).

The conditions under which people work and the type of work done determines the kind of protective device (primary or secondary) to use (Ballal, 1997; Rosenfield and Logan, 2009). The use of personal protective eyewear generally is intended to limit the risk of eye injury to the worker or his co-worker, supervisor, as well as, people who may visit the workplace.

b. Primary protective devices

i. Goggles

Goggles are protective devices intended to fit the face immediately surrounding the eyes to offer protection to the eyes and orbital cavities (Reese, 2011; Carson, 2009). Goggles are normally designed for sprotection from specific hazards such as infectious fluids, chemicals, dust or water from striking the eyes and from impact. Some goggles are designed to fit over corrective lenses and may also incorporate prescription spectacles with side shields and protective lenses that meet the standard requirements for protection against work place hazards while also correcting vision (Reese, 2011; Peate, 2007; Good, 2001; Wyman, 2000).

Goggles are divided into two main categories, impact resistant and splash resistant goggles. Vents are classified into four main types; gas-proof (for protection against harmful vapours), non-vented (for protection against fumes and vapours), indirect (permits the passage of air but not liquid) and direct (allows the dissipation of humidity and heat) (Good, 2001; Wyman, 2000). Goggles protect both the eyes and orbital cavities and come in two types, namely box goggles which is a transparent box which covers both eyes and cup/wire gauze goggles which offer protection to the eye and orbital cavities but have a cup for each eye (Carson, 2009).

Box type goggles have a one piece lens made of cellulose acetate, polycarbonate or toughened glass and the housing is made of PVC (polyvinyl chloride) which gives a good fit around the brows and cheeks. They are light weight with good ventilation and create no obstruction of vision. It is possible to wear prescription spectacles underneath but comfort can be affected. Prescription spectacles or laser goggles incorporate high optical density filter materials or reflective coatings to reduce potential harm from laser radiation and have no possible adjustment across the bridge (Carson, 2009; Wyman, 2000).

Wire gauze goggles are made from wire gauze which has very good impact resistance but are rarely used because they impair vision and give no protection against splashes of molten metal (Rosenfield and Logan, 2009; Good, 2001). Wire gauze is sometimes found as part of a face shield into which lenses are fitted. The housing is generally made of polyvinyl chloride (PVC). They sometimes have adjustable nasal fittings and if the rims have screws the lenses can be replaced or exchanged for another type of lens such as tinted or impact resistant. Some cup-type goggles also have large bridge aprons to protect the nose. However, the disadvantages of this are that ventilation is often poor which causes lenses to mist up when worn over prescription spectacles. If ventilation holes are present they must be screened to prevent penetration and blockage by dust or chemicals (Rosenfield and Logan, 2009; Peate, 2007). Goggles with a hard cup are sometimes uncomfortable to use and the frequently wide separation of the lenses, which obscure the sides, can obstruct central and peripheral vision (Rosenfield and Logan, 2009).

ii. Safety glasses

In general, spectacles only protect the eyes but offer limited protection to the orbital cavities. Safety glasses can be made in prescription or non-prescription form which may be incorporated into protective eyewear devices (Carson, 2009). The level of protection provided by eye glasses designed for ordinary wear is not necessarily sufficient to protect against work place hazards as they may splinter and cause more injury to the eye should they break or be hit by a projectile (Good, 2001; Wyman, 2000; Pitts and Kleinstein, 1993).

When choosing eye protection for workers, special care must be taken for workers who wear glasses with corrective lenses. This includes comfortable fitting goggles worn over corrective spectacles without altering the alignment (Rosenfield and Logan, 2009; Good, 2001). Protection for contact lens wearers is also vital because they are also exposed to the potential of an eye injury. Protective eyewear provided to workers may also incorporate corrective spectacles. Safety spectacles made of safety frames constructed of plastic or metal can be fitted with either plain or corrective impact resistant lenses for protection (Good, 2001; Wyman, 2000).

c. Secondary protective devices

i. Face shields

Face shields are devices that offer protection to both the eye and face from certain hazards (Reese, 2011; Carson, 2009). They are secondary protectors and are used only in conjunction with primary protectors which may be clear, filtering or mesh. These designs must be selected according to the type of task being performed (Carson, 2009). For example, head band supported visors that cover the face and neck are used to provide protection from chemical splashes, flying particles and molten metals. One major advantage is that they can be easily worn over prescription glasses or other types of protection if necessary and do not obstruct the field of view (Pitts and Kleinstein, 1993). The shields are usually made from either polycarbonate or cellulose acetate (Rosenfield and Logan, 2009). They can be hand held such as welding screens which have filters like an ocular tinted window. It is recommended that the use of goggles in conjunction with face shields or safety glasses to protect against impact hazards is emphasized because face shields alone do not provide the necessary protection from impact hazards for workers (Rosenfield and Logan, 2009; Peate, 2007; Good, 2001; Wyman, 2000).

ii. *Side shield*

A side shield is a device that attaches to the front of the frame, to provide angular protection from impact hazards because of its design, but does not offer full protection against chemical splashes. Wire mesh or plastic is used to make side shields and eyecup type shields provide the best protection (Wyman, 2000).

iii. *Helmets and visors*

A protective headgear made of hard material to resist blows include safety helmets, armor visors, firefighter's helmets and batting helmets (Carson, 2009). They are commonly worn during specific conditions such as a welding helmet which is a shielding device that filters intense light and radiant energy with the use of special absorptive lenses produced during welding operations (Rosenfield and Logan, 2009; Good, 2001). The entire face and neck are protected from intense radiation and splatter. Harmful radiation can be prevented from reaching the eyes by the use of an ocular containing a filter. Filters are designed in such a way that it can be flipped up to expose the impact resistant clear lens which is used during grinding and chipping operations (Rosenfield and Logan, 2009). In superior versions the window is fitted with a polarizing cell which darkens to welding densities as soon as the arc is struck. There is a tendency for the helmets to mist over but this can be eliminated by the inclusion of respiratory equipment, a feature essential where the gases from welding rods are toxic (Rosenfield and Logan, 2009; Good, 2001).

2.9.3 Utilization and barriers to use of ocular protection among farm workers

Protective equipment such as goggles and safety glasses are recommended for all farm activities that have a potential of causing injury to the eye such as spraying of chemicals, cutting and grinding, weeding, pruning, harvesting, among others (Forst et al, 2006). The use of such equipment has generally been successful in preventing injuries (Chatterjee et al, 2012). However, injuries may occur while farmers are wearing safety glasses/goggles (Quandt et al, 2012; Sprince et al, 2008; Forst et al, 2006). "Although the use of appropriate eye protective equipment is a recognized strategy to prevention of eye injury" (Sprince et al, 2008:18), goggles or safety glasses are infrequently used among farmers (Verma et al, 2011; Quandt et al, 2008: CDCP, 1995).

The Centre for Disease Control and Prevention (CDCP) in 1995 reported that 50% of farmworkers never used protective eye devices for high-risk activities such as pesticide application. Another study by Blanco-Muñoz and Lacasaña (2011) reported only 2% of ocular protection use among pesticide handlers in Mexico. Another study among a different category of Latino farmworkers recorded 1.6% use of glasses/goggles when working in the fields (Quandt et al, 2001). However, a study by Verma et al (2011) indicated that farm workers used varried types of eye protection although eye protection use was inadequate among the participants. The proportion of devices used included 4.7% (n = 14) sunglasses, 0.3% (n = 1) face shield, 4.0% (n = 12) protective glasses, and 2.7% (n = 8) goggles. Those who reported using the devices used it for activities such as planting, cultivating, harvesting, picking, and pruning. Similar findings were reported by Quant et al (2008) among migrant farm workers in North Carolina. In this study the overall use of eye protection was recorded among 8.9% participants who wore safety goggles or safety glasses, sunglasses, face shields and hats.

Reasons for the lack of use of eye protection are varied in the literature and include the device interfering with vision (visual acuity reduction), comfort (slipping, fogging), cosmetic, economic (Lack of funds to purchase protective devices), misconception, ignorance of eye protective device, and low education and training (Verma et al, 2011; Quandt et al, 2008; Forst et al, 2006; Quandt et al, 2001). Other reasons accounting for the low use of ocular protection among farmers include the lack of awareness of various risks associated with farm activities, indiscipline and low level of compliance (Diamantopoulou, 2003). There is therefore the need to intensify training and education on the use of ocular protection among farm worker populations.

In spite of the low use of eye protection reported among farmers in the literature, some authors have reported higher rates of use. For example a study by Schmid-Kubista et al (2010) indicated that 89.7% of farmers used ocular protection. Sprince et al (2008) also reported a relatively higher use of safety glasses (88%) among farmers who were 50 years and older and (47%) among the younger age group farmers (20-49 years). The high numbers of ocular protection use reported in these studies is in sharp contrast to the low use of goggles and other ocular protective devices widely reported in the literature.

It must, however, be noted that the use of sunglasses as reported by Schmid-Kubista, et al (2010), as well as, Verma et al (2011) and the use of hats reported Quandt et al (2012) as well as working under shades by (Schmid-Kubista et al, 2010) does not guarantee adequate ocular protection. At best, these devices reduce the amount of UV radiations entering the eye and farmers could be injured by projectiles or any other hazards that hits the eye with a high impact (Wyman, 2000).

The use of goggles has been closely linked with the perception of risk of ocular injuries among farmers. In a survey of 1554 cocoa farmers in six districts in Ghana, the use of personal protective equipment correlated with risk perception especially for children involved in pesticide spraying (Asuming-Brempong et al, 2006). The authors reported that all of the 13 children who perceived chemicals as a health hazard used personal protection equipment. This result was significant because it indicates that increasing awareness of the health risk of farming activity is likely to increase the use of personal protective equipment.

2.10 Ocular health seeking behaviour

In spite of the numerous ocular health challenges documented, several authors have reported poor attitudes towards eye care seeking behaviours among agricultural workers (Quandt et al, 2012; Verma et al, 2011; Verma, 2010; Quandt et al, 2008; Quandt et al, 2001; Villarejo et al, 2000). For example, Villarejo et al (2000) reported that two-thirds of farmworkers in California studied had never had an eye examination before. In a related study, Quandt et al (2008) reported that over 38% of farmworkers had never seen an eye care professional in their working life, 27% sought eye care a year before the study while 17.9% had done so in more than 2 years. Similarly, Quandt et al (2012) reported that 53.3% of farmworkers in North Carolina had never had an eye examination.

Major barriers reported to seeking eye care among such farmers are low income, long distance to health care facilities and issues with transportation as well as lack of health insurance (Verma, 2010; Quandt et al, 2008; Quandt et al, 2001a). These factors may be compounded by the individual's own perception about his or her visual status which influences their choice of whether to seek health care or not (Slappendel, 1995). Quandt et al (2008) indicated that 28.1% farmworkers who had not sought eye care in more than 2 years reported having difficulty with access to eye care facilities, 17.5% cited cost or no insurance as a reason for not seeking eye care while 28.1% had never thought of it with the last group of 42.1% indicating that they had no eye problems so saw no reason to do so.

It is also known that "agricultural workers mostly ignore or self-treat their illness rather than use medical care (Arcury et al, 2010: 240). This is because farmers do not lose their job, although they are unaware of any effective treatment options (Rao et al, 2004). The use of traditional remedies including herbs, chlorine bleach, milk, and medicine purchased at small local stores that serve have been reported among farmers (Arcury et al, 2010; Poss et al, 2005; Mainous et al, 2008). Although these methods of treatment may be efficient, they could have serious repercurssion on the ocular health of farmers (Arcury et al, 2010; Cathcart et al, 2008).

2.11 Conclusion

Most studies on eye health among farmers focuses on self-reported ocular complaints and injuries using questionnaires. For this reason, eye conditions among these workers are normally based on reports from farmers rather than from assessment and diagnosis (Quandt et al, 2008). However, few authors have documented ocular conditions based on hospital records or registry. Although hospital records provide useful data, they do not always represent the actual prevalence of ocular conditions in a population. This study aims at providing a fairly balanced data on ocular conditions based on complaints, assessment and diagnosis. Similarly, few studies have documented the level of refractive errors and visual impairment in farming populations (Verma et al, 2011; Verma, 2010). This gap will be filled through a comprehensive refraction in this study.

Further, most of the literature consulted outlined a number of demographic and farm characteristics that influence eye injuries. However, ocular risk factors associated with the occurrence of eye injuries have not been explored. This study aims at exploring these factors to contribute to the knowledge in this area.

Several reasons have been postulated in the literature as being the barriers to the use of PEW among farmers (Verma et al, 2011; Quandt et al, 2008: CDCP, 1995). However, no such data exists for cocoa farmers in Ghana. Similarly, several authors have reported poor attitudes towards eye care among agricultural workers (Quandt et al, 2012; Verma et al, 2011; Verma, 2010; Quandt et al, 2008; Quandt et al, 2001; Villarejo et al, 2000). It is unclear which of these reasons will suffice in the geographical area and population under study. This study therefore seeks to fill in these gaps through the provision of relevant data.

Agriculture remains the bedrock of most African economies and plays an important role in alleviating poverty among its citizens. Notwithstanding the high rate of ocular hazards in agriculture, there is a paucity of literature on the ocular health of agricultural workers in Africa with the bulk of research concentrating on crop yields and pest and disease control. With the high prevalence of ocular hazards in agriculture, effective approaches for the prevention or elimination of these hazards need to be explored. This will ensure that all agricultural workers within the continent enjoy quality eye and general health as enshrined in the ILO Convention 184 on Occupational Health for Agricultural workers.

The African policy agenda has reaffirmed the enforcement of agricultural development through policy amendments, capacity building, improvements in rural health and education and advocacy, as well as increase in investment in public infrastructure (Gitau et al, 2009; Cleaver and Donovan, 1995). However, the success of any eye health policy in Africa will largely depend on awareness and willingness of entrepreneurs, sector organizations and governments to establish new initiatives to combat risk taking behaviour, negative perceptions about ocular hazards and poor health seeking behaviour that exists among agricultural workers (Quandt et al, 2012). These measures must be well integrated into the primary health care systems across Africa. There is also the need for eye care professionals within the continent to be encouraged to work in rural areas where most of these farmers work.

CHAPTER 3: THEORETICAL FRAMEWORK: OCCUPATIONAL HEALTH AND SAFETY

3.1 Introduction

This chapter discusses issues relating to occupational health and safety (OHS) in the workplace, with specific reference to cocoa farmers and their activities to provide context to this study. It begins with a review of the concept of health, OHS and occupational diseases, with specific reference to farm workers. The theoretical concepts which underpinned the development of the study protocol are highlighted, with a focus on the global burden of occupational health, diseases and injuries. The burden and economic cost of visual impairment and blindness as well as work-related eye injuries are also discussed. The historical antecedents regarding occupational safety, health and diseases are traced in this chapter. The chapter also discusses various perspectives on OHS and then focuses on its legal framework in Ghana, with emphasis on the lack of a regulatory framework that addresses the eye health of farmers. Finally, relevant issues on healthy workplace and workplace hazards that influence the health of farm workers and their ocular health and safety are briefly discussed.

3.2 Concept of health and healthy worker

Health is defined by the World Health Organization (WHO) as “a state of complete physical, mental and social well-being and not merely the absence of disease and illness” (WHO, 1948: 100). The physical health of an individual has been described as a continuum that ranges from a disease state at one extreme, through a situation in which the person has no specific disease, even though they do not enjoy the utmost health credentials, to the other extreme where a person may enjoy full health (well-being). This definition of health implies that people may claim to be healthy even though this may not be the case, as they may not manifest symptoms of a pre- clinical illness. It is therefore likely that not everyone has the same expectations of what is meant by health, as they may be operating in a state they perceive to be convenient and normal, hence the difficulty in defining who a healthy person is.

The daily activities of an individual, including their work, determine an individual's location on the health continuum. Health cannot be maintained if there are hazards in the workplace, such as noxious fumes, dust, chemicals and heat, which can undermine the health of workers (Pantry, 1995). For example, a farmer may not be able to continue if he has a cataract that had developed as a result of a trauma suffered at the workplace or long-term exposure to radiations and heat. Such a person may be a danger to himself and others as a result of the inability to see. Therefore, the achievement and maintenance of an optimum state of health in the workplace should not only be an individual responsibility, but also that of companies, communities and governments. Many people spend a considerable amount of time at their workplace (Saha et al, 2010; Roy and Dasgupta, 2008; WHO, 1997). For many agricultural workers, particularly in the developing countries, the home and work setting may be in very close proximity or the same location, this being the case for most of the cocoa farmers involved in this study. They may be exposed to several hazards such as chemicals which may affect their ocular health which they otherwise would not have experienced if they lived away from the farm settings. Therefore, efforts to address the health of agricultural workers must be comprehensively approached taking all factors affecting their health into consideration to ensure that a healthy workforce with good vision is maintained to enhance and sustain productivity. According to Diamantopoulou (2003), a healthy worker is an individual who is able to accomplish the task by which he or she earns a livelihood. This definition, however, is limited to an extent in that the ability to accomplish a task by which one earns a livelihood in an unhealthy workplace has both immediate and long-term consequences. Therefore, a healthy worker must be able to accomplish a livelihood in a healthy and safe workplace. It is important to note that vision is critical in task accomplishment for most workers, particularly with regards to farm workers in their daily activities on the farm.

3.2.1. Definition of occupational health and safety

An understanding of issues on occupational health and safety (OHS) is fundamental in discussing the ocular health of farmers. As alluded to earlier, several factors (social, physical, personal lifestyle, work) impact on the health status of workers. A good balance of these factors enables individual workers to achieve set targets and goals that enhance their daily survival. Work has been said to contribute greatly to the health status of individuals (Raphael et al, 1997; Nutbeam, 1990), hence the heightened interest of international organizations in occupational health. According to the WHO and International Labour Organization (ILO),

> "Occupational health is the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention amongst workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the workers in an occupational environment adapted to their physiological and psychological capabilities; and, to summarize: the adaptation of work to man and of each man to his job" (WHO, 1995: 3; Guidotti 2011: 5).

The above definition suggests that occupational health is not just a single risk-oriented activity but a multidisciplinary one that focuses on several factors (physical, mental, emotional, social, general health, personal development among others) of their work and work setting (Amponsah-Tawiah and Dartey-Baah, 2011; WHO, 1994a). As output is partly dependent on the workers' state of health, an understanding of the concept of OHS is important to ensure the survival of any organization (Pitts and Kleinstein, 1993). The multidisciplinary and multisectoral character of OHS requires that more professionals from diverse backgrounds, employers, workers and governments work together to achieve the desired health benefits for workers, as well as, productivity outcomes (Rantanen and Fedotov, 1995). This underscores the need for a multidisciplinary (eye care professionals, Cocoa Marketing Companies, Ministry of Health, Ministry of Agriculture, COCBOD, Government of Ghana, among others) approach in efforts aimed at resolving the ocular health challenges faced by cocoa farmers.

The focus of OHS schemes has conventionally been on the exposure to biological, physical and chemical hazards to the derelict of psychosocial threats at work which are inadequately understood especially in developing countries (WHO, 2007). Psychosocial factors include health issues in the physical work environment, effect of health outcomes due to nature of work, work arrangement and its related stress, among others. According to WHO (2007), these issues are now given high priority in OHS programmes across the globe, specifically in the developed countries. These efforts have been enhanced in recent times by the WHO through the declaration that, "all workers have the right to healthy and safe work and to a work environment that enables them to live a socially and economically productive life" (WHO, 1994b: 1). This declaration lends credence to the fact that workers are the focal point of all productivity issues at the work place and hence, issues relating to health are important and should not taken for granted, particularly as it relates to their vision.

Harter et al (2003) stressed the need for employers to take an interest in OHS matters as up to one-third of a working adult's time is spent at work, and career satisfaction has a direct bearing on productivity. The benefits of high productivity due to sound OHS policies do not only accrue to organizations and enterprises, but also to national economies through taxes and a reduced reliance on national social support systems. This assertion has been supported by the WHO, with a high standard of OHS showing a positive relationship with high gross national product per capita (WHO, 1995). Thus, a country with high investment in OHS has high productivity and strong economy and vice versa (WHO, 1995). This is an indication that low investments in OHS are a disincentive to economic development. Hence there is a need for developing economies of Africa to begin paying the needed attention to OHS activities, policies and programmes especially in the area of agriculture as most depend on its proceeds for economic growth.

3.2.2. Occupational diseases among farm workers

According to the ILO (2009), any disease acquired due to exposure to hazards and risk factors in the work environment may be termed an "occupational disease". It is one of the most complex issues confronting workers in modern times (WHO, 2006). For example, eye conditions such as cataract and pterygium could be occupational diseases if it is established that their occurrence among a particular population, such as farmers, is associated with exposure to ultraviolet radiation at the workplace. The ILO (2009) reported that the diagnosis, identification of causes and the subsequent control of risks to reduce occupational disease are complex. Indeed, the period between exposure and diagnosis of occupational diseases can be as long as 30 years (ILO, 2009; Pantry, 1995). There is therefore the recognition that the challenges of preventing occupationally induced diseases are largely neglected, as there is great variability in their occurrence. As a result, a lot of resources need to be dedicated to studies of occupationally induced diseases to aid appropriate interventions especially in developing countries where the effect is felt greater (Geller, 1996; Petersen, 1996).

While it is acknowledged that occupational diseases contribute immensely to the global burden of diseases, complexities surrounding its occurrence, coupled with inadequate monitoring systems and ineffective policies, have culminated in poor reporting of occupational diseases, as well as, inaccurate assessment of the extent of liabilities due to such diseases (Drummond, 2007; ILO, 2003; Pantry, 1995). This may well explain the low reports on occupational eye diseases as opposed to occupational eye injuries. The main reason for this is due to the fact that most occupational diseases are multifactorial in nature, with workplace exposure being just one risk factor, making data collection and reporting a challenge due to difficulties in defining cases. This has led to fragmentation in reporting such diseases across the globe (Driscoll et al, 2005; Leigh et al, 1999). It is therefore necessary to use a range of data sources in estimating the burden of occupational disease in most countries, such as "death records, hospital records, workers' compensation claims, cancer registries, workplace records, surveys and sentinel reports" (Drummond, 2007: 10). To this end, there is a need to prioritize data collection for occupational diseases, having in mind that no single data source accurately provides the answer to the burden of such diseases (Leigh et al, 1999).

Other reasons may be related to the latency period of exposure to hazards leading to a disease, the multiple causation of diseases, gaps in taking the medical history of patients, and poor record keeping (Driscoll et al, 2005; Kendall, 2005; Herbert and Landrigan, 2000; Leigh et al, 1999). Despite these challenges, the ILO proposes that,

> “Occupational diseases are those that are included in international or national lists, and are usually compensable by national workers’ compensation schemes and are recordable under reporting systems (for example, silicosis and diseases caused by many chemical agents). For occupational diseases, work is considered the main cause of the disease. Work-related diseases are those where work is one of several components contributing to the disease. Such diseases are compensated only in very few cases and in very few countries.” (ILO, 2005: 11).

3.3 Theoretical framework: Occupational Safety and Health in the workplace model

Work-related eye diseases and injuries among farmers are due to the interactions between farm workers and the physical work environment. For the purposes of this study, two models were used as a basis for developing the study protocol: the occupational safety and health in the workplace model, and the health belief model, each of which will be reviewed (EASHW, 2003; Janz et al, 2002).

3.3.1. The Occupational Safety and Health in the Workplace model

The Occupational Safety and Health in the Workplace model **(Figure 2.1)** was adapted for this study due to its applicability to the settings of cocoa farms in Ghana (EASHW, 2003). The model has three main components, each of which will be explored with respect to how they will influence the vision, safety and health outcomes among the farmers.

a. Work organization: the model recognizes modern and traditional methods of farming. Each of these methods may expose farmers and farm workers to different levels of ocular injury and diseases. These farmers may be full-or part-time workers (a determinant of time spent on farms) with different working conditions that may impact on their ocular health. The model also recognizes that working time flexibility, such as long hours and other stressors, may influence general, as well as, ocular health outcomes among farmers.
b. Work conditions: the model refer to differences in exposures to physical, chemical and biological risks. These risks and hazards on the farm may emanate from a variety of activities including spraying with agrochemicals and pesticides, weeding, cutting trees, plucking of pods, pricks from trees and bites from insects among other activities. Individual life styles, such as the use of alcohol and tobacco, may also produce unique ocular health outcomes.
c. Occupational safety and health systems: such as health promotion, interventional practices including the use of protective eye wear and rehabilitative practices, and occupational health policies and their implementation form the third component of the model. It is expected that, where available, well-implemented occupational health policies would help reduce negative (ocular) health outcomes among farm workers.

These components of the model could influence vision, safety and health outcomes among the farmers either individually or by an interaction between the components and workers. The three key levels of providing health care in the model are health promotion, prevention and cure. Health promotion seeks to ensure that activities and life styles are such that undesired visual health outcomes will not occur in a population. Prevention deals with attempts to ensure that an individual or a group is not affected by a problem. "Primary prevention and counselling on proper eye protection is essential, as over 90 percent of injuries can be avoided with the use of eye protection devices" (Peate, 2007: 1020). Curative measures entail seeking treatment after an undesired visual condition has occurred. Issues considered in this model were fundamental in designing the study instruments (i.e. interview questionnaires, eye examination and ocular health and safety education and intervention programme).

The model was adopted due to the fact that it can accommodate the traditional practices of cocoa farms and the employment relationships. Cocoa farmers may also be exposed to all the hazards mentioned in the model such as physical, biological, chemical and ergonomic. Finally, occupational health and safety practices that are a component of the health care system in Ghana, although weak, are also acknowledged by the model. Notwithstanding these strengths, the model does not take into consideration the fact that in the Ghanaian setting, most of the cocoa farms are owned by individual farmers and that complex employment relationships, such as part- and full-time workers, may therefore not exist as happens in Europe. While the model acknowledges that individual biological differences may influence health outcomes, exploring their interaction with workplace hazards is not feasible in this study. The model is summarized in **Figure 3.1**.

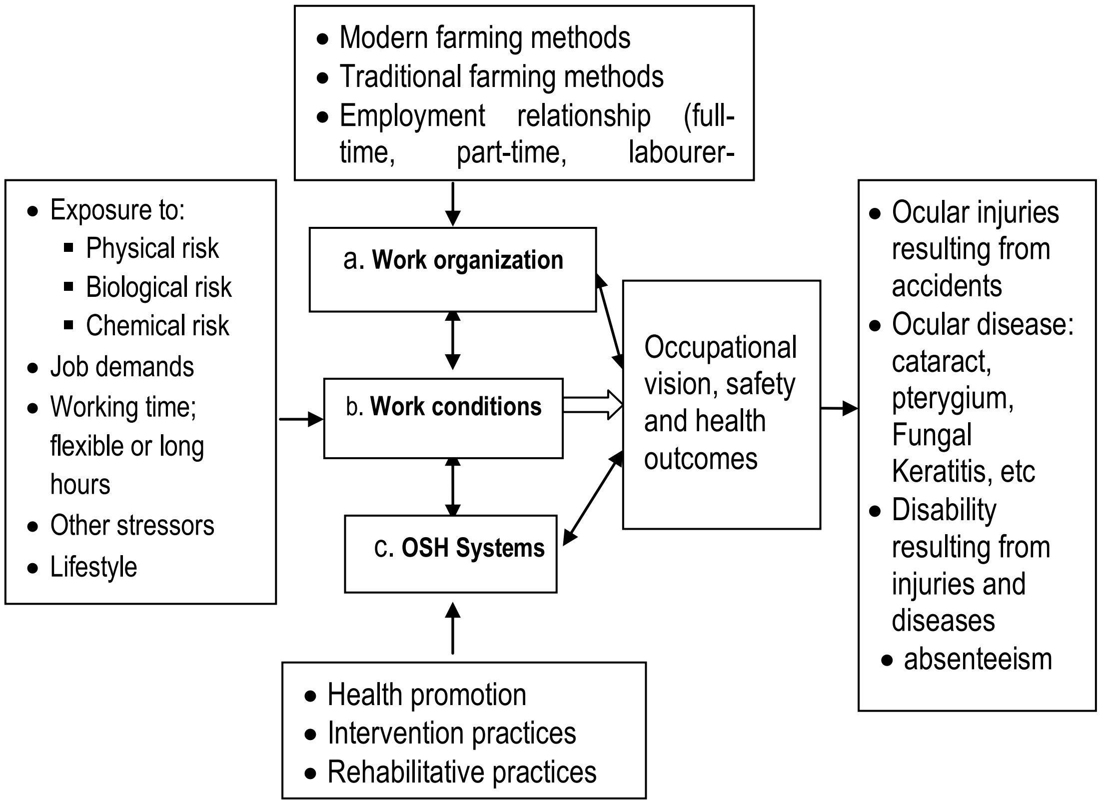

Figure 3. 1 Occupational Safety and Health in the Workplace Model

Source: European Agency for Safety and Health at Work, 2003.

As a result of the challenges indicated above, the Occupational Safety and Health in the Workplace model was situated within a broader context of the health belief model (HBM) in designing this study. This was done to enhance an understanding of the individual factors that may influence disease outcomes among the study participants.

3.3.2. The health belief model

Several models have been proposed to explain the behaviour of individuals in predicting health outcomes, or participating in health promotions and preventive health behaviour. The health belief model (HBM), "an interpersonal (individual, knowledge and beliefs) model" focuses on assessing the health behaviour of individuals through a critical examination of the perceptions and mind-set of a person towards a disease and the consequences of certain actions (Janz et al, 2002; Rosenstock, 1974). The model assumes that change in behaviour occurs due to the existence of three ideas at the same time, namely; individual perception (perceived susceptibility and severity); modifying factors (perceived threats); and likelihood of action (perceived benefits and barriers) (Janz et al, 2002; Rosenstock, 1974).

a. Individual perception: this contends that a person must appreciate the need to prioritize a health concern. It involves the knowledge and beliefs of a person about health behaviour and the associated outcomes. It covers two main components; perceived susceptibility and perceived severity. Perceived susceptibility focuses on the individual's beliefs about how the likelihood of their behaviour will lead to a certain negative health outcomes (Glanz et al, 1997). This could be attitudes to smoking, alcohol intake, work involved in among others. The purpose of this is to understand the individual opinion and change the perception of susceptibility in order to affect or move towards behaviour change. Perceived severity focuses on how serious a disease can be. For example, in the case of cocoa farmers, they may not understand how painful an eye disease or injury may be, as well as, its implication on productivity and the quality of life. The goal of the HBM in this context is to increase the understanding and awareness of how serious the outcome of a behaviour could be (such as blindness in the context of this study) in order to increase the quality of life.

b. Modifying factors: these focus on whether an individual understands that they may be vulnerable to a disease or a negative health outcome (perceived threats), how the environment impacts on such disease and cues to action that influences a behaviour. Threat in this context examines the likelihood of a disease being developed (from perceived susceptible conditions). For example, a farmer who does not use protective eye equipment most of the time may feel less threatened by a potential eye condition as opposed to a farmer who has developed traumatic cataract due to injury on the farm. The later may be concerned by the possibility of poor vision, which could trigger his decision to change his attitude towards ocular protection use. The HBM also acknowledges that environmental factors can contribute to the occurrence of a disease. These factors may include demographic factors such as race, ethnicity and socioeconomic status. For example, poverty could influence the ocular health seeking behaviour of individuals. Equally, conditions within a community (poor health facilities, negative peer influences, etc) could contribute to disease outcomes. If in a community, farmers suffering from eye diseases resort to the use of herbs, it is likely to be emulated by other community members. In the case of cocoa farmers, environmental factors may include ocular hazards they are exposed to in the farm as enumerated in the Occupational Safety and Health in the Workplace model discussed earlier. The last factor under the modifying conditions examines the cues to action that focus on anything that triggers a decision to change behaviour. The individual may be made aware of the threats of a disease through the media, family or friends. It could also be through health education (ocular health education), which was a component of this study.

c. The likelihood of actions: the individual must understand that it is important to have a change in behviour, and that the reward of such a change supercedes the cost of doing so, when the individual is educated on the possibility of developing a disease (perceived benefits and barriers). A perceived benefit should therefore assists in improving the quality of life for an individual both mentally and physically. While a benefit from change could improve health outcome, there can also be perceived barriers that influence why an individual cannot change their behaviour. This could be attributed to a wide range of factors, such as economic (lack of money), socio-demographic, geographic, socio-psychological, socio-cultural, and organizational (Cummings et al, 1980). More recently, self-efficacy which concentrates on personal beliefs in one's own ability to do something about a health situation has been added to the model (Glanz et al, 1997).

The three components of the HBM works simultaneously to promote healthy lifestyle among individuals who are at risk of developing ocular injuries and diseases such as cocoa farmers (Janz et al, 2002).

3.3.3. Combined factors from the Occupational Safety and Health Model and Health Belief Model

The two models provide a good background in understanding issues that may influence the ocular health of cocoa farmers in Ghana. Although there are some overlaps in the two models, they played complementary roles in designing a complete study protocol. Combining the factors enumerated by the Occupational Safety and Health in the Workplace model and those raised in the HBM, the factors investigated in this research study consisted of the following issues:

- socio-demographic and socioeconomic,
- work organization,
- work conditions (occupational exposure: hazards and threats to eye health),
- Occupational safety and health systems (ocular protection use, etc)
- access to eye health,
- barriers to seeking eye care, as well as,
- perceptions and risk beliefs on ocular health and safety practices in the farm.

These factors formed the basis for designing the protocol used in this study to enhance our understanding of the issues that affect the ocular health of cocoa farmers in Ghana.

3.4 Obtaining an occupational health history

In assessing any working population, taking the occupational health history plays a pivotal role in examining the association between work and health problems, therefore, it should be a routine component of any comprehensive assessment of workers. It requires much more details than just a brief question about the patient's job title which is mostly asked by practitioners. Occupational history has two components; the survey occupational history, if needed, the diagnostic occupational history and task analysis (Pitts and Kleinstein, 1993; Goldman, 1986).

3.4.1. Basic and diagnostic occupational history

Gathering information about workers occupational history includes obtaining a description of current and past jobs and occupations; employment status; exposure to hazards; and an evaluation of the work-relatedness of the major complaint made by the worker or diagnosis made after examination. The basic questions that may be adapted to address these key points are;

a. "Describe your current and longest-held former jobs, including duties, materials used, and existing potential hazards including eye and vision hazards.
b. Are you now, or have you ever been, exposed to high intensity light, radiation, chemicals, fumes, dusts or biologic agents? Practitioners may include a brief assessment of types, intensity, and duration.
c. Do you believe that any of your problems (signs and symptoms) are related to your work (or activities or hobbies at home)?

d. Did any change in your normal work task (procedures or processes) occur before you noticed your recent problem or complaint?
e. Do any of your co-workers have problems similar to yours?" (Pitts and Kleinstein, 1993: 19)

The occupational health history is as important as all other parts of the history taking. The relevance of these questions is to assist the eye care professional to determine if there is a reasonable association between the major complaint of the worker and work/home activities or exposure to hazards, either at present or in the past and ultimately helps in making diagnosis (McCunney, 1998). It is also important to consider other factors that may contribute to the ocular health challenges which workers may face such as cigarette or tobacco smoking, medications or drug or alcohol use (Hiratsuka and Li, 2001; Cheng et al, 2000). For example, complaints of poor night vision could be caused by exposure to carbon monoxide from cigarette smoking (Havelius and Hansen, 2005; Von Restorff and Hevish, 1998).

It may be important to pay attention to whether reported symptoms reduce or disappear when the patient is away from work (i.e. weekends or vacations) and reappear with their return to work in making a determination of its occupational relatedness (McCunney, 1998; Cullen et al, 1990). However, this may not apply in all situations, especially if there is an accumulated or latent disease such as the gradual formation of cataract and among certain occupations such as farmers who hardly go on vacations and mostly spend almost the entire weekdays in the farm such as the case of cocoa farmers in this study.

Diagnostic occupational history is an expanded version of the basic occupational history and may be explored if there are doubts that the patient's signs or symptoms are related to work or the environment following a survey occupational history (McCunney, 1998). More detailed information on the workers' health, work environment and hazards are documented under this procedure to enhance decision making on the occupational relatedness or otherwise of an ocular condition. The key information collected may include

a. "a listing of all jobs,
b. identification of all specific work on these jobs,
c. description of all operations performed on the job,
d. assessment of illness in other workers similar to those of the worker." (Pitts and Kleinstein, 1993:19).

It is important to mention that asking workers about their job titles alone may not be sufficient to elicit hazards associated with these titles. It is therefore imperative to directly ask workers about the potential hazards they face at work because they are often well-informed about their workplace hazards and exposures than the eye care practitioner may assume to know (Pitts and Kleinstein, 1993). There is always a need for a follow up for workers who may not have adequate knowledge on the hazards they face at work than to make a wrong assumption based on job titles. Where possible, it will be particularly useful to estimate exposure dose during an assessment of exposure hazards. This will give a clear indication as to how often and the level of hazards the worker is exposed to during a typical working day (Pitts and Kleinstein, 1993). Other determinants of exposure levels, which must not be ignored, include a consideration of the use of personal protective equipment and protective clothing among the workers. It may also be important to consider the non-occupational exposures occurring in the homes or communities in which workers live, as well as, personal habits since these may contribute to and or exacerbate the effect of hazardous exposures at the workplace.

3.4.2. Task analysis

Task analysis involves a detailed assessment of tasks undertaken by workers with the aim of maximizing visual performance and reducing vision hazards at the workplace. This detailed assessment is based on the fact that different jobs require different visual skills, hence, the need to be thorough and specific in carrying out this procedure (Good, 2001; Pitts and Kleinstein, 1993). Key requirements needed for this task include knowledge of visual and ophthalmic optics, binocular vision and oculomotor control, photopic and scotopic illuminance requirements, colour contrast, contrast glare, ergonomic performance, and many others which are usually part of the training of the optometry professional. These procedures are carried out keeping in mind that workers with good vision have enhanced production levels with reduced incidence of accidents and are more stable on the job (Pitts and Kleinstein, 1993). The task analysis begins with the assessment of the visual requirement of the job and requires assessment of the following data:

a. "Job description, including all the different tasks and procedures done during the usual work day, indoors or outdoors. Infrequent tasks should also be described including frequency and duration. Working position should also be described including sitting, standing, walking, among others.

b. Distance from the workers' eye to the work areas, accommodative and convergence demands.
c. Work movement: fixed or changing, slow or rapid, constant or intermittent, vertical, horizontal, or rotary.
d. Work area size, centrally and peripherally.
e. Visual attention requirements: fixed or changing, casual or concentrated, detailed or gross, constant or intermittent duration.
f. Work and surrounding area illumination: quantity, quality, and direction of lamination, reflectance; disability or minimal glare; brightness ratios; and contrast.
g. Colour discrimination requirement: gross, fine or none.
h. Stereoacuity requirements: detailed, gross or none.
i. Position of work surface: at, below, or above eye level, angle of work with respect to straight head position, to left or to right.
j. Eye and vision hazards: metals or non-metal particles, dust, fumes, chemicals, moving machinery, radiation, UV, IR and laser sources.
k. Size of task details: fine, medium, gross.
l. Peripheral vision requirements." (Pitts and Kleinstein, 1993:29)

Information from these procedures not only aids in determining the visual requirements for each job, as well as, the type of ocular protection that may be needed to help maximize visual performance of workers' on the job, but also ensures that workers' carry out their tasks safely with increased productivity (Good, 2001). Due to the focus of this study in evaluating the ocular health status of cocoa farmers, not all the above recommended points were incorporated in the study protocol. However, some key points such as hazards assessment, peripheral vision assessment, and colour vision assessment among others were included.

3.5 History and current status of occupational health, safety and disease

Studies on OHS have been in existence since the inception of structured work. Several authors including Hippocrates (460-377 BC) and George Bauer (1492-1555) wrote about the threat poor work environments posed to slaves especially in the mining industry and suggested ways of improving those conditions (Raouf and Dhillon, 1994). The value placed on OHS is exemplified by the fact that Caesar (100–40 BC) had a safety manager among his soldiers (Pease, 1985). Prominent among the early writers on OHS issues was Bernadino Ramazzini (1633-1714), who documented occupational health hazards, death and injury rates in several industries (i.e., glass work, painting, weaving and mining) and discussed ways of reducing these occurrences (Barber, 2007; Tayyari and Smith, 1997; Raouf and Dhillon, 1994; Wright, 1964). Ramazzini also documented the effect of poor work conditions on the eyes, with its resultant blindness if care was not taken among cleaners of privies and cesspits (Wright, 1964). The extensive work done by Ramazzini has earned him the accolade 'father of OHS' in the realms of health and safety studies.

These early safety experts certainly set the stage for advancing measures aimed at reducing injuries and illnesses across occupations. Unfortunately, earlier efforts to reduce occupational illness or injury were stalled by the fact that the employee rarely reported work-related diseases and injuries for fear of being dismissed and being out of the job (Pettinger, 2000). This phenomenon has however changed over the years with increased awareness of the need for good health among workers currently being championed by the WHO and the ILO that have led several international and sub-regional fora on improving workers' health. Of much relevance to this study among the many conventions and declarations by WHO and ILO, is the ILO Convention 184, on occupational health and safety for agricultural workers (ILO, 2001) which was preceded by ILO Convention 155 on occupational health and safety at the work environment. The ILO convention 184, sought to promote the health and well-being of agricultural workers. Several WHO/ILO joint efforts on OHS in Africa that have also sought to build capacity for OHS; and formulate polices and legislations for employee health and safety in Africa (Puplampu and Quartey, 2012). Similarly, the "Global Plan of Action on Workers Health": which has been touted as a landmark document which gave clear meaning to the "1995 Global Strategy on Occupational Health for All", by spelling out precise goals and setting a clear agenda for execution of OHS services and promotion (Burton, 2010) was also passed by the WHO and ILO. Based on this plan, the current concept of OHS also includes health protection and health promotion in the workplace and workplace settings (Burton, 2010).

All these global initiatives and several declarations since the formation of the "Joint ILO/WHO Committee on Occupational Health" in 1950, by the WHO and the ILO, regional bodies and governments, have contributed to the current trend of much attention being paid to workers' health culminating in an improved awareness of occupational injuries and diseases. Although several declarations have been made and signed by member countries, implementation at the national level leaves much to be desired, especially in developing countries. Much more commitment needs to be made by governments and other agencies to help improve OHS across developing countries especially in Africa.

3.5.1. Perspectives on Occupational Health and Safety

There are several perspectives on the subject of OHS regarding its definition and an appropriate name for research studies conducted in this field. While there are distinctions between occupational health and occupational safety, there is yet another term; worksite health which does not focus on the traditional OHS issues (Baker et al, 1996; Tayyari and Smith, 1997). However, a combination of the first two terms has initiated a debate on the appropriate name for industrial research. While some researchers argue in favour of occupational health and safety (OHS) (Baker et al, 1996; Goldenhar and Schulte, 1994), others are in favour of occupational safety and health (OSH) (Burton, 2010). Each of these terms seeks to achieve targets that compliment the other. This is indicated by research on occupational safety focusing primarily on preventing injury, engineering or human factors involved in injury, education and training, discipline or compliance to safety regulations, as well as property damage (Bird and Germain, 1997). While occupational health also explores controlling employees' exposure to occupational disease, worksite health programmes focus on the individuals' lifestyles or health-related habits that may take place on or outside the workplace (Kerr et al, 1996; Opatz, 1994). These perspectives served as a guide in designing this study.

However, with regards to safety-related interventions at work, occupational safety, occupational health and worksite health promotion have similar characteristics, all three being centered on health behaviour. Health behaviour refers to how the conduct of individuals, groups or organizations live a healthy and safe life, their health seeking behaviour, as well as, following the prescribed medical intervention when help is sought following a sickness (Glanz et al, 1997; Gochman, 1997; Winett, 1998).

According to Kasl and Cobb (1966a, 1966b), there are three categories of health behaviours: preventive, illness and sick-role behaviours. The authors define preventive health behaviour as "any positive response taken to maintain a healthy lifestyle" (Kasl and Cobb, 1966a:247). Such positive attitudes at the workplace may include but is not limited to the wearing of safety belts, using personal protective equipment and adhering to other safety standards (Pettinger, 2000; Gel1er, 1998a; Geller, 1996). Illness and sick-role behaviours focus on the attitude of the individual when they have diseases or sustain an injury. The target of most OHS interventions is primary in nature and there is therefore an overlap in the definition of preventive health behaviours and targets of OHS. As a result of these discussions, this study examined the preventive health behaviour (such as the use of goggles and other forms of protection) and the illness/sick role behaviour of cocoa farmers after sustaining ocular injury on farms as mentioned in the Occupational Safety and Health in the workplace model.

3.5.2. Global burden of occupational injuries and diseases

A healthy workforce does not only inure to the benefit of workers and their relatives, it is also of immense benefit to organizations and industries, as well as, the national and international economy (Burton, 2010; WHO, 2010b; Ylikoski et al, 2006). Factors affecting workers' health and safety are often compromised, leading to work related accidents, injuries, diseases, and in some cases death. An occupational accident is defined as "an occurrence arising out of or in the course of work and resulting in a fatal or non-fatal occupational injury" (ILO, 1996: 2), whiles "a work-related disease is one that has been shown to have an association with work" (Takala, 1999:641).

It has been reported that the annual global fatal unintentional occupational injuries stand at about 312,000 (Concha-Barrientos et al, 2005) with farming contributing greatly to this burden (Leigh et al, 1999). Hämäläinen et al, (2007, 2006) also projected that approximately 2 million fatal work-related diseases and occupational accidents occur annually (345,000 fatal occupational accidents and 1.6 million work-related diseases). Further, about 263 million occupational accidents occur annually causing at least four days of absence from work. A recent statistic from the ILO and WHO indicated that more than 2.3 million people lose their lives annually (7 000 people per day) due to fatal occupational accidents or work-related diseases (Hämäläinen et al, 2009). A further 960,000 workers get hurt at work every day. According to the current global estimates, fatal work-related diseases and occupational accidents that cause a loss of at least four work days have significantly increased to about 300 million (Hämäläinen et al, 2009), while about 160 million incidence of work related illnesses has been reported to occur every year (WHO, 2010b; ILO, 2005; 2004). Further, reports indicate that work-related injuries result in 250,000 potential productive years of life being lost annually (Baker et al, 1996; Leigh et al, 1999).

These figures point to a needless health burden and suffering of workers arising out of an unacceptable high global workplace fatalities, injuries and illness which reduces gross domestic product of nations by 4-5% across the world (McKenzie et al, 2008; ILO, 2003). Therefore, with an approximate total gross national product (GNP) of the world in 2003 projected at $34 * 10^{12}$ USD, the annual cost of work-related injuries and diseases was approximately $1.36*10^{12}$ USD (Hämäläinen et al, 2009; Statistics Finland, 2005). If curtailed, these huge losses could improve the economic fortunes of nations.

However, the reported economic losses and negative statistics reflect only fatal illnesses and injury data from registered workplaces while occupational accidents that caused at least four days of lost work time are mostly not reported (WHO, 2010b; Hämäläinen et al, 2009). The challenge of obtaining accurate data is compounded by the fact that most people in many countries especially in Africa, are employed in the informal economy, where it is difficult to keep track of diseases or injuries that affect them (Burton, 2010). The case is not different in Ghana as about 53.9% of the total workforce is employed in the informal agricultural sector (Heintz, 2005) where it is difficult to keep track of work-related diseases and injuries. This makes it difficult for the development of any effective intervention and planning. Although Mock et al (2005) reported a high prevalence of occupational injuries, as well as, work related morbidity (9661 per 100, 000) among informal sector workers in Ghana, the report lacked any details to aid effective interventional planning.

3.5.3. Global burden of visual impairment, blindness and uncorrected refractive errors

Several eye diseases show little or no early symptoms, may slowly progress and may only be detected after vision has been lost or altered. As a result, visual impairment and blindness presents a considerable burden to individuals, families and nations (WHO, 2007). Recent WHO data indicates that the prevalence of visual impairment stands at 285 million. Of these, 246 million have moderate to severe visual impairment, while an estimated 39 million people are blind (WHO, 2012b) and approximately 80% of these cases could have been cured, treated or prevented (IAPB, 2010). According to the data, the major causes of blindness in 2010 were cataract, glaucoma and age-related macular degeneration, while uncorrected refractive errors (UREs) are the main causes for moderate to severe visual impairments (WHO, 2012b). These conditions impose heavy physical, financial and quality of life limitations on individuals (WHO, 2007) and may be more pronounced depending on the WHO sub-region under consideration.

The burden of blindness and visual impairment remains a major global challenge to national economies. While the economic cost of visual impairment and blindness due to diseases and UREs are available in the literature, the contribution of work-related eye injuries to this burden are scarcely available as they are mostly reported as part of the general work-related injuries (Leigh et al, 2009). However, their contribution to the global burden may be enormous. In quantifying the economic cost of the global burden of UREs, Fricke et al (2012) estimated the burden of distance visual and near impairment was a challenge among 158 million and 544 million cases respectively worldwide in 2007. According to the authors, "the estimated loss in global gross domestic product due to distance vision impairment caused by UREs was US$ 202 000 million annually" (Fricke et al, 2012: 736). Similarly, Smith et al (2009: 433-434) "estimated the value of the productivity lost due to distance vision impairment secondary to UREs to be between 121 400 million and 427 700 million International dollars (equivalent to US$ 91 300 million to US$ 327 700 million) before and after adjusting for labour force participation rate and the employment rate with an estimated potential productivity loss of I$ 121.4 billion".

According to the European Forum Against Blindness (EFAB, 2014: 1), "more than 350,000 healthy life years are lost due to cataracts, glaucoma, AMD and diabetic retinopathy, totalling more than 123 million workdays lost per year".

Furthermore, the authours estimated that, "the annual economic costs due to preventable vision impairment and blindness were more than € 20 billion Euros" (EFAB, 2014: 1). It must be noted that, the burden of, and economic cost of, these diseases may be higher in developing economies that contributes greatly to the global burden of eye diseases. Similarly, according to Prevent Blindness America, in 2007 the annual cost of adult vision problems which include AMD, cataract, diabetic retinopathy, glaucoma, refractive errors, visual impairment and blindness in the U.S., stood at about $51.4 billion of total burden to the U.S. economy (Frick et al, 2007). Several other countries including Poland, Mexico, Ireland, Australia among others, have also computed the economic cost of the burden of visual impairments and blindness to their national economies (Saka and Kleintjens, 2014; Taylor et al, 2006b).

Although the economic cost of the burden of work-related eye injuries are scanty in the literature, there are some evidence that its contribution is enormous. For example, the Occupational Safety and Health Administration of the United States reports that "eye injuries accounts for more than $300 million per year in lost production time, medical expenses and worker compensation" (OSHA, 2014: 1). Other reports by the Vision Council of America, 2007 indicates that work related eye injuries cost an estimated amount of $8 billion annually to employers.

The evidence provided above on the burden and economic cost of eye diseases, visual impairment and blindness as well as work-related ocular injuries give credence to the impact of poor eye health on national economies. There is therefore, the need to work towards prevention and elimination of these conditions, particularly among workers (in this regard cocoa farmers), who may be at high risk of such conditions in order to reduce the burden suffered by individuals, society and nations at large.

3.5.4. Occupational Health and Safety Policies in Ghana

Several reports have highlighted a high prevalence of occupational hazards, risks and diseases in the major industrial sectors in Ghana such as mining (Agbenorku et al, 2010; Ackerson and Awuah, 2010; Amedofu, 2002; Avotri and Walters, 1999). However, same cannot be said about the Small and Medium Scale Enterprises (SMEs) and the informal sectors such as agriculture, although there are reports that they face several work-related health challenges (Ackerson and Awuah, 2010).

The WHO stresses that “Occupational health is an important strategy not only to ensure the health of workers, but to also contribute positively to productivity, quality of products, work motivation, job satisfaction and thereby to the overall quality of life of individuals and society” (WHO, 1994b: 2). Therefore, a country whose workplaces are without efficient policy to ensure the health and safety of its workers is likely to experience economic loss (Rantanen, 1994). Occupational health and safety are still not well developed in countries such as Ghana, despite their being signatories to international declarations on OHS. Muchiri (2003:45) asserted that a

> "lack of a complete OHS policy, poor infrastructure and funding, insufficient number of qualified occupational health and safety practitioners, and the general lack of adequate information are among the main drawbacks to the provision of effective enforcement and inspection services in most African countries".

Ghana exemplifies the above assertion because despite the numerous occupational health challenges arising out of the diverse and vibrant industrial activities in the country, there is still no national policy on OHS (Puplampu and Quartey, 2012; Amponsah-Tawiah and Dartey-Baah, 2011; Clarke, 2005). A 2000 draft OHS policy has been drafted for and is waiting for adoption by the Parliament of Ghana (Amponsah-Tawiah and Dartey-Baah, 2011), indicating little political commitment to the course of OHS (Amponsah-Tawiah and Dartey-Baah, 2011). According to Muchiri (2003), this has been the trend in most African nations, where comprehensive OHS policies are outdated or unapproved.

Although Ghana is a signatory to ILO Conventions, it has only ratified 11 out of over 70 ILO conventions on OHS (45, 81, 89, 90, 103, 115, 119, 120, 147, 148 and 184). However, the four core conventions on OHS (Conventions 155, 161, 170 and 174) on which the others hinge have been ratified (Amponsah-Tawiah and Dartey-Baah, 2011; Clarke, 2005). Although ILO Conventions 155 and 161 have not been ratified by Ghana, section 15 of the Labour Act 2003, Act 651 (GoG, 2003) covers some portions of these conventions (Wilson et al, 2006; Clarke, 2005). While endorsing the ILO conventions will not resolve the OHS issues in Ghana, it will indicate the importance government and civil society attaches to the subject of OHS of its citizens who work to sustain the Ghanaian economy. Although there is currently no comprehensive OHS policy in Ghana, there are two main edicts that have guided the implementation of OHS. These are the "Factories, Offices and Shops Act of 1970", Act 328 (GoG, 1970a) and the "Workmen's Compensation Law of 1987", PNDC Law 187 (GoG, 1987).

The Factories Offices and Shops Act of 1970, provides for the safety, health and well-being of employees in factories, offices, shops, dock work and construction. However, it does not cover workers in the agricultural and other informal sectors that employ majority of the working population in Ghana (Amponsah-Tawiah and Dartey-Baah, 2011; Clarke, 2005). This confirms the assertion that, there are several challenges in the provision of health for workers in the formal and informal sectors in most African countries (Regional Committee for Africa Report, 2004). It is important to note that the provisions in the Act are limited in scope. For example, there are inadequacies in prevention strategies like assessments of risk, standards of measurement and evaluation, medical surveillance and hazards control as prescribed by the WHO (Amponsah-Tawiah and Dartey-Baah, 2011; Clarke, 2005). This could lead to exploitations on the part of employers, as well as, law enforcement agencies.

The Workmen's Compensation Law 1987 allows employees to receive monetary rewards in an event of injury occurring at work, or to their dependants, as well as, of death arising out of work upon determination by competent courts of jurisdiction (GoG, 1987). Unfortunately, these compensations have little relationship to the risks faced by the workers, and is made worse by the tedious court processes they have to go through to receive such a small compensation enshrined in the law (Amponsah-Tawiah and Dartey-Baah, 2011). As a result, workers who may not have the means to pursue such cases may lose their compensation or rely on the generosity of employers.

In spite of the limitations with the legal provisions on workmen's compensation, the Labour Department of Ghana is reported to have paid an amount of GHC 956, 362.00 as workmen's compensation to 121 victims of occupational accidents in the public sector. An amount of GHC 915, 177.00 was paid to 273 private sector workers who sustained various degrees of industrial injuries, rendering some of them disabled and the others dead, resulting in a loss of GHC1.8 million to the economy of Ghana in 2012 (Zaney, 2013). This is in spite of the underreporting of accidents and injuries at the workplace (Annan, 2010). This figure on economic loss to Ghana also excludes those in the informal sector such as agriculture. This gives an indication that, should the legal regime be changed, there could be an upsurge in number of claims from victims which could lead to greater economic loss through payment of compensations due to accidents and injuries at work. This could be a possible reason why governments are reluctant to introduce standard OHS laws. A legal regime change in OHS will, however, bring relief to workers who have to endure accidents and injuries without any form of compensation.

Apart from the two main laws outlined above, there are other minor ones that relate to OHS in Ghana. These are the "Mining Regulations Legislative Instrument of 1970, LI 665" (GoG, 1970b), the "Environmental Protection Agency Act, Act 490 of 1994" (GoG, 1994), "Small Scale Gold Mining law; Act 218 of 1989" (GoG, 1989), the "Mining and Mineral Act; Act 703 of 2006" (GoG, 2006), "Section XV of the Labour Act 651, 2003" (GoG, 2003), the "Ghana Health Service and Teaching Hospitals Act 526, 1999" (GoG, 1999) and the "Ghana Aids Commission Act, Act 613 of 2002" (GoG, 2002).

Occupational health services in Ghana are mainly provided by government, private and mission hospitals or clinics, with some companies having their own health facilities that cater to the needs of health and safety of their workers. Despite the existence of these facilities, their scope of practice is limited (i.e. primary medical care, first aid and curative care) compared to the provisions of "ILO Convention No. 161 on Occupational Health Services" (Rantanen, 1995; ILO, 1985). According to Amponsah-Tawiah and Dartey-Baah (2011: 124)

> "with the exception of a few multinational companies who undertake comprehensive preventive occupational activities such as medical surveillance, risk assessment, and worker education on HIV/AIDS prevention programmes, these are grossly lacking in the country".

As mentioned earlier, OHS in Ghana has largely neglected informal sector workers, especially in agriculture (Puplampu and Quartey, 2012). ILO Convention No. 184 was passed in June 2001, which made provision for agricultural workers health and safety, yet it was only recently ratified by Ghana in 2011 (ILO, 2013). This should have marked a turning point for safety and health in agriculture in Ghana, but implementing the convention has not been comprehensive. The absence of any direct regulatory body on farm practices compounds the challenges in reporting and keeping track of farm related ocular diseases and injuries. This challenge is also compounded by the poor practices of insurance systems in the agricultural industry, especially among farmers, as they have been a major source of compiling injury data in developed economies and could have been utilised in the Ghanaian context (Drummond, 2007). The widespread practice of subsistence or small household cocoa farming with individual ownership also limits the extent to which policies can apply compared to countries where farms are mostly owned by identifiable companies. The implication is that although individual owners of cocoa farms may hire labourers, they do not take particular interest in the safety of their workers with particular reference to ocular safety.

Due to the ever-present dangers to workers health and safety in Ghana, it is essential to have a comprehensive OHS policy, especially for those in the informal sector. This policy should be an amalgam of OHS policies adopted internationally to ensure that they are not just cosmetic but they apply to the peculiar informal sector (agricultural) characteristics in Ghana.

3.6 Healthy workplace

The WHO makes it clear that it is a moral obligation to develop a workplace that has no negative implication to the health and well-being of workers (WHO, 2010b). As a result, the WHO affirms that "a safe and healthy work environment is a fundamental human right" (Burton, 2010:5) and therefore advocates that attempts must be made to ensure that workers conduct their duties in healthy workplaces. A healthy workplace according to the WHO, "is one in which workers and managers collaborate to use a continual improvement process to protect and promote the health, safety and well-being of all workers and the sustainability of the workplace by considering the following, based on identified needs:

a. health and safety concerns in the physical work environment;
b. health, safety and well-being concerns in the psychosocial work environment including organization of work and workplace culture;
c. personal health resources in the workplace; and ways of participating in the community to improve the health of workers, their families and other members of the community". (Burton, 2010:16). Takala and Urrutia (2009:22) put it even simpler by stating that "a healthy workplace is a place where, as far as possible, there are no occupational hazards which could, in the broadest sense, directly harm the workers' health".

Accordingly, the definition suggests that the concept should focus not only on the traditional OHS measure but also on psychosocial hazards, the physical environment, personal resources and the community in which a worker lives and works (Burton, 2010; WHO, 2010b). The goal of focusing on these core issues is to ensure that the opportunities for injuries and diseases to occur in the work place are limited. However, when they do occur, it is recommended that they are properly taken care of, either at the workplace or in the communities where health facilities are available. Similarly, when injuries or diseases have occurred, the work environment should alter the conditions to prevent a reoccurrence when the people involved return to work. Finally, the focus is to ensure that the work environment supports gender dynamics, the elderly, weak and disabled workers (WHO, 2010b; Burton, 2010).

Agricultural employment in Ghana is highly informal, and the cocoa industry is no exception (Anang, 2011; Otoo et al, 2009). Even when labourers are hired, there is virtually no formal contractual relationship, as reported by Otoo et al (2009). The situation therefore limits attaining the intentions of the WHO, as expressed in the definition of a healthy workplace. This may also limit the health of the members of the communities in which cocoa farmers live and work. However, whether in formal or informal employment, the promotion, protection and wellbeing of workers' health and safety must be a priority to all. As a result, all work environments must be 'healthy' to help sustain national and global economies (Burton, 2010). Unhealthy workplaces, with visible hazards are likely to produce accidents and injuries as well as diseases and even death among workers. These conditions are contrary to the ideals for workers as espoused by the WHO and ILO.

3.7 Conclusion

The safety and wellbeing of workers has been enshrined in sound occupational health and safety policies as espoused by the WHO and ILO and adopted by nations across the world. However, the complete wellbeing of workers depends on the proper implementation of these policies at the workplace. Proper implementation of OHS policies must be worker-focused with regular training and education. This must be supported with strict rules to ensure compliance among such workers. However, in the informal sector, such as, among cocoa farmers in this study, regular education and awareness creation on OHS policies may be ideal, as strict laws on enforcement and compliance to OHS rules may not achieve the desired results due to poor or no supervision in most cases.

If well implemented, OHS policies will contribute immensely towards the reduction of the burden of occupational diseases and injuries. In addition, the burden of work-related eye injuries and disease that leads to visual impairments and blindness can be curtailed. Although little information on occupational eye diseases and eye injuries exist, especially among agricultural workers in Ghana (Alfers, 2010) just as in other developing countries (Leigh et al, 1999), the burden of eye disease and injuries leading to visual impairment and blindness may be exacerbated by the nature of work, community environment, as well as, the socio-demographic and socio-economic conditions among a working population. Therefore the implementation of OHS policies must be tackled in a multifaceted approach to achieve the desired results.

From the literature, there is an overwhelming data on occupational eye injuries in developed economies, although same cannot be said of ocular injuries in developing economies like Ghana. Throughout the literature, there are few reports on occupational eye diseases and equally worse in Sub-Saharan Africa. A range of data sources such as "death records, hospital records, workers' compensation claims, cancer registries, workplace records, surveys and sentinel reports"(Drummond, 2007: 10) have been used to provide accurate data in developed economies. Such records are poorly kept in Ghana and hence cannot be relied upon. This study will serve as good source of information to fill in the gap created by the lack of accurate data on eye injuries and diseases. It is also evident that, making a claim of occupational or work-relatedness of a disease should not be based only on the patient's job title which is mostly asked by practitioners. Gathering information about workers occupational history includes obtaining a description of current and past jobs and occupations; employment status; exposure to hazards; and an evaluation of the work-relatedness of the major complaint made by the worker or diagnosis made after examination. Other factors that may contribute to the ocular health challenges which workers may face include cigarette or tobacco smoking, medications or drug or alcohol use (Hiratsuka and Li, 2001; Cheng et al, 2000). This study aimed at comprehensively addressing these issues identified in the literature.

It is evident from the literature that no comprehensive occupational health policy exists in Ghana (Puplampu and Quartey, 2012; Amponsah-Tawiah and Dartey-Baah, 2011; Clarke, 2005). The scanty legislation on OHS in Ghana has largely neglected informal sector workers, especially those in agriculture (Puplampu and Quartey, 2012). The study will provide a basis for the consideration of occupational health and safety policy for agricultural workers in Ghana.

CHAPTER 4: OCULAR HEALTH AND SAFETY EDUCATION

4.1 Introduction

This chapter focuses on safety and health training (ocular health education) for farmers, and provides an overview of the theoretical concepts that underpins health education and the traditional approach that underlined early safety interventions. It also focuses on the primary reasons for conducting training, and the various approaches used in training and evaluation. This is followed by a review of eye and vision health education, including strategies and methods that have been adopted to implement successful eye safety training programmes, as well as, barriers to the acceptance of training programmes among farmers. The chapter concludes with a discussion on identifying knowledge, perceptions and risk beliefs on ocular practices among farmers, and the training method adopted for this study.

4.2 Theoretical concepts in health education

Health education is defined as “the consciously constructed opportunities for learning involving some form of communication designed to improve health literacy, including improving knowledge, and developing life skills, which are conducive to individual and community health” (WHO, 2012a:13). The term ‘health literacy’ as used in the previous definition is defined as “the degree to which people are able to access, understand, appraise and communicate information to engage with the demands of different health contexts in order to promote and maintain good health across the life-course.” (Kwan et al, 2006:6). There are many planning models on health education that are based of health behaviour theories. These include the

- "rational model,
- the health belief model,
- the extended parallel process model,
- the trans-theoretical model of change,
- the theory of planned behaviour,
- the activated health education model,
- the social cognitive theory,
- the communication theory and
- the diffusion of innovation theory" (WHO, 2012a:7).

The choice of theory depends on the objectives of the training/ health education under consideration (Rimer and Glanz, 2005). For the purpose of the training in this study, the core objectives were accommodated by the rational model (knowledge, attitude and practices model), which states that "increasing a person's knowledge will prompt a behaviour change" and "assumes that the only obstacle to acting responsibly and rationally is ignorance" (WHO, 2012a:6). The model therefore, proposes that individuals and groups are educated with the aim of encouraging positive, and preventing negative, health behaviour choices through the provision of unbiased information. This implies that ocular health training in this study is expected to pass on information on ocular hazards in agriculture, eye conditions and injuries that occur due to exposure to these hazards and improve the knowledge of participants (cocoa farmers) on eye health and safety in agriculture. This will motivate trainees to take action on how to prevent the occurrence of eye diseases and injuries on farms, and when injuries or diseases do occur, how to seek appropriate remedy. However, it must be noted that although "knowledge is vital, it may not usually be a sufficient factor in changing individual or collective behaviour" (WHO, 2012a:22; Green and Kreuter, 1991:20). Motivation and other factors may play a role in adopting a positive health behaviour.

The diffusion of innovations theory also applies in this study, it is "the process by which an innovation is communicated through certain channel over time among the members of a social system" (WHO, 2012a:34). According to the theory, diffusions represent new ideas that are regarded as products or services. It is suggested that if health education is believed to be an innovation, the target population will follow a certain pattern in adopting the message. The pattern is normally distributed as a bell shape curve with "five categories of adopters; innovators (active information seekers of new ideas - 2.5%), early adopters (very interested in the innovation but not the first to sign up - 13.5%), early majority adopters (needs external motivation to get involved - 34%), late majority adopters (sceptics who will not adopt an innovation until most people have done so - 34%) and laggards (last to be involved usually with the help of a mentoring programme or constant exposure - 16%)" (WHO, 2012a: 34-35). This helps health educators to effectively plan and implement strategies that are tailored to the needs of the characteristics of people in each adopter category by identifying such needs (Rimer and Glanz, 2005; Campbell, 2001). This was considered appropriate as it was expected that the participants would accept the training lessons at different levels and could fall into any of the five categories of people propounded by this theory. It was assumed that the participants would react in different ways to the training or safety and health education. These assumptions helped to guide the planning and execution of the training process used in this study and to manage the expectations from the results. However, due to the nature of this study, we did not envisage a typical early adopters as participants were recruited to be part of this study.

4.3 Traditional Safety and Health Interventions: three “E”s of safety

Traditionally, safety and health issues among workers are addressed in a three dimensional approach to direct workers' behaviour: engineering, education and enforcement (Pettinger, 2000; Wilde, 1998 Geller, 1996; Petersen, 1996). *Engineering* approaches include manufacturing protective equipment (i.e. hats, ear plugs, boots, etc), which evolved in the early 1900s to reduce threats faced by workers (Menendez et al, 2012; Burton, 2010; Pettinger, 2000; Haddon, 1980). New tools and machinery were developed to enhance efficiency at work although their introduction was accompanied by potential injuries. However, “it was difficult to provide a safe work environment solely through safety engineering” (Hoyos and Ruppert, 1995: 107). There was therefore, the need for safety *education* and training to help reduce injuries due to human errors and to create awareness about potential work hazards. Educational safety programmes were initially developed during the 1900s, and focused on increasing peoples’ knowledge by giving them sound and accurate information that helped in improving their risk taking behaviour.

The goal “was to provide an environment for the acquisition of attitudes, knowledge or skills, so that newly acquired behaviours may be transferred to the job setting” (Enos et al, 2003:371; Pettinger, 2000 :12).

According to Weil (2010), *enforcement* is mainly the responsibility of those within the industry (discipline) and governments (compliance). In most industries, safety guidelines were initially established to ensure that workers did not injure themselves unnecessarily. If these guidelines were disobeyed, stringent punishments were applied. Organizations or employers were expected to comply with safety and health rules made by governments and they in turn, received sanctions if they did not (Geller, 1998b). It is important to note that most of the safety and health interventions currently in use for safety health education and health promotion are an improvement upon these approaches that were employed by the early safety and health experts (Mitchell et al, 2003). For example there is much emphasis on community engagement in developing health promotion campaigns than previously advocated.

4.4 Health and Safety Training

Training is defined as "a planned effort to facilitate the learning of specific occupational health and safety (OHS) competencies.” (Robson et al, 2010:4). However, O’Connor et al (2011:3) defines training more broadly as "a range of efforts designed to engage trainees with the goal of affecting motivation, attitudes and behaviour for the purpose of improving workers’ health and safety on the job". According to the authors, OHS training goes further than simply attempting to pass on knowledge. Consequently, OHS training should be widely recognized as a vital element of hazard awareness creation and control of risk taking attitudes among workers (Robson et al, 2010), as several reviews have reported positive results following training interventions. These include improvements in safety knowledge and a reduction in risk taking attitudes, leading to positive health outcomes (Burke et al, 2006; Burke and Sarpy, 2003, Islam et al, 2000; Cohen and Colligan, 1998).

As asserted by Segerist (cited in Abbrams; 2001:72), “The doctor of the future will not wait for his fellow men to become sick but will teach them how to remain in good health and will be with them in the factories, on the farms, in offices, wherever people live and work and are exposed to illness and injury”. The quotation highlights the relevance of health and safety training, specifically prevention and positive behaviour at workplaces, which must be championed by healthcare professionals and occupational health experts.

It is important to consider the objective of the intended training, as this will influence the method and approach to adopt (O’Connor et al, 2011). According to O’Connor et al (2011:4) the objectives of a training programme may include but is not limited to the following:

a. "Knowledge Transfer/Skills Development: Example, a programme designed to teach workers about the chemical hazards present in their workplace and the warning signs and labels associated with each;

b. Attitudinal Change: For example, a programme geared towards increasing workers' degree of concern about safety and health hazards in the workplace or enhancing the extent to which they believe that it is possible to reduce their exposure to such hazards by taking certain actions; or

c. Motivational Change/Empowerment: Example, a programme designed to encourage people to talk with their co-workers about job hazards and to take action together to solve associated problems."

A good training programme does not concentrate on only one objective, but usually addresses a combination. For example, an OHS training programme may aim at *giving sound information* about ocular hazards in agriculture so as to *change the mind-set of workers* about the threats these hazards pose to enhance *adopting new behaviour* and reduce their exposure to such hazards (O'Connor et al, 2011; Arcury et al, 2010; Burke et al, 2006). The objective of the training programme adopted in this study among the cocoa farmers was aligned with these principles.

4.4.1. Overview of Training Methods

While training on safety and health usually combines lecture formats and distributing reading materials (O'Connor et al, 2011), a wide range of engaging methods of training are available. The methods are influenced by the "principles of popular education, an approach that encourages the active roles of training participants in discussing challenges and deducing practical solutions" (O'Connor et al, 2011: 6). The efficacy of these methods of training has been documented, and the review suggests that they are more effective than the less interactive traditional lecturing method (Burke et al, 2006). Training methods are usually grouped into three categories; low, medium and high degree engagements. The levels of engagements have a bearing on the impact of the training outcomes as discussed below.

a. Low degree of engagement: this deals with passive participation from trainees with no practical session and usually has very little cognitive role on the part of the learner, although it may include a post evaluation of training without any feedback to the participant. In most cases, trainees are simply expected to sign a log book to register their presence without playing any active role. Such training may include "oral presentations, lectures with or without brief question-and-answer periods, the use of videos, pamphlets and manuals that do not contain interactive exercises or computer-based instruction" (Burke et al, 2006: 315), that does not engage the trainee to provide any meaningful feedback or allow trainees to actively engage in the training (Burke et al, 2006; Burke and Sarpy, 2003).

b. Medium engagement: involves methods that allow active participation by trainees. Examples of such methods may include lectures that incorporates discussion and feedback, training where feedback is given on tests used for evaluation or a print material where workers can read, assess their knowledge and check the accuracy of their answers in an answer booklet (Arcury et al, 2010; Taylor et al, 2005).

c. High engagement: There is a substantial level of engagement of participants in the process of learning in high engagement training methods. The training usually adopts a face-to-face approach, but can include virtual environments with the current advances in technology. Trainees equally have the opportunity to ask questions, make decisions, obtain feedback, and also engage in practical sessions to apply the knowledge gained from the training. Several training methods could be designed to fit into this approach by ensuring that workers or trainees are actively involved. These may include lectures with practical sessions such as teaching participants on how to handle ocular emergencies. With current trends in technology, computer based training could also be designed to fit into this level (Burke et al, 2006; Taylor et al, 2005).

According to Burke et al (2006) the level of a training programme as discussed above, determines the effectiveness of the training outcome as active approaches have been reported to be more superior to less active ones (Taylor et al, 2005; Frese and Zapf, 1994). Burke et al (2006: 316) asserts that "as the method of safety and health training becomes more engaging, the effect of training is greater in terms of knowledge acquisition and reductions in negative outcomes" and further reports that "the most engaging methods of safety training are, on average, approximately 3 times more effective than the least engaging methods in promoting knowledge and skill acquisition".

A summary of the current successful approaches of training used by OHS experts are described below. Any of these methods can be combined to achieve the desired results based on the primary purpose of a training programme.

i. **'Small group discussions and group problem-solving approach':** This is based on the “Small Group Activity Method Concept”, which operates on the principle that "working adults learn best in situations that maximize active participation" (O’ Connor et al, 2011:8). Proponents of this method argue that “lecture-style teaching methods used in most programmes actually hurt the learning process, promote passivity on the part of workers, de-value their knowledge and skills, and make them feel inadequate.” (OCAW, 1994:1).

ii. **'Body Mapping'**: This simple tool is used to identify work-related health symptoms and signs. Participants in a training programme may be put into small groups and given an outline of the human body, and are asked to place dots indicating where they experience pain in their bodies. The goal of this exercise is to elicit symptoms of ill health that may be common to workers due to the nature of their work (O’ Connor et al, 2011, Burke and Sarpy, 2003). In doing so, participants are able to understand how work contributes to such symptoms.

iii. **Telling a story using graphic materials':** This approach is useful in communicating with low-literacy workers and stimulating a discussion through the use of simple language, limited text and illustrations. The goal of this approach is to present a human drama, rich in context and providing interesting scenarios that convey an OHS message. Such training materials assist in undertaking effective health promotional training among workers and community members (O' Connor et al, 2011; Arcury et al, 2010).

iv. **'Role Plays':** Trainees are asked to dramatize a typical work-related or OHS related challenges under the guidance of a trainer and then discuss the subject matter to find a solution to the drama presented (O' Connor et al, 2011). It is another way of communicating with low-literate workers, enabling them to reflect on the situation as a group (Arcury et al, 2010).

v. **"Photovoice," 'Theater, Video, and other Arts-based Approaches':** This involves the identification of problems through the creativity of participants and finding answers to them. The scenarios used reflect a real life situation. Trainers who adopt this approach are expected to freely flow in delivery and also have good knowledge of the local people, thereby encouraging problem-solving by allowing community members or workers take charge in envisaging how safely they can work or live their lives (Sullivan and Siqueira, 2009). The "Forum Theater," method involves presentation of a simple theatre piece depicting specific OHS challenges or any other issue relevant to the training. At any point of the drama, the participants training are encouraged to step in to present their views on the story line in a manner that influences the story, which enables them to reflect on how they will react to any OHS challenge they may anticipate. This has been successfully used to teach workers on the challenges they may face at work and explore possible hindrances to addressing them. “Photovoice” involves the identification of hazards by all workers who are equipped with cameras and asked to photograph hazardous work situations or to collect images that portray such occurrences. The photos are then used as the basis for group discussion and solutions found to the OHS challenges identified in the photographs (O’Connor et al, 2011; Flum et al, 2010).

vi. **'Story telling':** This is another learning tool and a creative method of training, and involves using stories told by peers to shape the mind set of other workers on OHS issues rather than from an OHS professional (O’ Connor et al, 2011). Studies indicate that storytelling by experienced workers on workplace fatalities by survivors of such incidents is a very persuasive approach to change the attitudes of young workers. As asserted by Cullen and Fein (2005:19), “stories work at a very different level than pure information-sharing because they deal not just with rational thought, but also with how we feel about what we have heard.”

vii. **'Hands-on exercises and simulations':** These methods entail participants actively engaging in applying previously gained knowledge in real life or work experience. It could be used for both simple and complex training programmes. Burke et al (2006: 316) argues that this method is "particularly effective in reinforcing training messages because it requires trainees to reflect on lessons learned, leading them to infer causal and conditional relations between events and actions, leading to the development of strategies for handling unforeseen events and initiating and promoting self-regulatory motivational processes (e.g., self-monitoring and self-efficacy expectations). ”

viii. **'Computer-based instruction'**: This is a passive or an active programme and could include lectures or an interactive computer presentation. Participants are expected to understand the lesson from the presentations and to apply them to solve challenges they face at work. It is recommended that feedback is given to participants to enable them evaluate the training they have received and learn from their mistakes (Burke et al, 2006). This could be both a medium or high engagement training method.

ix. **'Quizzes and Games':** These are entertaining ways of transferring and reinforcing information to trainees as an alternative to other passive methods of learning, such as lectures and slide presentations. For example, instead of reading a text on ocular hazards on farms, it can be presented in a quiz format, followed by true or false statements and in some cases a detailed description of relevant issues. The group may be invited to discuss issues or questions that arise (O’ Connor et al, 2011; Burke et al, 2006).

x. **'Risk Mapping':** In this method, trainers actively engage participants to identify significant hazards in their work environments on their own. Participants in a training are grouped based on common characteristics such as workplace and create a miniature sketch of their workplace, including details such as equipment and walkways and major production activities, among others. With the aid of coloured pens, hazards in each area of work are identified. Different colours are used for various categories of hazards and preventive measures are then discussed (O' Connor et al, 2011; Burke et al, 2006).

4.4.2. Factors to consider in choosing/developing training programmes

Several factors must be taken into consideration in deciding on the approach and method to adopt for training programmes, including socio-economic and cultural factors. For example, many farmers have been known to have low education and may therefore have very limited literacy (Verma et al, 2011; Quandt et al, 2008). As a result, a training programme for such farmers may have to use few words, more pictures and possibly video displays rather than relying heavily on written material. However, in dealing with people with limited literacy, it is important to respect the great deal of skills and experiences that they bring to the issues. While they may have some challenges in learning, they may also be a great source of knowledge on health and safety issues due to the experiences gathered over a long period of time (O' Connor et al, 2011). With this in mind, it may be necessary to conduct a basic needs assessment on the level of education of participants to enable trainees to choose appropriate training materials and methods prior to the training.

Another important factor to consider is the cultural appropriateness of materials and training activities (Burke et al, 2006). Culture is defined as “the collective programming of the mind which distinguishes the members of one group or category of people from another” (Hofstede 1997: 5). Training programmes must therefore be situated in a context acceptable to the people to avoid serious resistance. Afunah (cited in O’ Connor et al, 2011:12) advanced that,

> "a range of factors must be considered when examining cultural appropriateness, including how to reach target audiences, developing a document, translation issues, how graphics or images are presented, format, and factors related to readability such as sentence structure, vocabulary, reading level, and the content itself".

Other authors (Massett, 1996, Larson et al, 2009) have suggested that issues of cultural appropriateness must take into account the involvement of the target population in designing the training, or at least conducting a focus group-test of the material with the target audience. This will give a clear indication of acceptable formats of training materials. For example, Hispanic women were found to prefer to receive health training through the use of photos arranged in a dramatic and beautiful fashion while telling a story alongside (Cullen and Fein, 2005; Massett, 1996). In summary, "there is the need to ensure that health and safety training programmes for agricultural workers are culturally, linguistically and literacy-appropriate" (Arcury et al, 2010: 237).

Arcury et al (2010) recommends that training programmes should be based on principles of adult, low literacy education and theoretically based within modern health education theory and practice. If these factors, as well as other barriers such as gender dynamics are not properly addressed in the design of new training programmes, there is a high probability of not achieving the desired outcome. For example, Whalley et al (2009) reported that about one-quarter of participants who received pesticides training indicated they did not understand what they were taught.

Trainings should also take into consideration the workers' status, such as unionized, temporary or contractual or unregistered workers, as each group has specific needs that must be addressed through different programmes and time lines (O'Connor et al, 2011). For example, unionized or permanent workers in recognised establishments are less intimidated to talk about issues that affect their safety and health than temporary or contractual workers, who may be afraid to talk about safety and health issues for fear of picking up conflict with their employer and losing their job (Arcury and Marin, 2009). Therefore, training strategies among such category of workers should consider the level of influence their position enables them to influence changes about health and safety issues. Another category of workers not considered by O'Connor et al (2011), may be those who are self-employed but do not incorporate safety principles in their daily work due to lack of awareness or ignorance. Training for such people should adopt strategies that could self-motivate them to change their behaviour without instilling fear of hazards in them, as there is no external supervision. Occupational health and safety training designed for permanent workers could be done in repeated sessions, while a programme targeting casual/wage workers may be very brief or conducted on a single occasion. It is therefore important to recognize the challenges faced by these workers in receiving and implementing lessons to be learned in a training programme even at the formulation stages.

4.4.3. Evaluation of training programmes

Evaluation involves a process of assessing the prevailing conditions prior to training and noting differences that may have taken place due to the programme (Burke et al, 2006). An evaluation could also be conducted before or after the transfer of knowledge gained in the training is applied to the job setting (Arcury et al, 2010; Taylor et al, 2005). This pre-post process helps in assessing improvements in knowledge, self-efficacy and appropriate behaviour transformation (Grzywacz et al, 2009). It also assesses the success or otherwise of the training programme, such as knowledge gained, changes in behaviour patterns, as well as, modifications at the workplace due to the training. Evaluation also helps to improve on-going and future programmes to better accomplish their training goals, and therefore need to be done effectively.

Training evaluation methods are grouped broadly into two categories: quantitative and qualitative methods. Quantitative methods of evaluation usually involve the use of structured or multiple choice questions in surveys to identify the opinion of participants about a training intervention. It could also be done using specific measurements or by monitoring actions expected from trainees following a training intervention, such as the increase or decrease of the number of injuries, hospital attendance, use of protective equipment and other safety measures among workers in a given time frame. A basic and standard approach to this is to note the conditions before and after the training intervention. Data obtained from such surveys are usually analyzed using quantitative methods of analysis (Arcury et al, 2010; Monaghan et al, 2008; NIEHS, 1997).

Generally, qualitative approaches to evaluation deal with in-depth descriptive information from participants of a training programme. This approach allows individuals or groups in a training to describe and discuss their opinions on the intervention and for the trainer to identify key areas of interest, fill in gaps, re-design and improve on training packages. It also allows for the trainer to fully understand the cultural background of participants that has influenced their behaviour. These may include the use of open-ended questions and/or focus group discussions among others (USDOL-OSHA, 2010; NIEHS, 1997).

While each of the methods has its advantages and disadvantages, the choice of one over the other depends on the objective of the evaluation. In some cases, they could be combined to help gain a broader understanding into the perspectives and behaviour of a group of workers, as well as to verify some assumptions that may have been made about a group before initiating the training process. It is important to note, however, that some confounding factors may impact on the successful outcome of an evaluation process (O' Connor et al, 2011). For example, there could be a change in company's policies, an inadequate and ultimately reduced supply of PPEs for workers, poor maintenance of machinery by organizations, and accidents during the training sessions, among others. Where such confounding factors are anticipated, they should be taken into account during the evaluation process so that the right judgments and conclusions are made.

4.5 Safety training models for agricultural workers

There are several safety training models that address specific occupational health challenges among agricultural workers. Some of these include those that deal with issues of heat stress (LOHP, 2008; NCFHA, 2001), musculoskeletal injuries (May et al, 2008; Earle-Richardson et al, 2006) and green tobacco sickness, (Rao et al, 2004; Quandt and Arcury, 2001a) among others. Most of these programmes are developed by academic faculties and mostly concentrate on pesticides safety (Thompson et al, 2008; Arcury et al, 2009; Arcury et al, 2010). However, few academic faculties and investigators have concentrated on developing eye safety programmes for agricultural workers (Luque et al, 2007; Forst et al, 2004). Some of the models are outlined below.

a. *Lay health promoter or Promotora de Salud model*: most agricultural training programmes often adopt this model in which lay health promoters

(LHPs) are used to influence a working population through trainings. The high acceptance rate of this training module, coupled with the fact that there is little resistance from the agricultural industry, makes it an ideal programme for training. For example, "the Migrant Health Promotion Camp Health Aide Programme", the most widely used health and safety programme in the United States, uses this approach of training (MHP, 2009; Hovey et al, 2007; Liebman et al, 2007; Booker et al, 1997).

b. *Community health workers (CHWs) model*: the original intention of this concept was to extend health care to communities with limited access to health care through an extension programme by qualified health practitioners (Sidel, 1969). However, with transformation, the concept currently includes,

> "connecting people with available services, bridging cultural gaps between economically disadvantaged communities and the health care system, providing health education that is culturally appropriate, providing social support and informal counselling, advocating for the needs of individuals and communities, and building capacity of communities and individuals to get their own health care needs met" (Wiggins, 1998:13).

This has been used as a behavioural change tool among workers, while the education is done at homes (Monaghan et al, 2011; Marin et al, 2009). The influence of CHWs are normally considerable as they are familiar with local norms and language, are able to make connections with community members easily and more effectively than traditional health care providers can, and can easily disseminate health and safety information (Arcury et al, 2010; Go´mez-Murphy, 1998). The University of Illinois, adopted the "Community Health Worker Model (CHW)" in an eye health and safety training programme to deal with the eye health and safety challenges encountered by Latino farm workers in southeastern Michigan and northern Illinois (Forst et al, 2004). The results of the study indicated eye health and safety knowledge, as well as, the use of eye safety equipment improved markedly among participants who received safety training through promoters (Forst et al, 2004).

c. *Train-the-trainer Programme:* as another format of the "lay health promoter or Promotora de Salud model", "competent and reliable individuals in the work or community are identified and trained on a specific health and safety challenge. The trained individuals are then mandated to train and educate their colleagues to influence their behaviour. The underlying principle behind this approach, just like the others discussed above, is that people are more open to information from individuals who they believe are "like them" (Forst et al, 2004).

d. *Community-based participatory research (CBPR):* is often used for agricultural safety training (Israel et al, 2005; Arcury et al, 1999; Quandt and Arcury, 2001b). In this approach, agricultural workers themselves are engaged in gathering material, developing and implementing the training through a careful consideration of the language, culture and literacy levels of the participants (Thompson et al, 2008; Quandt et al, 2001b). This approach normally uses oral, face-to face and multiple meetings rather than a single session to address several health and safety challenges among agricultural workers. The training may be conducted through the use of several media such as theatre, flipcharts, videos, cartoons, and brochures, among others (Quandt et al, 2001b).

e. *Community-Based Prevention Marketing (CBPM):* this combines several approaches, including community-based participatory research, social marketing, and community health workers, to design, implement, evaluate, and disseminate public health interventions (Monaghan, 2011; Bryant et al, 2009; Bryant et al, 2000). The concept includes using community members to assist in conducting consumer or market surveys, market segmentation, selection of group, and developing a market plan to aid in reaching into the objectives of the programme (Monaghan et al, 2008). This is usually followed by feasibility studies on promotional materials to access the level of acceptance among the target group, after which plans are modified if needed and appropriate branding done to promote the product or intervention. The model has the advantage of community ownership of the problems and solutions, and it is mostly culturally acceptable to the target audience as they were involved in its conceptual and developmental stages (Monaghan et al, 2008; Gerstein and Green, 1993). This approach has been used to successfully design and implement an eye safety training programme for citrus farmers by the University of Florida (Monaghan, 2011, Monaghan et al, 2008). Evaluation of the project proved a high success rate of use of safety eyewear for the prevention of eye injuries among the citrus farmers in Florida (Monaghan, 2011; Mashburn et al, 2009).

Although these innovative training models have been useful in training and changing workers' health behaviours, the training is mostly conducted at off the job settings or environments where practical lessons could help attain maximum benefit from the trainings rather than conducting the trainings in the community. Therefore, new training programmes may need to be developed to promote appropriate training that could be conducted at the work site. This could possibly improve compliance and could lead to a further decline in disease and injury outcomes.

4.6 Relevance of ocular health and safety education for agricultural workers

Ocular health education is an important element of primary eye care services and can be delivered to people at different locations, such as within the private practice to individual patients, to small groups of workers at safety meetings, to safety personnel, or to large employee groups. However, within the workplace, eye and vision health education needs to be consistent, with the overall goals of occupational optometry: prevention and performance (Abbrams, 2001; Pitts and Kleinstein, 1993).

The numerous ocular hazards among agricultural workers underpin the need for regular ocular health and safety training. It must be noted that although educational interventions alone will not eliminate all the ocular health challenges faced in agriculture, they remain a vital tool in enhancing the knowledge of workers on the potential threats they may come across at work. It will also provide them with tools needed to protect themselves, and to make them aware of available edicts that protect their safety and health (Arcury et al, 2010).

Training and education on eye health is crucial to workers as they need to be familiar with how to recognise hazardous practices and environments, how to work safely and report hazardous elements needing change. Workers using PPE also need to understand the importance of using then, the risk of not using it and their responsibility for helping to protect co-workers and visitors from ocular accidents and hazards. They also need to learn how to recognise when their PPE needs replacement and above all, how to manage eye and vision injuries prior to movement of an injured worker (Carson, 2009; Geigle, 2000; Good, 2001).

Arcury et al (2010) asserts that although eye injuries are largely preventable in agriculture, it remains one of the most overlooked health challenges. Farmers, who are usually low-skilled, lack health insurance and have had no relevant training and education, face a range of ocular risk in most countries (Islam et al, 2000; Villarejo and Baron 1999). Although the use of PPEs has generally been accepted to reduce the occurrence of eye injuries and diseases, the use of this equipment is not common among agricultural workers (Arcury et al, 2010: Verma, 2010; Quandt et al, 2008; Quandt et al, 2001a). While changing the culture of eye safety and modifying the behaviour of individual workers to adopt safety measures through training is a difficult task, particularly when employees are low-skilled (Arcury et al, 2010), studies have demonstrated that adopting such measures (i.e. use of safety glasses, etc) prevents the majority of eye injuries and diseases (Dzugan, 2010; Fong and Taouk, 1995; Xiang et al, 2005). It is important, therefore, that training methods are geared towards motivating workers to accept and adopt preventive measures in safeguarding their eyes and vision (Lipscomb, 2010). However, it must be noted that apart from motivation and understanding, PPE use is enhanced with comfort, availability and appearance of the equipment (Chatterjee et al, 2012; Carson, 2009). This requires training programmes to be well planned and executed with the knowledge that a reduction in the level and severity of eye injuries and diseases among agricultural workers have a positive impact (enhances productivity, reduces personal cost and suffering, etc). It also reduces the cost to employer (lost time and wages though hospital visits and cost of insurance) and translates into positive gains for national economies (O'Connor et al, 2011; WHO, 1994b).

4.7 Barriers to acceptance of safety training among agricultural workers

Several factors have been identified as hindrances to accepting safety and health training among agricultural workers. Firstly, low educational attainments as the skills needed for learning complex ideas are low (Doak et al, 1996). This could lead to agricultural workers' ignoring key components of educational interventions or trainings given to them (Arcury et al, 2010). In the case of cocoa farmers in Ghana, it has been found that educational attainment is mostly at the basic level, with a limited comprehension of the English language (Asuming-Brempong et al, 2006). This could limit an understanding of training lessons if the appropriate language is not chosen.

Other factors, such as the cultural experiences, beliefs and practices, may affect the reaction of farmers to a training intervention (Arcury et al, 2010). According to Arcury and Marin (2009:28), "the influence of culture and experience for the acceptance and implementation of safety behaviour is common to all groups, including agricultural employers and this may affect how health and safety training should be presented". For example, among Latino agricultural workers, there is a general belief that individuals do not have control over the occurrence of an illness but rather it is controlled by a supernatural being. This belief, according to Arcury and Marin (2009), has a negative influence on farmers' willingness to accept safety and health training. Similarly, certain personal beliefs and risk taking factors may affect farmers' readiness to abide by the tenets of safety and health education they receive (Neufeld et al, 2002). The perception among some farmers that hazards are intrinsic in agriculture and are therefore unavoidable is another negative belief that limits the acceptance of new ideas from training (Sorensen et al, 2008).

> "The farmer's high tolerance of risk, denial of susceptibility, and skepticism regarding safety measures may contribute significantly to the problems encountered in the implementation of safety and health training for agricultural workers" (Arcury et al, 2010:239).

These factors must be considered in designing training programmes for agricultural workers in order to make appropriate decisions on their mode of delivery to maximize gains by adopting strategies that could reduce these and many other barriers.

4.8 Knowledge, perception and risk beliefs about eye health and safety

Apart from above issues identified as barriers to accepting safety and health training, information about farmers knowledge, perception and risk beliefs regarding ocular health is needed to help plan appropriate eye safety and health interventions. As Ahmad et al (2006) asserts, understanding what farmers know, believe and practice is crucial in developing effective training packages. While vast data exists on ocular injuries among agricultural workers, few researchers have documented issues on knowledge, beliefs and practices among agricultural workers (Arcury and Marin, 2009; Sorensen et al, 2008; Forst et al, 2004).

In a study to assess the knowledge of ocular safety and health among Latino farm workers by Verma et al (2011), 69.3% reported that "they are not well trained in preventing eye injuries". Nearly one quarter (23.7%) did not believe that "rays of sunlight can cause cataracts". On first aid, 91.7% and 98.0% respectively indicated that they will wash their eyes with water if either sand or chemicals got into their eyes, an indication that they had very good knowledge in this area. Reporting on risk beliefs, 74.7% indicated that "eye injuries are always avoidable during work" but in sharp contrast, 81% reported that "their chances of getting an eye injury at work was very low on any given day." Such misconceptions among farmers, as stated by Verma et al (2011), could have a negative influence on farmers regarding safety practices. Again, 46.3% of the participants reported "taking risks to the eyes in order to save time or get more work", with 14% disagreeing with the assertion that “if I lost my safety glasses but need to do a job that is hazardous to my eyes it is important to get another pair before doing that job" (Verma et al, 2011: 147).

The use of safety glasses and goggles has been recommended to be effective in injury prevention (Quandt et al, 2012; Sprince et al, 2008). In a study on ocular protection use among farmers, Verma (2010) reported that approximately 74.0% of farmers believed "it was important to wear safety glasses all the time while working in agriculture, with 86.0% accepting that safety glasses protect the eyes when working in agriculture". However, approximately half of the respondents (48.7%) indicated that "there are many jobs in agriculture where a worker does not need to wear safety glasses". Although the majority of the farmers believed injury to the eye could be prevented through the use of eye protection, the misconception that there are many jobs that do not require protection could hinder the use of ocular protection. Another erroneous impression about eye protection (goggles or safety glasses) was that one looks funny when it is worn, this being reported by 13.7% of the farmers. These reasons could possibly account for the low use of ocular safety protection (8.3%) among the farmers reported in that study. Equally, Forst et al (2004) reported an improvement in knowledge on eye health and safety among Latino farm workers who received a training using a Likert scale response in a pre- and post-assessment.

From the data, it is imperative to investigate further into the knowledge, perceptions and risk beliefs among farmers. As asserted by Arcury et al (2010), these beliefs (cultural, religious, etc), as well as, those as a result of gender, have the potential of influencing risk behaviour among workers, and could also limit their acceptance of training interventions.

4.9 Ocular health and safety training for cocoa farmers

A key strategy to adopt in designing health education material is to investigate what the target population already knows, and what they do in order to determine what they lack. Most health education and safety programmes, do not start from this fundamental premise (Ahmad et al, 2006: Hughes et al, 1996). As Oakley et al (1995:311) argue "health education that builds on an accurate understanding of the beliefs and knowledge about health of the target group is probably more effective than strategies which lack this foundation". There are currently no standard data on the ocular health hazards and specific ocular health needs of cocoa farmers in Ghana. According to Arcury et al (2010:237),

> "designing appropriate occupational safety and health training for agricultural workers requires having accurate knowledge of the size and composition of the agricultural workforce and accurate knowledge of the occupational injuries and illnesses that agricultural workers experience".

As there is very little data on ocular health of cocoa farmers in Ghana to augment the planning of comprehensive ocular health training programmes, a number of methods of training were put together to achieve a medium engagement training (Burke et al, 2006), these being used in the training programme for this study. The training combined face-to-face lectures with pictures, case scenarios, practical training on basic ocular first aid and maintaining personal protective equipment in small groups within each village selected for the study. Participants contributed to the discussion on ocular health hazards on the cocoa farms, on how to handle unforeseen ocular injuries, as well as, methods they deemed appropriate that could be adopted to help reduce eye injuries and disease. They also discussed simulation questions using structured guidelines and rehearsed first aid procedures that were discussed during the training. Feedback was given to participants to emphasize key elements that were missing in the discussion.

All participants answered basic questions on knowledge, attitudes and beliefs on ocular health and safety during the interview phase of the study. This allowed for an understanding of the perception and beliefs of participants before the training intervention. The same questionnaires were used to measure the training outcomes in the trainees after the training. Particular note was taken on change in "knowledge, beliefs, attitudes, skills, motivation and behavioural intentions" (Robson et al, 2010: 5) (pre- and post-training) as these were expected to change due to the exposure to the training, as well as, improved knowledge and self-efficacy (Grzywacz et al, 2009). Information gathered in this training, as well as, knowledge of specific ocular hazards among these farmers will help to develop a comprehensive ocular health training programme for cocoa farmers in Ghana.

4.10 Conclusion

There is general agreement in the literature that ocular health hazards are common among agricultural workers, and that they can lead to several eye injuries and diseases. However, there is a potential to limit their occurrence using the appropriate health and safety training programmes. Few researchers have documented issues on knowledge, beliefs and practices among agricultural workers (Arcury and Marin, 2009; Sorensen et al, 2008; Forst et al, 2004). The situation is not different among cocoa farmers in Ghana.

The training intervention in this study is aimed at filling this gap and to provide data that will serve as the basis for the development of a training manual and training programme for agricultural workers in the cocoa industry in Ghana. In assessing the knowledge and perceptions of participants, a five point Likert-scale will be chosen (Kearney et al, 2013) for this study as in previous studies (Forst et al, 2004; Verma et al, 2011) which employed dichotomized style of questions reported skewed agreement to questions with participants providing inconsistent and socially accepted responses (Verma et al, 2011). Medium engagement training methods will be employed over less engagement training methods in this study to achieve a much accurate and reliable data (Burke et al, 2006). This study will be conducted based on an understanding of the barriers to the acceptance of safety training among participants such as level of education, language barriers, culture, perceptions, among others as this approach is more effective than strategies which lack this foundation (Oakley et al, 1995)

CHAPTER 5: METHODOLOGY

5.1 Introduction

Cocoa farmers constitute a major component of the working population in Ghana and make a significant contribution to the economic growth and development of the nation. These workers have been reported to face several ocular hazards that can lead to eye diseases, injuries and impairment due to other conditions such as refractive error, which can negatively impact on productivity and their quality of life. This chapter outlines the study methodology used, and includes the study design, study area, study population and sample size, inclusion and exclusion criteria and data collection instruments. Other areas included are data management and analysis as well as ethical considerations. A structured questionnaire administered by interviewers, eye examinations and an ocular health education/training intervention were employed to achieve the objectives of the study. The study was conducted from December, 2013 to July, 2014. The chapter is based on the objectives of the study as presented in **Table 5.1**.

Table 5. 1: Showing the study aim, objectives and methods

Aim		Objectives	Methods	Phases
To examine and understand the factors that affect the ocular health of cocoa farmers in Ghana	1	To determine the prevalence of ocular conditions, refractive error and visual impairment among cocoa farmers in Ghana.	Clinical eye examination	1. Examining the ocular health of cocoa farmers
	2	To determine the prevalence of ocular injuries among the cocoa farmers.	Questionnaire	
	3	To examine the use of protective eyewear among the cocoa farmers in Ghana.		
	4	To determine eye care seeking behaviour among cocoa farmers in Ghana.		
To improve their knowledge and awareness on ocular health and safety practices through a training intervention.	5	To investigate the cocoa farmer's knowledge, perceptions, and beliefs on ocular health and safety practices.	Questionnaire	2. Developing and implementing an education intervention
	6	To develop an education training intervention to improve the cocoa farmers' knowledge on ocular health and safety practices.	Literature review, inputs from farmers, extension officers and other players in the cocoa industry.	
	7	To implement a training intervention to improve the cocoa farmers' knowledge on ocular health and safety practices.	Training workshop	
	8	To establish changes in the cocoa farmers' knowledge, perceptions and beliefs on ocular health and safety practices.	Questionnaire	
	9	To finalise the ocular health and safety practices training manual for cocoa farmers.	Review of the manual based on result/outcome of the training workshop	

5.2 Study design

The study used two quantitative methods; a cross-sectional survey and a quasi-experimental pre-post-test study design for the training intervention. Farm workers constitute a ‘hard-to-reach’ population, for which no specific sampling frame exists (Arcury et al, 2008; Magnani et al, 2005), necessitating the use of simple random sampling through a multistage approach to reduce the likelihood of selection bias in this study, as was shown with other studies among the study population of farm workers (Aneani et al, 2011; Larson et al, 2005).

The cross-sectional study involved administering a structured questionnaire and conducting a comprehensive ocular examination among cocoa farmers in four districts selected from the cocoa growing regions of Ghana. The design of the questionnaire was based on previous studies, as well as, issues mentioned in the health belief model and the occupational health and safety in the workplace model (Quandt et al, 2012; Verma et al, 2011; Burton, 2010; Quandt et al, 2008, Forst et al, 2006; Forst et al, 2004; Janz et al, 2002). The ocular examination involved an assessment of the participants’ visual acuity following the case history, preliminary examinations, external and internal eye health examination and refraction. In addition, a a quasi-experimental pre and post assessment knowledge scores on ocular health and safety practices was conducted using a 5 point Likert-scale questionnaire adapted from previous studies (Verma et al, 2011; Forst et al, 2006; Forst et al, 2004). The initial assessment of knowledge was conducted within six weeks prior to the health education/training intervention while the post assessment was conducted six weeks after the ocular health and safety education/training.

5.3 Study area

Ghana is located on the west coast of Africa and had a population of approximately 24.6 million in 2010 (GSS, 2010). There are ten administrative regions in Ghana, with cocoa production occurring in the forest agro-ecological zones of six of the regions, namely Western, Ashanti, Brong-Ahafo, Central, Eastern, and Volta regions (Teal et al, 2006). However, for the purposes of cocoa production, there are seven regions zoned by the Ghana Cocoa Board. This is because the Western region has been divided into two; Western north and Western south. Each region is made up of districts for administrative purposes. Currently, there are 73 cocoa growing districts covering all the cocoa growing regions of Ghana. The main cocoa-producing region is presently the Western Region, which accounts for more than 50% of the total annual production (World Bank, 2011; Brinkman et al, 2008; Anim-Kwapong and Frimpong, 2004). The Ashanti region is second in cocoa production following the Western region (World Bank, 2011). Cocoa production occurs in the forest areas of these regions, where rainfall is 1 000 – 1 500 millimetres per year.

The study was conducted in the four districts from the cocoa growing regions, which were; Juaboso (Western), Kwahu West (Eastern), Atwima Mponua (Ashanti) and Assin North (Central) (**Figure 5.1**) selected from these regions using simple ballots.

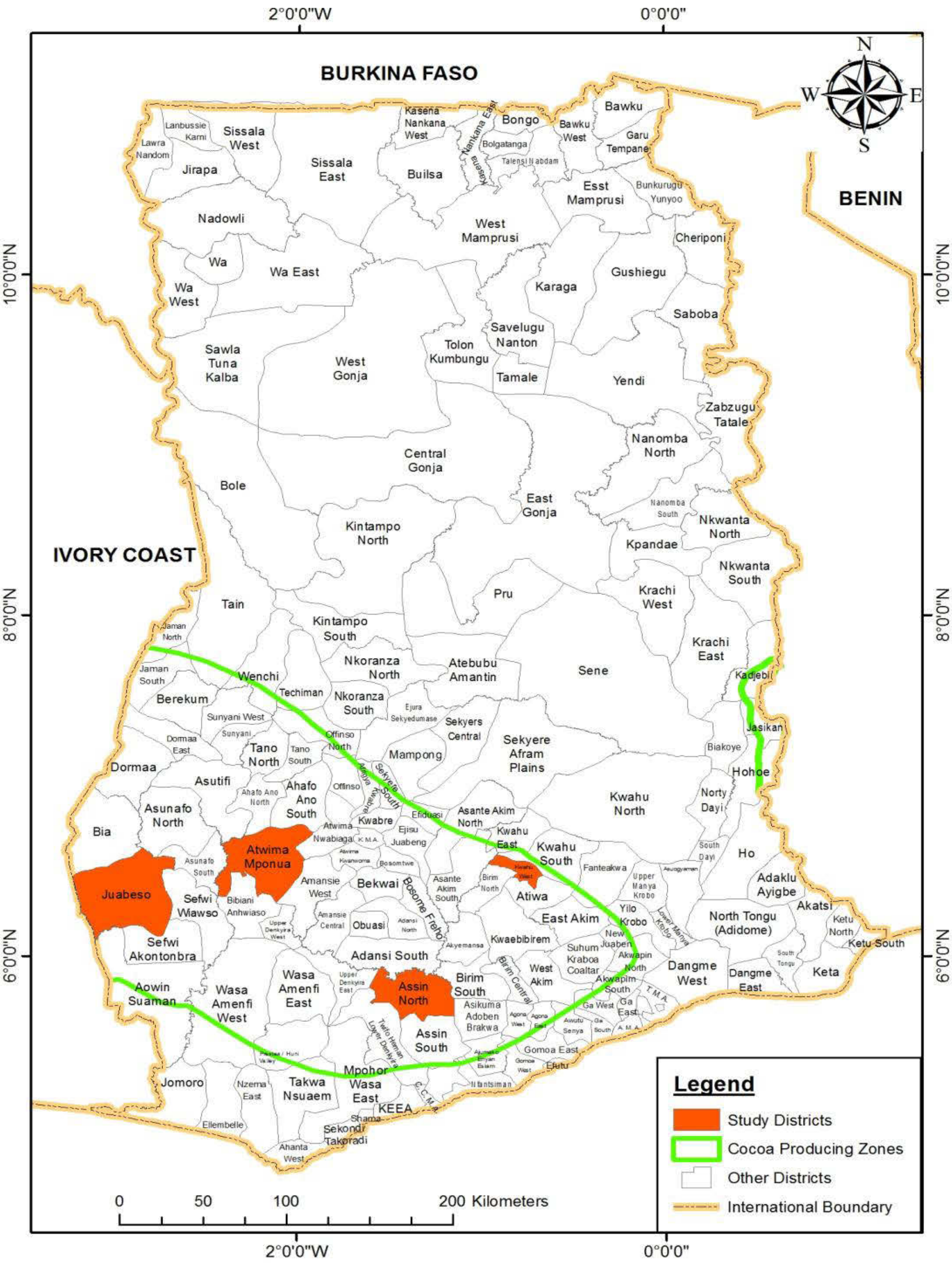

Figure 5. 1: Study area

Agricultural activities provide employment to about 65-95% in all the selected districts with cocoa production playing a significant part (GSS, 2010). While many of the farms are small, the areas in which they are located tend to be rural in nature, with people living in villages that are connect by poorly serviced road infrastructure. Although most of the villages have schools, not all farm workers complete 12 years of schooling, and very few have access to facilities such as the internet. In this context, the workers and their families rely on health information about their employment from health care workers who seldom visit the villages for health outreach services. These outreaches mainly focus on general health care with little emphasis on eye care due to the limited number eye care professionals in Ghana (Ilechie et al, 2013). Few of the farmers have access to healthcare in their villages while majority have to travel long distances. In the case of eye care facilities, the distances are even further as most eye care services through the public health care sector are usually located in urban centres, and nurses in the primary health care facilities have limited training in eye care. Each district is described further.

a. *Juaboso District* is located within latitude 6° 6N and 7°' N, and Longitude 2° 40' W and 3°15 W, with Juaboso town as the administrative capital. According to Population and Housing Census (PHC) of Ghana, the district had a population of 111 749 in 2010, with agriculture being the main form of employment, engaging approximately 79.9% inhabitants, of which cocoa growing dominates. Illiteracy rate in the district is 32% according to the 2010 PHC (GSS, 2010).
b. *The Kwahu West Municipal* lies between latitudes 6°30' N, and 7° N and longitudes 0°30' W and 1° W of the equator, with a total land area of 440.5

km², and having Nkawkaw as the administrative capital. According to Population and Housing Census (PHC) of Ghana, the municipality had a population of 93,584 in 2010, with agriculture being the main form of employment, engaging approximately 60.0% inhabitants, of which cocoa growing playing a major part. Illiteracy rate for the municipality may not deviate significantly from the regional value of 36.4% (GSS, 2010).

c. *The Atwima Mponua district* is located in the south-western part of the Ashanti Region and covers an area of about 894.15 square kilometers with a population of 119,180 and a illiteracy rate of 29.4% with limited health facilities (GSS, 2010). It lies between longitude 2° 00'W and 2 ° 32'W and latitude 6o32'N and 6° 75'N. The district shares borders with about six different districts and also has a very strong cocoa sector due to favourable weather conditions. Agriculture is the main source of employment for the inhabitants of this district as there are about 22,237 agricultural households (GSS, 2010).

d. *Assin North Municipal* lies within Longitudes 1° 05' E and 1° 25 W and Latitudes 6° 05' N and 6° 40 S with an illiteracy rate of about 13.6%. The total land area of municipal which is made up of about 1 000 settlements is about 1,500 sq. km. It has a population of 161, 341 and about 51 025 agricultural household members. Approximately 59.5% of the inhabitants of this district are employed in agriculture including forestry and fishing (GSS, 2010).

5.4 Study population

The study population comprised of cocoa farmers as defined by the Ghana Cocoa Board. A cocoa farmer is defined as an individual whose major occupation is cocoa farming and/or works on a cocoa farm for a living throughout the year or for major periods of the year (COCOBOD, 2002). Reports indicate that there are approximately 800 000 cocoa farmers in Ghana (World Bank, 2011; Anim-Kwapong and Frimpong, 2004). While some of the bigger commercial farm owners and farmers may have had tertiary education, many are peasant farmers who will not have attended an agricultural college where instruction on health care of workers is normally addressed. Agricultural colleges are mostly attended by Agricultural Extension officers who are mainly not in the mainstream farming but act as technical advisers to farmers. Several employment relationships with different payment or reward options exist on cocoa farms. Hired farm workers are paid for the days they work, mostly during the main crop season where there is an abundance of work on the farm. Other "category of cocoa farmers who are directly involved with routine cocoa farming activities are called by various names including: sharecroppers, caretakers or tenant farmers" COCOBOD, 2002: 1). They are not land owners but enter into special relationships with land owners. These may include wages for daily living or future prospects of owning part of the cocoa farm. Their contributions on cocoa farms are needed all year round.

5.5 Study sample and size

This section outlines the study sample for phases 1 and 2.

a. Sampling procedure for interviews and eye examination

The multi-stage simple random sampling included the selection of four cocoa growing districts from the cocoa growing regions in Ghana using ballots. Following the selection of the districts, cocoa marketing companies that purchase cocoa beans directly from the farmers within these districts were contacted. These companies have organized cocoa farmers into societies for easy purchases and access when distributing farm implements and information dissemination. A list of all cocoa farmers' societies in the districts was obtained, these being compiled based on villages. Similarly, using simple random sampling (ballots), five villages were selected from each participating district. With the assistance of the societal heads and chief cocoa farmers in the selected villages, a compilation of all cocoa farmers in the villages were made to constitute a sampling frame out of which participants of the study were randomly selected. A proportion of the sample size was assigned to each village based on the population size of the settlement to give equal weighting (Aneani et al, 2011; Larson et al, 2005). As a result, an average of 25 participants was selected from each of the five villages in each district to constitute the study sample. Where a selected farmer declined to participate or was unavailable, they were replaced through the same process of selection.

The sample size for the first part of the study, which involved interviews and eye examinations, was calculated using the formula,

$n = Z^2(1 - \alpha/_2)\ pq/d^2$

where,

$Z^2(1 - \alpha/_2) = 1.96$ at 95% confidence;

p = prevalence of a given ocular condition,

q = 1- p

d = absolute allowable error and assuming that the least prevalent conditions were not likely to exceed 10% based on available literature (Budenz et al, 2013; Verma et al, 2011; Oye and Kuper, 2007; Guzek et al, 2005; Lewallen and Courtright, 2001) (i.e. p = 0.1 and q = 0.9, a precision (d) of ± 3% and design effect of 1.5, a sample size of 576 cocoa farmers were required (Ahmad et al, 2012; Minassian, 1997; Cochran, 1977).

Reports indicate that the prevalence of major eye conditions such as cataract, refractive errors, glaucoma and corneal disorders are higher in people 40 years and above (Boadi-Kusi et al, 2014; Budenz et al, 2012). The assumption of the least prevalent conditions not exceeding 10% (lower than prevalence of major eye conditions in previous studies similar to the population dynamics of the current population of study) was to ensure the detection of the least prevalent conditions in the population sampled. The assertion was based on the fact that people aged 40 years and above were most likely going to form the majority of the study participants as literature indicates that the average age of cocoa farmers is 55 years (Asuming-Brempong et al, 2006; Anim-Kwapong and Frimpong, 2004).

b. Sampling procedure for quasi-experimental pre-test post-test intervention

To establish a change in knowledge score on ocular health and safety practices, a questionnaire was administered to a smaller number of farmers before and after a training intervention, for which a different sampling procedure was used. To detect a small effect size (Cohen's *d*[1] = 0.2) or change in score post intervention knowledge score versus pre-intervention with 80% power (1- β [type 2 error probability]) and 95% confidence (or 5% error probability [type 1]), a sample size of 199 cocoa farmers was required (i.e. 199 × 2 = 398 observations) (Cohen, 1988). Therefore a maximum of 10 participants were randomly selected from each participating village to undergo the ocular health education/training. Participants were selected from all the villages that were earmarked for the first phase. The villages were treated as clusters and 10 participants were randomly selected from among the participants of the first phase in each of the villages to constitute the sample for the second phase.

5.6 Inclusion criteria and exclusion criteria

Male and female farmers who met the following inclusion criteria were included:

a. were actively engaged in production activities on the farm.

b. were 18 years and above, and

c. had worked on cocoa farms for a minimum period of 3 years (average gestation period for a cocoa tree).

d worked only on a cocoa farm and were not employed in other farming activities

Farmers were excluded based on the following criteria:

a. were inactive cocoa farmers, such as those who have retired for more than one year.

b. only make decisions on sales and purchases and other administrative roles.

c. were employed in any other cash crop farming.

d. had worked for less than 3 years on cocoa farms

5.7 Data collection instruments

The study was divided into two main phases. Phase one involved the administration of survey questionnaire and clinical eye examination. A structured questionnaire (Appendix III) was used in addition to a standard clinical evaluation form (Appendix IV) for collecting the clinical data. The second phase of the study which assessed knowledge, perception and risk beliefs, as well as, change in knowledge scores following training made use of a Likert scale questionnaires (Appendix VI a and b). A five point Likert-scale was chosen (Kearney et al, 2013) for this study as previous studies (Forst et al, 2004; Verma et al, 2011) which employed dichotomized style of questions reported skewed agreement to questions with participants providing socially accepted responses and also reported inconsistently to questions (Verma et al, 2011). The main themes in the questionnaire which was used for data collection are highlighted below.

a. Phase 1: Ocular health of cocoa farmers

This phase consisted of two methods (questionnaire and eye examinations) to meet the first 4 objectives. Information regarding the participants' demographic details were obtained, as well as, data regarding their farm work experience before the questions regarding the objectives were explored.

i. Demographic and farming characteristics

The first part of the study was the administration of questionnaires to participants (Appendix III). The first part covered demographic information such as gender, age, level of education, income and marital status. The section also covered issues such as farm characteristics of participants which included years of farming, farm size, hours spent on farm per week, activities farmers are involved in on the farm (weeding, spraying, harvesting, *etc*), and other relevant information.

ii. Objective 1: To determine the prevalence of ocular conditions, refractive error and visual impairment among cocoa farmers.

The instrument covered issues on ocular complaints, ocular and medical history, visual acuity and other preliminary examinations such as cover test. The instrument also made provision for collecting data on tear film instability, anterior and posterior segment examinations, as well as, subjective and objective refraction and documenting findings.

Participants were also asked to report hazards in the farm they believed had consequences for their eye health. Similarly, issues relating to work such as difficulty seeing colleagues at a distance, difficulty doing close work and difficulty identifying ripped cocoa pods ready for harvesting were ascertained.

iii. *Objective 2: To determine the prevalence of ocular injuries among the cocoa farmers.*

This section of the questionnaire collected data on self reported ocular injuries. Eye injury in this study was defined as any injury occurring to the eye and/or adnexa that occur in the workplace and require medical attention (orthodox or traditional) or results in at least one-half day of restricted activities (Thompson and Mollan, 2009; Chen et al, 2007; McCurdy and Carroll, 2000; McGwin et al, 2000; Lyman et al, 1999). Participants were asked to report eye injuries occurring within the last one year preceding the study in order to reduce recall bias. Other variables collected in relation to injury were activity during which eye injury occurred, cause of injury, severity (graded using a scale 1- 10), type of medical intervention sought following the injury and loss of work days due to the eye injury, among others.

iv. *Objective 3: To examine the use protective eyewear among the cocoa farmers in Ghana.*

With the questionnaire, participants were asked about the kinds of ocular protection they used during farming activities and for which activities they used such devices if any, as well as the frequency of use. For those who reported not using any eye protective device or not using it frequently, reasons for such were sought and this constituted barriers to the use of ocular protection.

v. Objective 4: To determine the eye care seeking behaviour among cocoa farmers in Ghana.

By means of the questionnaire, all the participants recruited for the study were asked if they had had an episode of eye symptoms within a year preceding the study (Ocansey et al, 2014). Those who responded "Yes" to the question were asked the type of symptom they experienced and if any, whether medical intervention was sought at hospitals or clinics and reasons for not visiting the hospital if any. Distances covered, means of transportation and other relevant information were also documented. Furthermore, they were asked if they sought any alternative form of eye care and the reasons for such choices.

b. Phase 2: Ocular health education intervention

This phase adopted the pre-post tested study design approach and made use of a 5 point Likert scale to meet objectives 5 and 8, while objectives 6, 7 and 9 were based on a review of the literature and inputs from major stakeholders, as well as, results from the pre-post training evaluation. Participants' demographic variables were collected prior to the main training. Participants were also asked if they had ever had training on how to maintain good eye health and prevent injuries while working on the farm. The opinions on how frequent such training should be organized, as well as, their willingness to participate were also enquired.

i. Objective 5: To investigate the cocoa farmer's knowledge, perceptions, and beliefs on ocular health and safety practices

The tool for this phase of the study was a five point Likert scale questionnaire which covered key issues that investigated participants' knowledge, perception and risk beliefs on ocular health and safety practices based on the literature (Verma et al, 2011; Forst et al, 2006; Forst et al, 2004). Issues on basic knowledge on eye health, ocular hazards in the farm, injuries, as well as, ocular first aid were covered. A five point Likert-scale was chosen for this study (Kearney et al, 2013) as previous studies (Forst et al, 2004; Verma et al, 2011) that used dichotomized style of questions reported skewed agreement to questions, with participants providing socially accepted responses, and an inconsistency in the answers (Verma et al, 2011).

ii. Objective 6: To develop an education training intervention to improve the cocoa farmers' knowledge on ocular health and safety practices.

The formulation of the training manual was based on a review of the literature on ocular health of agricultural workers with emphasis on agricultural workers (cocoa farming) as well as observation of activities of cocoa farmers on the farm. The manual was modified following the training of participants in the pilot study. Participants included cocoa farmers, agricultural extension officers and gang sprayers who are actively involved in cocoa farming activities who also made substantial inputs into the content of the manual. Other key stakeholders in the cocoa marketing companies and Ghana Cocoa Board at the selected districts also contributed in understanding the life of the farmers, which helped in shaping the content of the training manual.

iii. Objective 7: To implement a training intervention to improve the cocoa farmers' knowledge on ocular health and safety practices.

An ocular health and safety education/training was conducted among participants to improve their knowledge and awareness levels on issues relating to cocoa farming, eye health and safety.

iv. Objective 8: To establish changes in the cocoa farmers' knowledge, perceptions and beliefs on ocular health and safety practices.

The tool for this section was a repeat of the tools in objective 5. This was conducted by interviewers six weeks after the training intervention at the individual homes of participants.

v. Objective 9: To finalise the ocular health and safety practices training manual for cocoa farmers.

The fine tuning of the manual was done based on a comparison between the pre-post responses of participants. This was done to reinforce some key areas where major deficiencies were recorded following the training.

5.8 Training of field assistants and pilot study

Three field workers were recruited to assist in the administration of questionnaires and interviews in this study. They were university graduates from the Department of Population and Health of the University of Cape Coast, Ghana, who are experienced in interviewing and administering questionnaires. Since the interviews were conducted in a local Ghanaian language, experts from the Ghanaian Language Department and the Department of Population and Health of the University of Cape Coast, Ghana, assisted in the training of the interviewers to enable them to familiarize themselves with the concept of the study and questions. The training lasted for a period of three days.

Two optometrists (including the principal researcher), an ophthalmologist and two optometry interns from the Department of Optometry of the University of Cape Coast, Ghana, were involved in the collection of the clinical data. The optometrists and ophthalmologist were trained on the research protocol to standardize and agree on the protocol while the interns were trained to familiarize themselves with accurate recording of preliminary data which was assigned to them such as visual acuity, cover test and near point of convergence measurements.

Following the training of field assistants and clinicians, a pilot study was conducted at Wampam, a cocoa farming community in the Central Region of Ghana among 30 farmers selected through a multistage random sampling approach, participated in the first phase of the pilot study. They were made up of 21(70.0%) males and 9(30.0%) females. The mean age of the participants was 47.4 years ±11.3 with ages ranging from 26 years to 75 years. Minor post-pilot changes were made to the study instrument and these included elimination of duplicate questions, re-aligning some questions and the introduction few others.

Similarly, ten participants who were randomly selected from among the participants of the first phase were enlisted for the pilot of the second phase. They were made up of 6(60.0%) males and 4(40.0%) females. The mean age of the participants was 47.0 years ±7.9 with ages ranging from 32 years to 57 years.

Significant post-pilot changes were made to the study instrument. Redundant questions which did not contribute significantly to the Cronbach's Alpha were expunged from the 60 point questionnaire to give a final 50 point questionnaire and others were re-worded.

5.9 Data collection process

a. Field preparation and recruitment of participants

Prior to the main study, the principal researcher visited all the selected districts to obtain written permission from the District or Municipal Assemblies (political administrators), as well as, the local Health Directorates of the Ghana Health Services. After obtaining ethical approval to conduct the study, meetings were held with these officials to inform them about the commencement of the study and to seek their support. Meetings were also held with the Local Managers of the Ghana Cocoa Board and other License Produce Buying Company within the selected districts. This was done to inform them of the study and to obtain the data that was needed for the sample selection, as well as, to obtain the necessary information (such as contact details) of persons who could help reach the target population. After selecting the villages/societies, meetings were held with the chief cocoa farmers and societal leaders (leaders of cocoa farmers) and in some cases traditional leaders to discuss the modalities for the study and to seek their support and approval. Appropriate locations similar to clinical settings were also selected to be prepared for the eye examination component of the study.

Following the selection of potential participants, a house to house visit was made by the principal investigator and field assistants with the help of the chief cocoa farmers or leaders of the societies from which potential participants were selected. This was done to formally inform them of the study and to seek their consent to participate. In each of the selected villages, meetings were held with the entire participant's cohort to agree on two dates for which the researcher and field workers were to visit to conduct the study.

b. Objective 1: To determine the prevalence of ocular conditions; refractive error and visual impairment among cocoa farmers.

Eye examinations were conducted to achieve the objective outlined. The procedures followed included the following;

i. **Comprehensive history:** A comprehensive case history including major ocular complaint if any, oculo-visual, medical and family histories and cases of allergies, if any, were recorded. Previous eye examination and spectacle prescription were also ascertained. History of alcohol intake and smoking of tobacco were also recorded including duration and quantity of consumption per week. These were preceded by the measurement of the weight and height in order to calculate the body mass index of participants.

ii. **Blood pressure:** Three readings of the individual participants blood pressure was taken and the average recorded as the final blood pressure (mmHg) with a calibrated stethoscope.

iii. **Visual acuity**: The distance visual acuity (VA) of the right and left eyes was measured using the LogMAR chart at a testing distance of 4m. Participants who wore spectacles had their distance VA taken with their prescription on. Pinhole acuity was taken for participants who read 0.3 logMAR line or worse to confirm a refractive error. Near visual acuity was also measured using the near visual acuity logMAR charts for each participant at a distance of 40 cm.

iv. **Binocular vision test:** The cover test was performed using a hand held occluder to detect any phoria or tropia and any deviations detected were measured with a prism bar.

v. **Tear function test:** The integrity of the tears was assessed using the Tear Break Up Time (TBUT). This was done by instilling a drop of 1% sodium fluorescein into the eye and asking the participant to blink 5 times so that the fluorescein film formed on the cornea and bulbar conjunctiva. The participant was then asked to stop blinking and a cobalt blue filter light from the slit-lamp biomicroscope was used to monitor the appearance of a first randomly distributed dry spot and recording the time interval between the appearance of the last blink and the appearance of the dry spot (Kallarackal et al, 2002). An average of 3 measurements was recorded with a value of less than 10 seconds reported as abnormal.

vi. **External eye examination:** A hand held slit lamp was used to examine the external ocular adnexa for defects such as entropion, ectropion, trichiasis, ptosis, defective eyelid closure, blepharitis, etc. Pupillary function tests including direct, consensual, swinging light test, and near pupillary reflex tests were performed. The conjunctiva, cornea and lens were also examined for any abnormalities with the appropriate slitlamp technique and illumination.

vii. **Intra-ocular pressure (IOP) measurement:** A handheld Perkins tonometer (applanation) was used to determine the intra ocular pressure of all participants. The measurements were taken after instilling 1% drop of

Alcaine and fluorescein in both eyes. Intraocular pressure (IOP > 21mmHg) was considered abnormal (Kanski, 2009).

viii. **Refraction:** Both objective and subjective refractions were performed for all participants. Static retinoscopy without cycloplegia but with a fogging technique which has been shown to have comparable results to cycloplegic refraction was performed (Tanle et al, 2011). A full subjective refraction was conducted after which best corrected visual acuity (BCVA) was measured for both distance and near.

ix. **Colour vision assessment:** Colour vision screening was carried out using the Hardy Rand and Rittler (HRR) pseudoisochromatic plates. The test was done monocularly while participants were wearing the spectacle correction for distance and near, if any.

x. **Internal eye examination:** Pupil-dilated fundus examination using 1% Tropicamide eye drop and a hand held monocular ophthalmoscope was used to assess any abnormalities of the posterior segment (Al-Shaaln et al, 2011; Ajaiyeoba et al, 2007; Congdon et al, 2003).

Clinical impressions of participants were documented based on the procedures outlined above. For persons with visual acuity less than 6/18 in either eye based on presenting visual acuity, a single precipitating reason for visual loss in the affected eye was assigned (Congdon et al, 2003). For conditions with multiple causes, the one that was most readily curable was assigned as a major cause of impairment (Al-Shaaln et al, 2011; Oye and Kuper, 2007; Congdon et al, 2003; WHO, 1988). An impression of glaucoma was made based on an IOP of > 21 mmHg and a vertical CDR of ≥ 0.7 (Oye and Kuper, 2007). Cataract was defined as a lens opacity with a visual impairment of 6/18 or worse. Three qualified clinicians including the principal researcher and an ophthalmologist were the only persons responsible for making diagnosis of conditions and assigning causes of visual impairment. The ophthalmologist was not on site all the time, the other two clinicians referred cases of doubtful conditions, as well as, those that needed a determination of cause of visual impairment to the ophthalmologist for a final determination on the last day of attending to participants in a particular district. Appropriate intervention such as medication, spectacles or referrals for further examination to eye centres within the regions selected for the study were given.

c. Objective 2: To determine the prevalence of ocular injuries among the cocoa farmers.

This objective was assessed with the use of an interviewer-administered questionnaire. Participants reported eye injuries sustained within the last one year preceding the study, activity on the farm during which the injury occurred, cause of the injury as well as health intervention sought if any.

d. Objective 3: To examine the use of protective eyewear among the cocoa farmers in Ghana.

Using an interviewer-administered questionnaire, participants were asked to report farm activities they are engaged in and if they ever utilised any protective eyewear during any of the reported farm activities. For those who reported using any protective eye device, the frequency of use of the device was ascertained. Participants who reported less frequent use or non- use of protective eyewear were asked to report any reason they considered as a hindrance (barrier) to using protective eye devices.

e. Objective 4: To determine eye care seeking behaviour among cocoa farmers in Ghana

The eye care seeking behaviour of participants was assessed using an interviewer-administered questionnaire. This objective also focused on the last one year preceding the study. Participants were asked if they had had any episode of eye symptoms and the form of medical/health intervention sought if any. Factors considered as hindrances to seeking eye care were also recorded.

f. Objective 5: To investigate farmers' knowledge, perceptions and risk beliefs on eye health and safety practices.

This objective was assessed using a 5 point Likert scale questionnaire administered through interviewers. Participants had the option of choosing any response (strongly agree [5], agree [4], neutral [3], disagree [2] or strongly disagree [1]) to a set of questions. Participants were assessed on knowledge, perceptions, risk beliefs and practices on ocular health regarding their work (pre-training assessment). The questions were administered by interviewers in their local language. Five main areas were assessed, namely; basic knowledge about eye health, hazards and safety, perceptions and risk beliefs with ocular implications, ocular injury and potential hazards, ocular protection and ocular first aid (Appendix VIa).

g. Objective 6: To develop an education training intervention to improve the cocoa farmers' knowledge on ocular health and safety practices.

The development of the educational and training manual was undertaken through three main methods; literature review, personal communication and observation of farm activities engaged in by cocoa farmers and an analysis of the pre- training responses by farmers.

The review of relevant literature was done on MEDLINE from 1990 to 2012 using search words "agricultural workers", "hazards" "eye injuries", "eye diseases", "ocular protection", "ocular first aid", and "cocoa farmers". Relevant information from these searches, as well as, reviews from other relevant publications, were compiled to constitute the basic block (simplified) and structure of the educational and training manual, which was updated after the training.

The perception of ocular hazards faced by cocoa farmers from key persons within the cocoa industry in the districts selected for the study (i.e. agricultural extension officers, chief cocoa farmers and some officials of the Ghana Cocoa Board) were obtained through personal communications to shape the development of the manual. Similarly, the principal investigator, who has lived his entire life in cocoa growing areas also observed cocoa farmers for two weeks on their routine days at work on the farm to assess the ocular health challenges they face at work.

Finally, the development of the educational and training manual on ocular health among cocoa farmers considered the knowledge, perception and beliefs of cocoa farmers through an analysis of their responses in the pre-training assessment.

h. Objective 7: To implement a training intervention to improve the cocoa farmers' knowledge on ocular health and safety practices.

The training intervention was conducted by the principal investigator in smaller groups of 10 cocoa farmers using the training manual. Training materials used included a laptop, projector, picture posters, pen marker, flip charts, plastic washing basin, water, towel, bandage, face shields, goggles, and sun shades.

The training included a lecture using prepared Microsoft Power Point slides from the training manual, interspersed with questions and discussions as well as pictorial evidence of ocular conditions (diseases and injuries) recorded among farmers to aid an understanding among participants. Hands on practical sessions (simulation exercises) on handling ocular emergencies were also included in the training to enhance participants understanding and appreciation of concepts that were being passed on. Finally, simulations case scenarios provided in the manual among participants were discussed to reinforce the lessons learnt from the training.

i. Objective 8: To establish changes in the cocoa farmers' knowledge, perceptions and beliefs on ocular health and safety practices.

This objective was achieved using the same tool as in objective 5 following an ocular health and safety education/training among selected participants. The post-training questionnaires (Appendix VIb) were administered individually to the participants in the same manner as the pre-training was done.

j. Objective 9: To finalise the ocular health and safety practices training manual for cocoa farmers.

The final training manual was complied based on a comparison between the pre-post responses of participants. This was done to reinforce some key areas where major deficiencies were recorded following the analysis of the training.

5.10 Data management

The data obtained from interviews, clinical examination and ocular health education/training were checked for accuracy and consistency each day after data collection prior to leaving the site by the principal researcher. Where inconsistencies and errors were found, these were corrected prior to leaving the site. All participants in this study were assigned codes and their data captured on a database on a laptop computer which was password protected. Data capturing was done using a double blinding approach to ensure accuracy using Microsoft Access 2010. The data was then transported to Microsoft Excel version 10 and cleaned to ensure consistency and accuracy. Only persons who were associated with this work, such as supervisors, and statistician have access to the captured data as a way of ensuring confidentiality.

5.11 Data analysis

A general purpose statistical software package, STATA version 12 was used to analyse the data, in conjunction with the faculty statistician.

a. Demographic and farm characteristics

Descriptive statistics were computed for sample demographics and farm characteristics. Data was described using the mean ± standard deviation (SD) or confidence intervals (95% CI). Pearson's chi square, Fisher's exact test or students' t-tests were used to test associations between categorical variables measured. Differences in test were considered significant if $p < 0.05$. Where variables under investigation were unevenly distributed, the Wilcoxon rank sum test was used and the median and inter-quartile range (IQR) reported accordingly.

b. Eye conditions (visual impairment, refractive errors and diseases)

Visual impairment was analysed taking into consideration the global classification of visual impairment which is based on presenting visual acuity and is classified based on the three main levels of visual function: normal vision, visual impairment (moderate and severe) and blindness (Pascolini and Marriotti, 2010). According to the classification, moderate visual impairment combined with severe visual impairment together with blindness represents all visual impairment. Normal vision (NV) is defined as visual acuity (VA) of 6/18 (0.5logMAR) or better in the worse eye, visual impairment is defined as a visual acuity of < 6/18 (0.5logMAR) to 6/60 (1.0logMAR) (moderate visual impairment-MVI) using presenting visual acuity while visual acuity of <6/60 to 3/60 was classified as Severe Visual Impairment - SVI) and blindness is defined as visual acuity of <3/60 (1.3logMAR) in the better eye (Pascolini and Marriotti, 2010; WHO, 2010a). These definitions were applied in categorizing all measured habitual, as well as, corrected visual acuity of participants. Near visual impairment (NVI) was also defined as inability to read the 0.3logMAR @40cm (N8) (Naidoo et al, 2013; IAPB, 2010).

Refractive error was based on spherical and cylindrical values obtained from the subjective refraction. In this study myopia was defined as the spherical power in the better eye of −0.50D or worse and hyperopia as the spherical power in the better eye of +0.75D or more. Astigmatism was defined as −0.50D cylinder or worse in the better eye (Otutu et al, 2012). Where the refractive error in each eye was different (one eye myopic and the other hyperopic) it was recorded as antimetropia. Emmetropia was defined as spherical power of between – 0.25 D and + 0.50 D.

From the clinical procedures, diagnoses (a clinical impression) of all conditions identified among participants was made and used for computing disease prevalence among the study population (Kanski, 2009). An eye condition was deemed to be present if it was identified in one or both eyes. Glaucoma was diagnosed based on intraocular pressure assessment with a hand held applanation tonometer (IOP >21 mm Hg) and a vertical cup-to-disc ratio of greater than or equal to 0.7 and asymmetry of ≥ 0.2 (Oye and Kuper, 2007). Cataract was defined as a lens opacity with a visual impairment of 6/18 or worse. Classification of non-trachomatous scarring was done based on the case history and through the slit lamp assessment of the anterior segment. According to the World Health Organaization, trachoma is classified based on 5 grades: Trachomatous Inflammation – Follicular (TF); Trachomatous Inflammation – Intense (TI); Trachomatous Scarring (TS); Trachomatous Trichiasis (TT) and Corneal Opacity (CO).

Data on visual impairment, refractive errors and eye diseases were analysed using descriptive statistics and frequencies presented with the 95% confidence interval (95% CI). Bivariate analysis was also conducted and Pearson's chi square or Fisher's exact used to test association between variables with $p < 0.05$ being reported as statistically significant. Linear bivariate (unadjusted) and multivariate (adjusted) logistic regression was also used to predict the odds of diseases occurring in the study population based on some defined exposure supported by the literature. The odds ratio and 95% confidence interval for the results were also presented.

c. Ocular injuries, use and barrier to use of protective eyewear

To calculate the rate of eye injuries for the sample, the number of eye injuries reported that resulted in one or more days of lost work time was divided by the number of worker years at risk of injury. The variable worker years at risk was calculated by summing the self reported years working in cocoa farms for all 556 workers. Descriptive statistics was used to present the frequencies of injury (crude prevalence), use and barriers to use of protective eyewear with their 95% confidence interval (95% CI). Similar analyses were done for the data on ocular health seeking behaviour and barriers to seeking eye care. Bivariate analysis was also conducted and Pearson's chi square or Fisher's exact used to test association between dependent and independent variables. Apart from the crude prevalence of injuries, Confidence interval for the rate was calculated assuming a simple random sample (Quandt et al, 2012; Woodward, 2005). A *p*-value of < 0.05 was reported as statistically significant. Bivariate (undjusted) and multivariate (adjusted) logistic regression was also used to predict the odds of sustaining an eye injury based on some defined exposure, demographic, as well as, farm characteristics supported by the literature as reviewed in the previous chapters. The odds ratio and 95% confidence interval for the results was also presented.

d. Assessment of knowledge, perceptions, risk beliefs and change in knowledge score

Descriptive statistics was used to compute responses to individual questions used in assessing the variables in this section. Consequently, tables were presented to describe the pattern of responses on knowledge, perceptions and risk beliefs of participants.

Table 5. 2: Grading scale for individual questions (1-5)

Individual questions (1-5)	**Score**	**Grade**
	4.6 - 5.0	Excellent
	4.1 - 4.5	Very Good
	3.6 - 4.0	Good
	3.1 - 3.5	Fair
	2.6 - 3.0	Poor
	2.1- 2.5	Very Poor
	≤2.0	Fail

Table 5. 3: Grading scale for individual questions (1-50)

Sections (1-50)	**Score**	**Grade**
	46 - 50	Excellent
	41 - 45	Very Good
	36 - 40	Good
	31 - 35	Fair
	26 - 30	Poor
	21- 25	Very Poor
	≤20	Fail

In assessing the change in knowledge score of participants, the Wilcoxon sign ranked test was used to test for differences between the scores for the pre and post assessment. Results are presented as median score with inter-quartile range (IQR) and a P value of < 0.05 was considered statistically significant. A further analysis of the of individual questions which assumed normal distribution based on the interval scale was done using the student's *t*-test to enhance an understanding of the pattern of pre and post responses to the questions. The results were presented as mean (95% CI). The mean score for the individual questions was graded on a scale of 0-5 (Table 5.3) while that for each of the five sections was graded on a scale of 1-50 (Table 5.4). Ordinal multivariate logistic regression was also used to predict the factors that may have influenced the change in knowledge scores among participants following the training. The odds ratio and 95% confidence interval for the results have been presented.

5.12 Reliability and validity

To ensure reliability of data collected, only two optometrists, including the principal researcher and an ophthalmologist with relevant qualifications and experience were involved in clinical decisions. Three university graduates with relevant knowledge in data collection who were trained, were involved in the administration of the questionnaire. Similarly, two clinical optometry interns of the Department of Optometry, UCC who were competent to conduct preliminary investigation such as visual acuity and cover test were trained and used in the preliminary clinical investigations throughout the study.

The instrument for collecting clinical data conformed to standard optometric clinical procedures and practices. There was substantial to almost perfect agreement in some selected clinical measurements and observation among the clinicians following the pilot. For example cup-disc ratio had 87.7% agreement (Kappa, K= 0.84, p< 0.001), presence of cataract had 96.7% agreement (K=0.90, p< 0.001, pterygium, 96.7% agreement (K=0.91, p<0.001) while there was 80.0% agreement for IOP measurement (K=0.77, p<0.001). In spite of these agreements, clinicians mostly conferred and agreed on a single final diagnosis where there was the need to do so during the main data collection. The instrument for assessing knowledge score was validated for internal consistency with each section recording a Cronbach's Alpha (Cronbach's α) of between 0.8 and 0.86).

5.13 Ethical and legal considerations

Ethical approval for this study was obtained from the Ghana Health Service Ethics Committee on Research involving Human Subjects (GHS- ECRHS) as well as the Biomedical Research Ethics Committee (BREC) of the University of KwaZulu-Natal (Appendices VII a and b). Approval to conduct the study was also obtained from the Local Ghana Health Service Directorates and the District/Municipal Assemblies (political administration) of the selected areas (Appendices VIII a-i). The principles of informed consent, privacy and confidentiality were strongly adhered to in conducting this research. Since farmers who were involved in this study are not in any formal employment, individual informed consent was sought after explaining the procedure of the study to them in their local language and signatures or thumb prints were obtained for each participant (Appendices I and II).

Interventions such as eye medications and spectacles for near and in few cases for distance were provided to participants who required them based on the results of the clinical procedure at no cost to them. Farmers who needed further medical interventions were referred to appropriate health centres to receive the needed care at their own cost or at no cost if they were registered with the National Health Insurance Scheme (NHIS). However, the cost of transportation for participants who needed further determination and confirmation of their conditions by the ophthalmologist was born by the researcher. Furthermore, the cost of snacks for participants who underwent the ocular health and safety training was borne by the researcher. Participants who enrolled for the study were free to exit if they found the need to do so.

5.14 Data management - after analysis

Hardcopies of the data collected have been kept in a cupboard at the research office in Ghana and locked under key and will be shredded after 5 years. Only persons who were associated with this work, such as supervisors, and statistician have access to the captured data as a way of ensuring confidentiality.

5.15 Challenges encountered

The major challenge encountered in this study was accessibility to participants due to poor road networks. Similarly, most of the selected candidates were difficult to reach due to the nature of their job (leaving homes early for the farm and coming home late). This resulted in a number of visits to the selected villages by the researcher to ensure that participants were fully aware of the dates of the study thereby increasing running expenses. Some key personalities (chiefs, political leaders, opinion leaders, *etc*) did not fully understand why few people were selected and hence walked in with their relatives or acquaintances to be examined by the research team. This was a challenge as such people could not be easily turned away. Some of these people were examined after attending to the main participants of the study, and this increased the volume of work of the research team. Finally, binocular indirect ophthalmoscopy (BIO) was to be conducted on all participants but this was not practicable as most of the villages had no electricity for which reason the test procedure was modified to pupil-dilated fundus examination.

5.16 Conclusion

The overall experience of conducting this research was very rewarding. The study also provided an opportunity for many people who had never had their eyes examined to do so. Participants were generous with their time and the research team was very supportive from the beginning to the end of the study.

CHAPTER 6: RESULTS

6.1 Introduction

This chapter presents the results of the data analysis and is divided into two main parts, results from phases one (Objectives 1,2,3 and 4) and then phase two (Objectives 5,6,7,8 and 9). Phase one address issues on demographics of participants and farm characteristics, the ocular health assessment (eye diseases, refractive error and visual impairment) of cocoa farmers, as well as, the self reported eye injuries, use of protective eye wears and barriers to their use. It also includes the ocular health seeking behaviours and barriers to seeking eye health obtained through the use of a questionnaire. Phase two presents a description of the knowledge, perceptions and beliefs of participants on eye health and safety practices, as well as, results on the ocular safety and health training, i.e. intervention using the training manual developed for cocoa farmers as part of this study.

6.2 PHASE 1: Ocular health of cocoa farmers

The first phase of this study considered issues on the ocular health of cocoa farmers. Interviewer-administered questionnaire were used to gather data from participants. This was followed by an ocular health examination of all participants who consented. Information from the data gathered, are presented in this below.

6.2.1. Demographic profile of participants and farm characteristics

Out of the 576 who were recruited for this study, 556 met the inclusion criteria, and were therefore included in the analysis, giving an eligibility rate of 96.5%. All eligible participants were available for the study. The participants consisted of 359 (64.6%) males and 197 (35.4%) females, with 181 32.6%) being between 50 and 60 years of age and 198 (35.6%) being over 60 years of age. The mean age of all the participants was 54.9 years (± 11.2), with the mean age of male participants being 55.2 years (± 11.2) and that of the females being 54.6 years (±11.0). There was no statistically significant difference between the ages of males and females in this study (p=0.548) **(Table 6.1).** Educational attainment among the participants was low, with 142 (25.5%) having had no formal education and the majority (n=301, 54.1%) having attained middle or Junior High School education. Only 37 (6.7%) participants had attained a secondary or post-secondary education. There was a statistically significant difference between educational attainment of males and females (p <0.001) with males more likely to be educated than females **(Table 6.1).**

The majority of participants (69.6%) earned less than 5 000 Ghana cedis (GH¢5 000), this being equivalent to US $1, 500 annually from their farms, with few (20, 3.6%) in the higher income earning bracket of more than 15 000 Ghana cedis (GH¢ 15 000), equivalent to US $4 700 **(Table 6.1).** There was a statistically significant difference between the annual income of males and females from cocoa farming activities (p< 0.001) with males being in the higher income earning group than females. Of the participants, 358 (64.4%) were married, while 54 (9.7%) were divorced or widowed. Most (n=215, 38.7%) had a family size of between 7- 9 people, with 192 (34.5%) having a family size of between 4 - 6 people, with the average family size being 7.8 (±3.1) people. The use of mobile phones was reported by 363 (65.3%) participants, but access to internet facility was limited to 7 (1.3%) participants**.**

Table 6. 1: Demographic characteristics of cocoa farmers

Demographic characteristics	Sex		Total	*p*-value
	Male n = 359	Female n =197		
Age n (%)				
<40	29 (8.1)	15 7.6)	44 (7.9)	0.970
40-49	85 (23.7)	48 (24.4)	133 (23.9)	
50-59	115 (32.0)	66 (33.5)	181 (32.6)	
≥60	130 (36.2)	68 (34.5)	198 (35.6)	
Age/yrs (Mean SD)	55.2 (11.2)	54.6 (11.0)	54.9 (11.2)	0.548
Education n (%)				
No Education	69 (19.2)	73 (37.1)	142 (25.5)	< 0.001
Primary	51 (14.2)	25 (12.7)	76 (13.7)	
Middle/JHS	210 (58.5)	91 (46.2)	301 (54.1)	
Sec/Post Sec	29 (8.1)	8 (4.1)	37 (6.7)	
Income n (%)				
< 5000 GH¢	233 (62.1)	164 (83.3)	387 (69.6)	< 0.001 [a]
5000-9999 GH¢	89 (24.8)	30 (15.2)	119 (21.4)	
10000-14999 GH¢	28 (7.8)	2 (1.0)	30 (5.4)	
≥ 15000 GH¢	19 (5.29)	1 (0.5)	20 (3.6)	
Marital status n (%)				
Never married	2 (0.6)	3 (1.5)	5 (0.9)	< 0.001 [a]
Married	265 (73.8)	93 (47.2)	358 (64.4)	
Living together	65 (18.1)	20 (10.2)	85 (15.3)	
Divorced	13 (3.6)	41 (20.8)	54 (9.7)	
Widowed	14 (3.9)	40 (20.3)	54 (9.7)	
Family size n (%)				
> 4	7 (1.95)	11 (5.6)	18 (3.2)	< 0.001
4-6	113 (31.5)	79 (40.0)	192 (34.5)	
7-9	131 (36.5)	84 (42.6)	215 (38.7)	
≥ 10	108 (30.1)	23 (11.7)	131 (23.6)	
Family size (Mean, SD)	8.3 (3.4)	6.9 (2.2)	7.8 (3.1)	< 0.001
Mobile phone use n (%)				
Yes	258 (71.9)	105 (53.3)	363 (65.3)	< 0.001
No	101 (28.1)	92 (46.7)	193 (34.7)	
Access to internet n (%)				
Yes	5 (1.4)	2 (1.0)	7 (1.3)	0.521 [a]
No	353 (98.6)	195 (99.0)	548 (98.7)	

[a =] Fisher's exact test

The average number of farming years reported by participants was 23.1 (±12.5), with males having 24.3 (± 0.7) mean years of farming and females 20.9 (±11.7). There was a statistically significant difference between the reported years of farming by males and females ($p < 0.001$). The majority of participants (46.2%), irrespective of gender, had been farming for between 20-39 years. Participants spent an average of 33.3 (±13.4) hours per week on the farm, with males spending more time (35.3 hours ±13.9) than females (29.6 hours ± 11.8). The difference in the mean time spent between males and females was statistically significant ($p<0.001$). All participants spent an average of 10.8 (±2.2) months on the farm annually, with no statistically significant difference ($p=0.833$) being noted in this respect between males and females **(Table 6.2).** In most cases, participants (n=196, 35.3%) produced less than 10 bags of cocoa (1bag = 64kg) annually, while 78 (14.0%) produced more than 40 bags of cocoa annually**.**

Most of the participants (n= 462, 83.1%) owned their farms while 61 (11.0%) were sharecroppers. Participants worked mainly on smaller farms, with 195 (35.1%) and 165 (29.9%) working on farms of sizes ranging between 5-9 acres and less than 5 acres respectively. The median farm size of males was 8 acres (5-14) and 5 (3-9) acres for females, with a statistically significant difference of $p <0.001$ **(Figure 6.1).**

Table 6. 2 : Farm characteristics of cocoa farmers

Background characteristics		Sex		Total n = 556	*p*-value
		Male n = 359	Female n =197		
Farming years (mean, ±SD)		24.3 (0.7)	20.9 (11.7)	23.1 (12.5)	0.002
Farming years n (%)	<20	136 (37.9)	87 (44.2)	233 (40.1)	0.088
	20-39	166 (46.2)	91 (46.2)	257 (46.2)	
	≥40	57 (15.9)	19 (9.6)	76 (13.7)	
Months/year farmed (Mean, ±SD)		10.8 (2.2)	10.8 (2.1)	10.8 (2.2)	0.833
Farm hours/week (mean, ±SD)		35.3 (13.9)	29.6 (11.8)	33.3 (13.4)	< 0.001
Farm hours/week n (%)	< 20	38 (10.6)	38 (19.3)	76 (13.7)	< 0.001
	20-39	172(47.9)	115 (58.4)	287 (51.6)	
	≥40	149 (41.5)	44 (22.3)	193 (34.7)	
Farm status n (%)	Owner	293 (81.6)	169 (85.8)	462 (83.1)	0.656 [a]
	Family farm	14 (3.9)	7 (3.6)	21 (3.8)	
	Sharecropper	43 (12.0)	18 (9.1)	61 (11.0)	
	Caretaker	9 (2.5)	3 (1.5)	12 (2.2)	
Farm size/acres (median, IQR)		8 (5-14)	5 (3-9)		< 0.001
Farm size/acres n (%)	> 5	76 (21.2)	89 (45.2)	165 (29.9)	< 0.001
	5-9	134 (37.3)	61 (31.0)	195 (35.1)	
	10-14	63 (17.6)	26 (13.2)	89 (16.0)	
	≥15	86 (24.0)	21 (10.7)	107 (19.2)	
	Cocoa bags /yr (median, IQR)	15 (9 - 30)	8 (4-15)		<0.001
Cocoa bags /yr n (%)	<10	93 25.9)	103 (52.3)	196 (35.3)	< 0.001
	10-19	111 (30.9)	49 (24.9)	160 (28.9)	
	20-29	55 (15.3)	18 (9.1)	73 (13.1)	
	30-39	37 (10.3)	12 (6.1)	49 (8.8)	
	≥40	63 (17.6)	15 (7.6)	78 (14.0)	

[a] = Fisher's exact test

The median number of bags of cocoa produced by males was 15 (IQR: 9-30) and by females eight (IQR: 4-15), with a statistically significant difference between the sexes for this characteristic (p <0.001) **(Figure 6.2).**

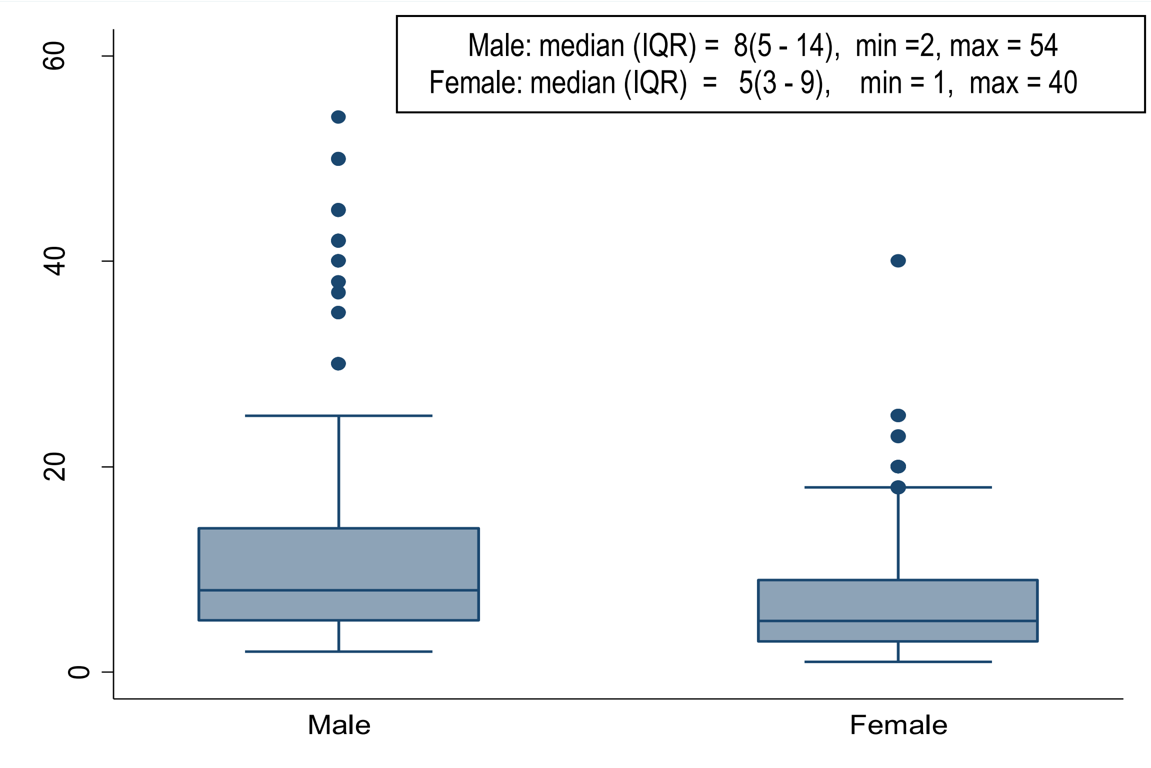

Figure 6. 1 : Farm size of participants by gender (1 acre = 0.4 hectares)

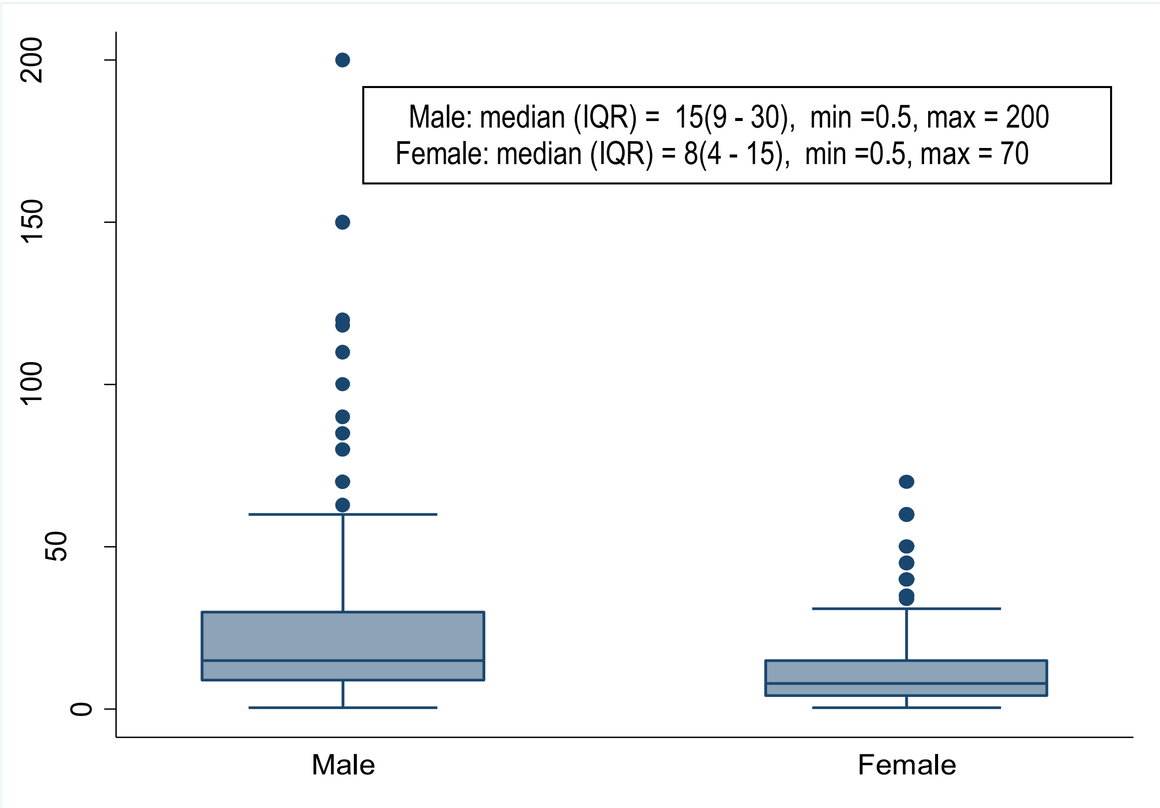

Figure 6. 2: Bags of cocoa produced by gender (1bag = 64kg)

Participants were engaged in several activities on the farm, including planting (99.5%), weeding (97.5%) and breaking of cocoa pods (96.4%). Other activities included harvesting (87.2%) and fertilizing (70.1%), with chemical spraying (45.7%) being the least frequent activity engaged in by participants themselves **(Figure 6.3).**

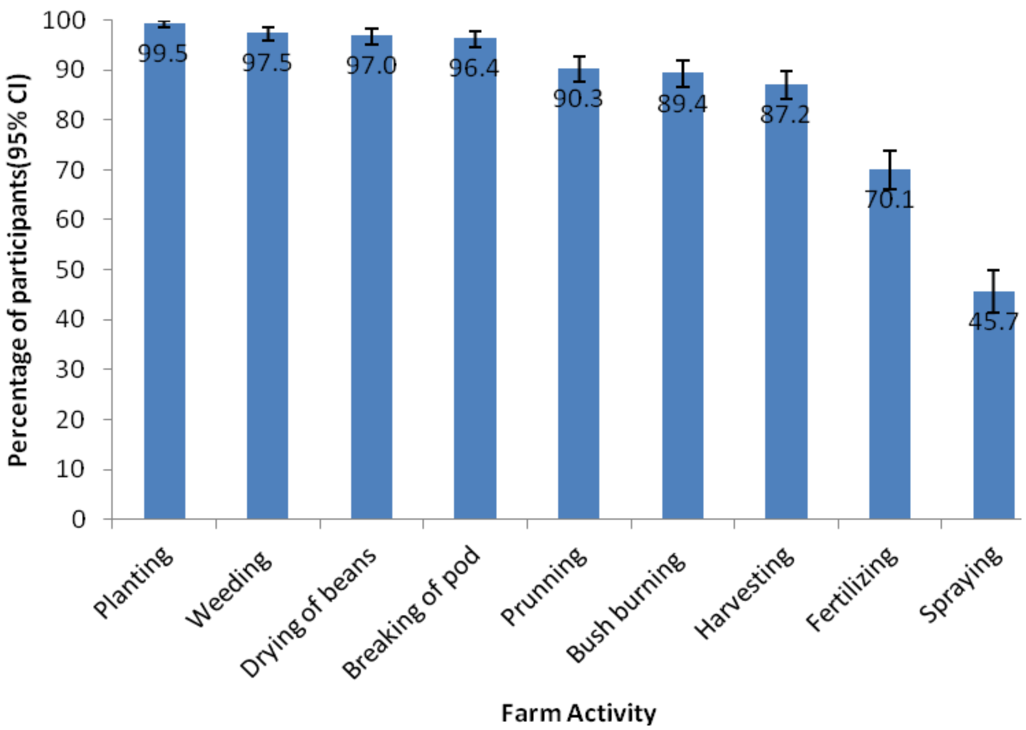

Figure 6. 3: Activities participants are engaged in on the farm

6.2.2 Objective 1: To determine the prevalence of ocular conditions, refractive error and visual impairment among cocoa farmers.

This section covers issues on ocular and medical history, preliminary eye examinations and external and internal eye examinations including refraction.

6.2.2.1. Ocular History

Several ocular complaints were reported by the participants, the most common being poor distance vision (33.3%), followed by itching and redness (19.3%) and poor near vision (11.9%) (**Figure 6.4),** with only 5% reporting no complaints about their eyes. Among those with ocular complaints, 353 (66.9%) participants attributed their eye symptoms to the activities they are engaged in on the farm.

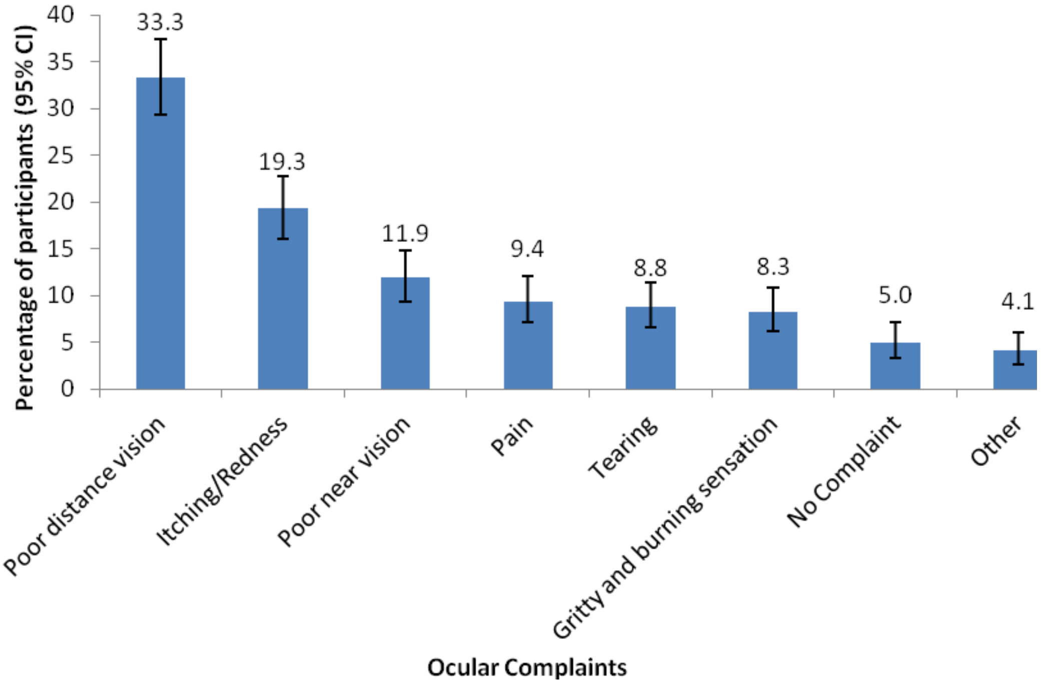

Figure 6. 4: Ocular complaints among participants

Among the participants, 52.4% had never had an eye examination in their lifetime, while 25% reported having had an eye examination within the last one year prior to the study **(Figure 6.5).**

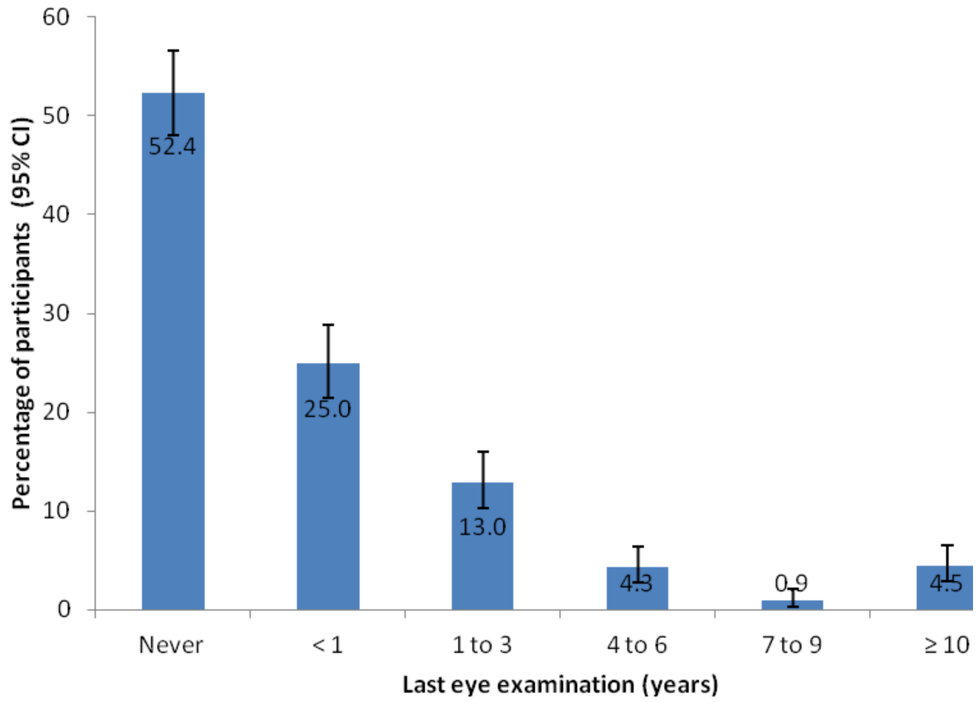

Figure 6. 5: Participants' last eye examination

Twenty-seven (4.9%) participants reported allergies to certain types of medication and food, with 76 (13.7%) being on medication, mainly to treat diabetes and hypertension **(Table 6.3).** The use of alcohol was reported by 137 (24.6%), with males more likely to consume alcohol than females (p<0.001). Among those who reported the use of alcohol, 54 (39.4%) had been taking alcohol for less than 10 years while 45 (32.9%) had done so for more than 20 years **(Table 6.3).**

Similarly, the use of tobacco was reported by 53 (9.5%) of the participants in this study. There was a statistically significant difference in the use of tobacco between males and females (p<0.001). Of those who reported smoking tobacco, 19 (37.3%) and 17 (34.0%) had smoked for 10-19 years and above 20 years respectively **(Table 6.3).**

Table 6. 3 : Participants' case history

History		Sex		Total	*p*-value
		Male n =359	Female n =197	n =556	
Eye exam in last one year	Yes n (%)	83 (23.1)	56 (28.4)	139 (25)	0.167
	No n (%)	276 (76.9)	141(71.6)	417(75.0)	
Any allergies	Yes n (%)	12 (3.3)	15 (7.6)	27(4.9)	0.025
	No n (%)	374 (96.7)	182(92.4)	529(95.1)	
Current medication use	Yes n (%)	42(11.7)	34(17.3)	76(13.7)	0.068
	No n (%)	317(88.3)	163(82.7)	480(86.3)	
Currently drinks alcohol	Yes n (%)	124(34.5)	13(6.6)	137(24.6)	<0.001
	No n (%)	235(65.5)	184(93.4)	419(75.4)	
Years of alcohol intake	>10	48(38.7)	6(46.2)	54(39.4)	0.760
	10-19	34(27.4)	4(30.8)	38(27.7)	
	≥20	42(33.9)	3(23.1)	45(32.9)	
Currently smoke tobacco	Yes n (%)	52(14.5)	1(0.51)	53(9.5)	< 0.001[a]
	No	307(85.5)	196(99.5)	503(90.5)	
Years of smoking	>10	14(28.0)	1(100.0)	15(29.4)	0.294[a]
	10-19	19(38.0)	0(0.0)	19(37.3)	
	≥20	17(34.0)	0(0.0)	17(34.0)	

a = Fisher's exact test

6.2.2.2. Medical History

There was a negative perception of the general health status among participants, as 185 (33.3%) graded this as fair, 145 (26.1%) as poor, while 25 (4.5%) said they were in very poor health **(Table 6.4).** In spite of the negative perception of the general health status, approximately 244 (43.9%) participants had never undergone a medical examination. As a result, only a few were aware of their hypertensive (n=91, 16.4%) and diabetes (n=17, 3.1%) status, while 3 (0.54%) and 120 (21.6%) were aware of their sickle cell and HIV/AIDS status respectively **(Table 6.4).**

Table 6. 4 : Participants' medical history

History		**Sex n(%)**		**Total**	***p*-value**
		Male n =359	**Female n =197**	**n =556**	
General health status	Very good	30(8.4)	7(3.6)	37(6.7)	0.032[a]
	Good	116(32.3)	48(24.4)	164(29.5)	
	Fair	111(30.9)	74(37.6)	185(33.3)	
	Poor	86(24.0)	59(30.0)	145(26.1)	
	Very poor	16(4.5)	9(4.6)	25(4.5)	
Last medical examination (years)	Never	158(44.0)	86(43.7)	244(43.9)	0.247[a]
	< 2	152(42.3)	94(47.7)	246(44.2)	
	2-5	24(6.7)	11(5.6)	35(6.3)	
	6-9	4(1.1)	2(1.0)	6(1.1)	
	≥ 10	21(5.9)	4(2.0)	25 (4.5)	
History of hypertension	Yes	56(15.6)	38(19.3)	91(16.4)	0.006
	No	53(14.8)	38(19.3)	104(18.7)	
	Not sure	250 (69.4)	111(56.4)	361(64.9)	
History of diabetes	Yes	11(3.1)	6(3.1)	17(3.1)	0.307
	No	71(19.8)	50(25.4)	121(21.8)	
	Not sure	277(77.2)	141(71.6)	418(75.2)	
History of Sickle cell	Yes	2(0.56)	1(0.51)	3(0.54)	0.157[a]
	No	63(17.6)	48(24.4)	111(20.0)	
	Not sure	294(81.9)	148(75.1)	442(79.5)	
History of HIV/AIDS	Yes	0(0.0)	0(0.0)	0(0.0)	0.107[a]
	No	70(19.5)	50(25.4)	120(21.6)	
	Not sure	289(80.5)	147(74.6)	436(78.4)	

[a]= Fisher's Exact

Among the participants in this study, 460 (82.7%) were registered with the National Health Insurance Scheme (NHIS). Reasons cited for not signing up by other participants included lack of funds 36 (37.5%), never falling sick 21 (21.9%) and no specific reason 14 (14.6%), as shown in **Table 6.5.**

Table 6. 5 : National Health Insurance Scheme (NHIS)

	Variable	Frequency n(%)
Registered with the NHIS	Yes	460 (82.7)
	No	96 (17.3)
Reasons for not registering with NHIS	Lack of funds	36 (37.5)
	Don't fall sick	21 (21.9)
	No reason	14 (14.6)
	Expired/missing	10 (10.4)
	Not important	6 (6.3)
	Time constraint	2 (2.1)
	Other	7 (7.3)
	Total	96 (100)

Among the participants in this study, 75(13.5%) were underweight while 141(25.4%) were overweight. More males than females were underweight and more females than males were overweight. Not surprisingly therefore, 47.7% of the female participants had elevated blood pressure while 42.3% of the male participants had elevated blood pressure of ≥140/90mmHg with 27 (4.9%) and 182 (32.7%) participants having an optimal (120/80mmHg) and normal (120-129/80-84mmHg) blood pressure **(Table 6.6).**

Table 6. 6: Participants' anthropometric and blood pressure information

Test	Sex		Total	*p*-value
	Male n = 359	Female n =197		
***BMI* (Mean, CI)**			22.7 (22.3-23.1)	
Underweight n (%)	55 (15.3)	20 (10.1)	75 (13.5)	< 0.001*
Normal n (%)	249 (69.4)	91 (46.2)	340 (61.2)	
Overweight n (%)	55 (15.3)	86 (43.7)	141 (25.4)	
Blood Pressure				
Systolic (mean, CI)			138 (136.8 - 140.8)	
Diastolic (mean, CI)			82.4 (81.2 - 83.5)	
Optimal(120/80)	17 (4.7)	10 (5.1)	27 (4.9)	0.685
Normal (120-129/80-84)	120 (33.4)	62 (31.5)	182 (32.7)	
Borderline (103-139/85-89)	49 (13.7)	20 (10.2)	69 (12. 4)	
Hypertension(≥140/90)	152 (42.3)	94 (47.7)	246 (44.2)	
Low(100/65)	21 (5.9)	11 (5.6)	32 (5.8)	

6.2.2.3. Oculo-motility

Convergence insufficiency classified as the near point of convergence break point ≥7.5cm and ≥ 10.5cm recovery point using a pencil tip as a target was a problem among 114 (20.5%) of the participants **(Table 6.7).**

Table 6. 7: Near Point of Convergence (NPC)

Description	n (%)
Normal	394 (70.9)
Convergence Insufficiency	114 (20.5)
Suppression	48 (8.6)
Total	556 (100.0)

The magnitude of ocular deviations were relatively low among the participants studied, with exophoria being a problem among 154 (27.7%) and 54 (9.7%) at near and distance respectively, while exotropia was a problem among 13 (2.3%) and 12 (2.2%) of the participants at near and distance respectively (**Table 6.8)**.

Table 6. 8: Ocular deviation

Cover test Deviation	Fixation distance	
	40 cm n(%)	**6m** n(%)
Esophoria	9 (1.6)	4(0.7)
Exophoria	154(27.7)	54(9.7)
Esotropia	4(0.7)	4(0.7)
Exotropia	13(2.3)	12(2.2)
No deviation	376(67.6)	482(87.7)
Total	556 (100.0)	556(100.0)

6.2.2.4. Tear function

Tear film instability was found in one or both eyes among 251(45.2%) of the participants **(Table 6.9).** Bivariate and multivariate logistic regression analysis of the factors that may have influenced the occurrence of tear film instability among the participants indicated that age, with an odds ratio of 1.02 (1.00 - 1.04, p=0.015), was the main predictor of tear film instability **(Table 6.10).**

Table 6. 9 : Tear film instability among participants

Tear Break-up Time (TBUT)	n(%)	CI (95%)
Normal (>10)	304(54.8)	50.4 - 58.7
Abnormal (≤ 10)	251(45.2)	41.1- 49.4
Total	555(100)	

Table 6. 10 : Factors influencing tear film instability

Factor	Bivariate regression (Unadjusted) odds ratio [95% CI]	*p*-value	Multivariable regression (adjusted) odds ratio [95% CI]	*p*-value
Age	1.02 [1.01-1.04]	**0.002***	1.02 [1.00-1.04]	**0.015***
Sex	1.1 1[0.78-1.58]	0.549	---------- -----	--- ----
Medication use	1.04 [0.64-1.69]	0.876	--------- ------	----- ---
Allergies	2.14 [0.96-4.75]	**0.063**	2.31 [1.03-5.18]	0.041
Alcohol use	0.96 [0.65-1.42]	0.850	--------- ------	----- ---
Yrs of alcohol use	1.00 [0.97-1.03]	0.967	--------- ------	----- ---
Tobacco use	0.85 [0.48-1.50]	0.568	--------- ------	----- ---
Yrs of tobacco use	1.01 [0.97-1.03]	0.452	--------- ------	----- ---
Spraying	0.89 [0.64-1.25]	0.507	--------- ------	----- ---
Yrs of spraying	1.01 [0.98-1.01]	0.448	--------- ------	----- ---
Weeding	0.61 [0.21-1.79]	0.369	--------- ------	----- ---
Yrs of farming	1.01 [1.00-1.02]	**0.044***	1.00 [0.98-1.02]	0.739
Farm size	1.00 [0.98-1.02]	0.714	--------- ------	----- ---
Hrs spent on farm	1.00 [0.99-1.01]	0.894	--------- ------	----- ---

* = significant *p* - value (Chi square)

6.2.2.5. Ocular pathology

a. Anterior Segment

Several anterior segment disorders, listed in **Table 6.11,** were identified among the participants, with cataract (25.5% CI: 22.0-29.3) and pterygium (23.7%, 95% CI: 20.3 - 27.5) being the most prevalent conditions. Other conditions included allergic/bacterial conjunctivitis (9.7%, 95% CI:7.4 - 12.5), corneal scar/opacity (6.1%, 95% CI:4.3 - 8.4) and keratitis (3.6%, 95% CI:2.2 - 5.5) (**Table 6.11)** .

Table 6. 11: Anterior segment eye conditions

Condition	Prevalence (95% CI)
Cataract	25.5 (22.0 - 29.3)
Pterygium	23.7 (20.3 - 27.5)
Arcus senilis	10.8 (8.3 - 13.7)
Allergic/bacteria conjunctivitis	9.7 (7.4 - 12.5)
Poliosis	6.1 (4.3 - 8.4)
Corneal scar/opacity	6.1 (4.3 - 8.4)
Ectropion/Entropion	4.9 (3.2 - 7.0)
Keratitis	3.6 (2.2 - 5.5)
Trichiasis	3.1 (1.7 - 4.8)
Pupillary defects (RAPD/Aide's pupil)	3.6 (1.7 - 4.8)
Ptosis	1.1 (0.4 - 1.2)
Band keratopathy	0.4 (0.0 - 1.2)
Other	1.6 (0.7 - 3.1)

There was no statistically significant difference between males and females in the distribution of anterior segment conditions except for corneal scar/opacity and pupillary disorders, which were statistically more prevalent in males ($p = 0.025$ and 0.038 respectively) **(Table 6.12).** Participants who had potentially dangerous pupillary defects were referred for further examinations.

Table 6. 12: Anterior segment conditions according to gender

Condition	n/N	Sex		Total	*p*-value
		Male n(%)	Female n(%)	n(%)	
Cataract	142/556	88 (24.5)	54 (27.4)	142 (25.5)	0.453
Pterygia	132/556	83 (23.1)	49 (24.9)	132 (23.7)	0.642
Arcus senilis	60/556	42 (11.7)	18 (9.1)	60 (10.8)	0.352
Allergic/bacteria conjunctivitis	54/556	35 (9.8)	19 (9.6)	54 (9.7)	0.968
Poliosis	34/556	21 (5.9)	13 (6.6)	34 (6.1)	0.724
Corneal scar/opacity	34/556	28 (7.8)	6 (3.1)	34 (6.1)	**0.025***
Ectropion/Entropion	27/556	17 (4.7)	10 (5.1)	27 (4.9)	0.858
Keratitis	20/556	11 (3.1)	9 (4.6)	20 (3.6)	0.362
Trichiasis	17/556	10 (2.8)	7 (3.6)	17 (3.1)	0.615
RAPD/Aide's	20/556	17 (4.7)	3 (1.5)	20 (3.6)	**0.038***[a]
Ptosis	6/556	5 (1.4)	1 (0.5)	6 (1.1)	0.310[a]
Band keratopathy *	2/556	2 (0.6)	0 (0.0)	2 (0.4)	0.416[a]
Other	9/556	6 (1.7)	3 (1.5)	9 (1.6)	0.598[a]

* = significant *p* - value - Chi square ([a] = Fisher's exact)

Unadjusted regression analysis of factors that may have influenced the occurence of anterior segment disorders indicated that age, with an odds ratio of 1.03 (1.01 - 1.04, p<0.001), was associated with the occurrence of anterior segment disease. Participants who were involved in fertilizer application were 34% less likely to develop an anterior segment eye disease. Only age remained a positive predictive factor for developing anterior segment disorder when all the other factors were adjusted, (OR= 1.03, 1.01-1.05, p<0.001), while involvement in fertilizer application remained negatively associated with the development of anterior segment disorders (OR=0.62, 95% CI: 0.42-0.49, p=0.029) **(Table 6.13).**

Table 6. 13: Factors influencing the occurrence of anterior segment diseases

Factor	Bivariate regression (Unadjusted) odds ratio [95% CI]	*p*-value	Multivariable regression (adjusted) odds ratio [95% CI]	*p*-value
Age	1.03 [1.01-1.04]	**<0.001***	1.03 [1.01-1.05]	**<0.001***
Sex	0.83 [0.58-1.18]	0.292	----- -----	---- ---
Allergies	0.52 [0.24-1.13]	**0.100**	0.53 [0.24 - 1.20]	0.125
Alcohol use	1.49 [1.00-2.21]	**0.055**	1.42 [0.99-2.22]	0.100
Tobacco use	1.10 [0.62-1.96]	0.735	----- -----	---- ---
Yrs of farming	1.01 [1.00-1.03]	**0.060**	1.00 [0.98-1.02]	0.922
Hrs worked/week	1.00 [0.99-1.02]	0.667	----- -----	---- ---
Weeding	2.37 [0.78-7.16]	**0.126**	2.79 [0.89 - 8.78]	0.079
Bush burning	0.94 [0.55-1.62]	0.827	----- -----	---- ---
Planting	2.59 [0.23-28.72]	0.438	----- -----	---- ---
Fertilizing	0.64 [0.44-0.93]	**0.019***	0.62 [0.42 - 0.94]	**0.029***
Spraying	1.00 [0.71-1.40]	0.999	----- -----	---- ---
Pruning	1.12 [0.64-1.97]	0.686	----- -----	---- ---
Harvesting	1.00 [0.60-1.65]	0.994	----- -----	---- ---
Drying of beans	1.60 [0.65-3.93]	0.304	----- -----	---- ---

* = significant *p* - value (Chi square)

b. Posterior Segment

Of the participants, 491 (88.3%) and 509 (91.7%) had an intraocular pressures (IOP) of less than 21mmHg in the right and left eyes respectively. However, 61 (11.0%) and 44 (7.9%) had an IOP of greater than 21mmHg in the right and left eyes respectively. Similarly, 410 (73.7%) and 415 (74.9%)

participants had a cup to disc ratio (CDR) of less than 0.5 in the right and left eyes respectively, while there was CDR of more than 0.5 in 88 (13.0%) and 63 (11.4%) in the right and left eyes respectively **(Table 6.14).**

Table 6. 14: IOP and CDR

Test		OD n(%)	OS n(%)
Intraocular Pressure (IOP)	< 21mmHg	491(88.3)	509(91.7)
	≥21mmHg	61(11.0)	44(7.9)
	Undetermined	4(0.7)	2(0.4)
Average Cup Disc Ratio (CDR)	Normal (<0.5)	410(73.7)	415(74.9)
	Border line (0.5)	31(5.6)	28(5.1)
	Abnormal (>0.5)	88(13.0)	63(11.4)
	Undetermined	43(7.3)	48(8.7)

An assessment of the posterior segment of the participants revealed several eye conditions that included glaucoma/suspects 15.8% (95%CI:12.9 - 19.1) and macular disorders with a prevalence of 4.9% (95%CI:3.2 - 7.0) among others listed in Table 6.15.

Table 6. 15 : Posterior segment eye conditions

Posterior Segment condition	Prevalence (95% CI)
Glaucoma/ suspects	15.8 (12.9 - 19.1)
Macular disorders	4.9 (3.2 - 7.0)
Vitreous disorders	2.0 (1.0 - 3.5)
Toxoplasmosis scars	2.0 (1.0 - 3.5)
Optic atrophy	1.1 (0.4 - 2.3)
Hypertensive retinopathy	0.7 (0.2 - 1.8)
Diabetic retinopathy	0.7 (0.2 - 1.8)
Other	1.3 (0.5 - 2.6)

There was no statistically significant differences between the distribution of posterior segment diseases among males and females with the exception of glaucoma/suspects and macular disorders, where a statistically significant higher prevalence was noted among males (p=0.007 and 0.014, respectively) **(Table 6.16).**

Table 6. 16: Posterior segment conditions according to gender

Condition	**n/N**	**Sex**		**Total**	***p*-value**
		Male n(%)	**Female n(%)**	**n(%)**	
Glaucoma/ suspects	88/556	68 (18.9)	20 (10.2)	88 (15.8)	**0.007***
Macular disorders	27/556	23 (6.4)	4 (2.0)	27 (4.9)	**0.014***
Vitreous disorders	11/556	10 (2.8)	1 (0.5)	11 (2.0)	0.055
Toxoplasmosis scars	11/556	7 (2.0)	4 (2.0)	11 (2.0)	0.588
Optic atrophy	6/556	6 (1.7)	0 (0.0)	6 (1.1)	0.071
Hypertensive retinopathy	4/556	3 (0.8)	1 (0.5)	4 (0.7)	0.555
Diabetic retinopathy	4/556	3 (0.8)	1 (0.5)	4 (0.7)	0.555
Other	7/556	5 (1.4)	2 (1.0)	7 (1.3)	0.522

* = significant *p* - value (chi square or Fisher's exact)

Unadjusted regression analysis of the factors associated with the development of posterior segment disorders indicated that age, alcohol use, tobacco use, years of farming, number of hours worked on the farm and use of chemicals were important **(Table 6.17).** For example, an increase in age had an odds of 1.10 (1.07-1.12, p<0.001) likelihood of developing a posterior segment disorder, while participants who used alcohol were 1.69 times (1.14-2.49, p=0.008) more likely to developing a posterior segment disease **(Table 6.17).**

Adjusting for all other factors, age, use of tobacco and number of hours worked on the farm remained statistically significant for the occurrence of posterior segment disease **(Table 6.17).**

Table 6. 17: Factors influencing the occurrence of posterior segment diseases

Factor	**Bivariate regression (Unadjusted) odds ratio [95% CI]**	***p*-value**	**Multivariable regression (adjusted) odds ratio [95% CI]**	***p*-value**
Age	1.10 [1.07-1.12]	**<0.001***	1.08 [1.05-1.11]	**<0.001***
Sex	0.71 [0.50-1.01]	**0.055**	0.60 [0.35 - 1.03]	0.063
Alcohol use	1.69 [1.14-2.49]	**0.008***	1.52 [0.87- 2.21]	0.063
Tobacco use	3.05 [1.67-5.58]	**<0.001***	2.64 [1.31-5.23]	**0.001***
Years of farming	1.05 [1.03-1.06]	**<0.001***	1.02 [1.00-1.03]	0.150
Hrs worked/week	1.00 [0.96-0.99]	**0.003***	1.00 [0.96-0.99]	**0.023***
Weeding	0.42 [0.14-1.27]	**0.123**	0.51 [0.15 - 1.74]	0.138
Bush burning	0.90 [0.53-1.55]	0.714	----- -----	---- ---
Fertilizing	0.66 [0.46-0.96]	**0.029***	0.95 [0.57-1.43]	0.677
Spraying	0.59 [0.42-0.83]	**0.003***	0.72 [0.43-1.20]	0.214

* = significant *p* - value (Chi square)

6.2.2.6. Visual impairments

The presenting (habitual) distance visual acuity (DVA) of participants indicated that 437 (78.6%) and 441 (79.3%) had a DVAs of better than or equal to 6/18 in the right and left eyes respectively, while 485 (87.2%) had the same DVAs when using both eyes. Similarly, 74 (13.3%) and 63 (11.3%) had a DVA of between 6/18 - 6/60 in the right and left eyes respectively, while 46 (8.3%) had the same DVA using both eyes. The distribution of DVA worse than 6/60 is also indicated in **Table 6.18.**

Table 6. 18: Participants' presenting distance visual acuity

Visual Acuity	Right Eye	Left eye	Both eyes
	n (%)	n (%)	n (%)
≥ 6/18	437(78.6)	441(79.3)	485 (87.2)
<6/18-6/60	74 (13.3)	63 (11.3)	46 (8.3)
<6/60-3/60	18 (3.2)	24 (4.3)	8(1.4)
<3/60	27 (4.9)	28 (5.0)	17 (3.1)

There was a moderate to strong correlation between the DVA of the right and left eyes of the participants (Pearson's correlation coefficient (r) = 0.62, p <0.001) **(Figure 6.6).**

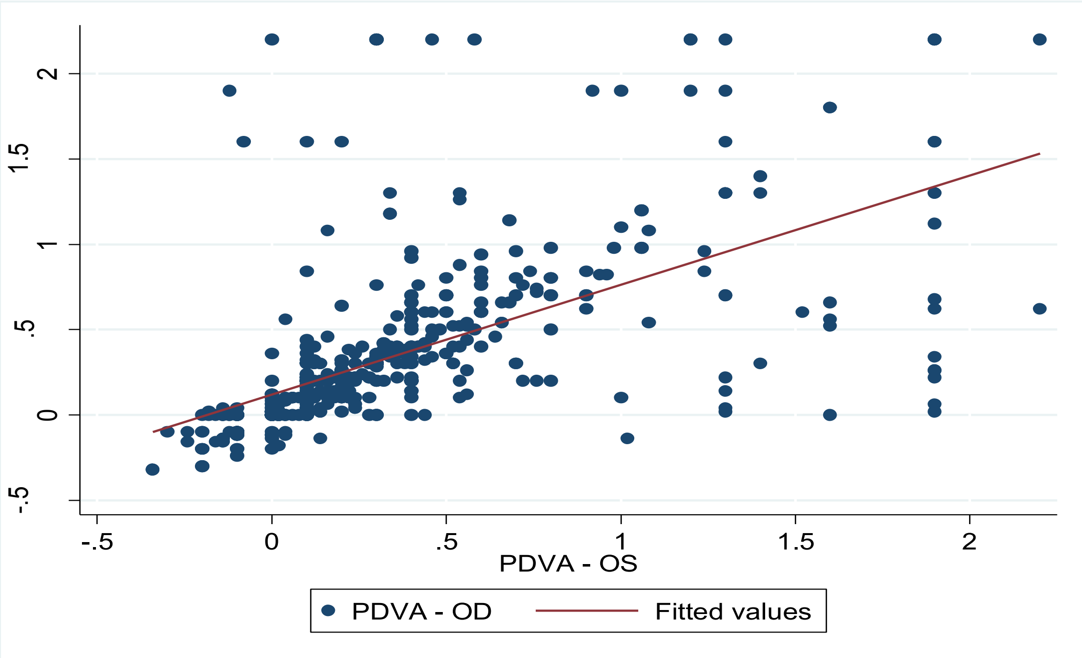

Figure 6. 6: Presenting distance visual acuity

Using the better seeing eye, moderate visual impairment (MVI) was present in 74 (13.3%) of the participants, while 18 (3.2%) had severe visual impairement (SVI) and 27 (4.9%) were legally blind **(Table 6.19).** There was a statistically significant difference between males and females in the distribution of visual impairment, with males more likely to suffer visual impairment (p=0.026). Normal vision (NV) was found among 437(78.6%) farmers.

Table 6. 19: Visual impairment according to gender

Visual impairment	Male(%)	Female(%)	Total (%)	*p*-value
MVI	38 (10.6)	36 (18.3)	74 (13.3)	0.026[a]
SVI	14 (3.9)	4 (2.0)	18 (3.2)	
Blind	21 (5.9)	6 (3.1)	27 (4.9)	

[a] = Fisher's exact * Percentages are out of the total participants

Similarly, there was a statistically significant diference between the age categories and visual impairment (p<0.001), as an increase in age presented with visual impairment compared to the younger age groups **(Table 6.20).**

Table 6. 20: Visual impairment according to age

Class	Age				Total	p-value
	> 40	40-49	50-59	60+		
MVI	2(4.6)	6(4.5)	14(7.7)	52(26.3)	74(13.3)	<0.001[a]
SVI	1(2.3)	2(1.5)	1(0.6)	14(7.1)	18(3.2)	
Blind	0(0.0)	0(0.0)	6(3.3)	21(10.6)	27(4.9)	

[a] = Fisher exact * Percentages are out of the total participants

The causes of visual impairment among the participants were mainly cataract (37.8%), uncorrected refractive error (35.3%), posterior segment disorder (13.5%) and corneal opacity (10.9%) **(Figure 6.7).**

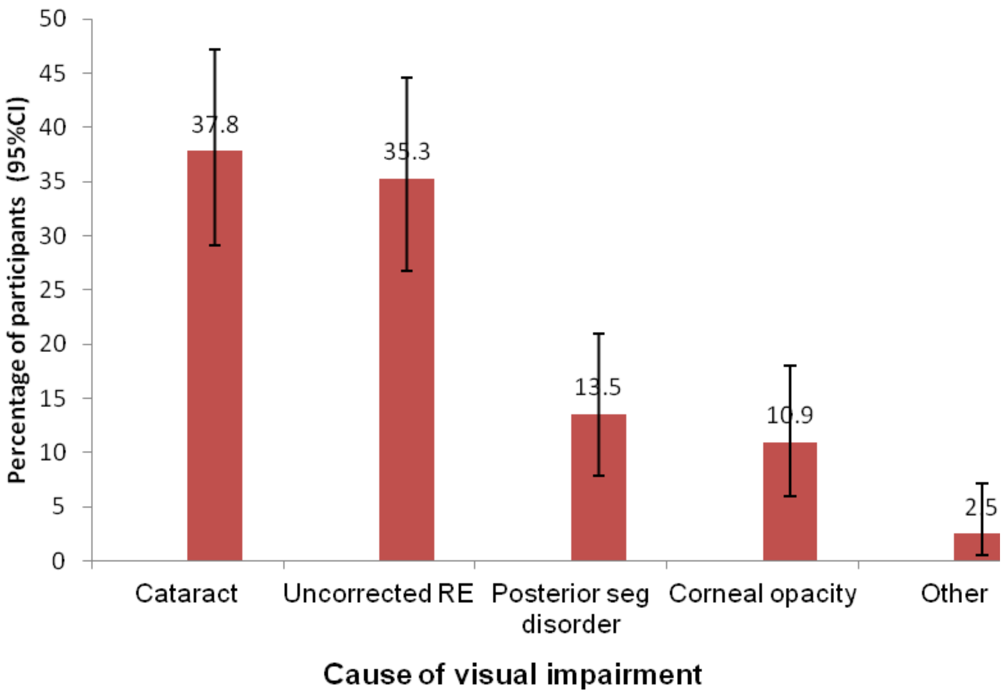

Figure 6. 7: Cause of visual impairment

Males were more likely to be visually impaired from all causes compared to females (p=0.047) **(Table 6.21)**.

Table 6. 21 : Distribution of cause of visual impairment by gender

Cause of visual impairment	Male	Female	Total	p-value
Cataract	25 (34.2)	20 (43.5)	45 (37.8)	0.047[a]
Uncorrected RE	21 (28.8)	21 (45.7)	42 (35.3)	
Posterior segment disorder	13 (17.8)	3 (6.5)	16 (13.5)	
Corneal opacity	11 (15.1)	2 (4.3)	13 (10.9)	
Other	3 (4.1)	0 (0.0)	3 (2.5)	
Total	73 (100)	46(100)	119 (100)	

[a] = Fisher's exact test

6.2.2.7. Prevalence of refractive errors

Following objective refraction, uncorrected refractive error was present in 67.6% of the population studied. Astigmatism was present in 164 (29.5%) participants, hyperopia in 151 (27.2%) participants and myopia in 58 (10.4%) participants. The distribution of refractive error according to sex is shown in Table 6.22. There was no statistically significant difference between males and females in the distribution of uncorrected refractive error (p = 0.721). However, there was a statistically significant difference between age categories and distribution of uncorrected refractive errors (p< 0.001), with participants having a higher prevalence of refractive errors **(Table 6.23).**

Table 6. 22 : Distribution of type of refractive errors by gender

Refractive error	Sex		Total n(%)	95%CI	*p*-value
	Male n (%)	Female n (%)			
Emmetropia	104(29.0)	50(25.4)	154(27.7)	24.0-31.6	0.721[a]
Myopia	36(10.0)	22(11.2)	58(10.4)	8.0 -13.3	
Hyperopia	91(25.4)	60(30.5)	151(27.2)	23.5-31.1	
Astigmatism	107(29.8)	57(28.9)	164(29.5)	25.7-33.5	
Antimetropia	2(0.6)	1(0.5)	3(0.5)	0.1-1..5	
Undetermined	19(5.3)	7(3.6)	26(4.7)	3.1-6.8	
Total	359(100)	197(100)	556(100)		

[a] = Fisher's exact test

Table 6. 23 : Distribution of type of refractive errors by age

Condition	Age (years)					
	< 40 n (%)	**40-49 n (%)**	**50-59 n (%)**	**60+ n (%)**	**Total n (%)**	***p*-value**
Emmetropia	19(43.2)	62(46.2)	57(31.5)	16(8.1)	154(27.7)	<0.001[a]
Myopia	6(13.6)	12(9.0)	5(2.8)	35(17.7)	58(10.4)	
Hyperopia	11(25.0)	26(19.6)	69(38.1)	45(22.7)	151(27.2)	
Astigmatism	8(18.2)	32(24.1)	48(26.5)	76(38.4)	164(29.5)	
Antimetropia	0(0.0)	1(0.8)	0(0.0)	2(1.0)	3(0.5)	
Undetermined	0(0.0)	0(0.0)	2(1.1)	24(12.1)	26(4.7)	
Total	44(100)	133(100)	181(100)	198(100)	556(100)	

[a] = Fisher's exact test

6.2.2.8. Magnitude of refractive errors

The mean minus spherical lens prescribed was -1.30DS (SD: ± 0.13) and -1.40DS (SD: ±0.16) for the right and left eyes respectively, with a minimum of - 0.50DS and a maximum of -7.50DS. Similarly, the mean plus lens prescribed to participants was +1.30 (SD: ±0.04) for both eyes, with a minimum plus lens of +0.75DS and a maximum of +3.50 DS and +4.00 DS for the right and left eyes respectively. Furthermore, the mean cylindrical lenses prescribed was -0.73DC (SD: ±0.03) and -0.69DC (SD: ±0.03) for the right and left eyes respectively, with a minimum of -0.50 DC for both eyes and a maximum of -2.50 DC and -3.50 DC for the right and left eyes respectively **(Table 6.24).**

Table 6. 24 : Summary statistics of refractive errors

Summary of Refractive error	Right Eye		Left Eye	
	Mean (SD)	95% CI	Mean (SD)	95% CI
Myopia	-1.3 (0.13)	-1.56 to -1.03	-1.4 (0.16)	-1.75 to -1.08
Hyperopia	1.3 (0.04)	1.19 - 1.34	1.3 (0.04)	1.19 - 1.36
Astigmatism	-0.73 (0.03)	-0.79 to -0.68	-0.69 (0.03)	-0.74 to -0.63
	Min	Max	Min	Max
Myopia	-0.50DS	-7.50DS	-0.50DS	-7.50DS
Hyperopia	0.75DS	3.50DS	0.75DS	4.00DS
Astigmatism	- 0.50DC	- 2.50DC	- 0.50DC	- 3.50DC

Measurement of distance visual acuity correction of their refractive errors showed that 37 (6.7%) and 33 (5.9%) had visual acuities of 6/18-6/60 in the right and left eyes respectively, while 14 (2.5%) and 16 (2.9%) had a VAs of <6/60-3/60 in the right and left eyes respectively **(Table 6.25).** The rate of MSVI reduced by 7.4% following correction of refractive errors.

Table 6. 25 : Best corrected distance visual acuity after correction

Visual Acuity	Right Eye	Left eye	Both eyes
	n (%)	n (%)	n (%)
≥ 6/18	480 (86.3)	481 (86.5)	503(90.5)
6/18-6/60	37(6.7)	33 (5.9)	32(5.8)
>6/60 ≤3/60	14(2.5)	16(2.9)	4(0.7)
>3/60	25(4.5)	26(4.7)	17(3.0)

The majority of the participants (n=462, 83.1%, CI: 79.7-86.1) were presbyopic on presentation based on their near visual acuity. Most had their near vision significantly improved after near correction ($p<0.001$) **(Table 6.26).** The median near spectacle correction prescribed was +2.00DS (IQR: 1.5 - 2.5DS) **(Figure 6.8).**

Table 6. 26 : Presbyopic status

Status	Presenting	After correction	p-value
Yes	462(83.1)	0(0.0)	< 0.001[b]
No	82(14.8)	544(97.8)	
Undetermined	12(2.2)	12(2.2)	

b = Exact McNemar test

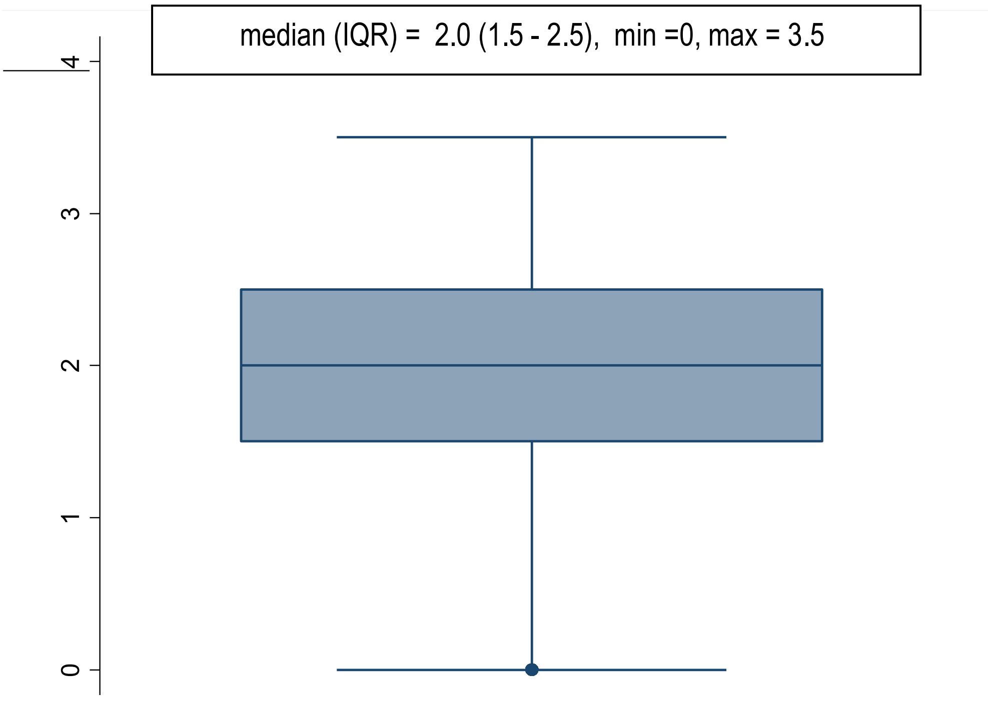

Figure 6. 8 : Near vision correction (in dioptre sphere) prescribed

Among the participants, 173 (31.1%) had previously used spectacles, with males more likely to have used them than females (p<0.001). Of those who reported ever using spectacles, 124 (22.3%) were using them at the time of the study, 105 (84.7%) being for near vision only, 11 (8.9%) for distance vision only, while eight (6.5%) used bifocals. Reasons cited for not using spectacles by those who were not in possession of their spectacles included that they were scratched 19 (38.8%) or lost 8 (16.3%) among others, as indicated in **Table 6.27**.

Table 6. 27: History of spectacle use

History		**Sex n (%)**		**Total**	**p-value**
		Male	**Female**		
History of spectacles use (n = 173)	Yes	132(36.8)	41 (20.8)	173(31.1)	<0.001*
	No	227(63.2)	156 (79.1)	383(68.9)	
Currently using spectacles (n=124)	Yes	103(28.7)	21(10.7)	124(22.3)	<0.001*
	No	256(71.3)	176(89.3)	432(77.7)	
Purpose of spectacle use	Near	90 (87.4)	15 (71.4)	105(84.7)	
	Distance	6 (5.8)	5 (23.8)	11 (8.9)	
	Bifocal	7 (6.8)	1 (4.8)	8 (6.5)	
Reasons for spectacle non use (n = 49)	Scratched	12 (41.4)	7 (35.0)	19 (38.8)	
	Lost them	5 (17.2)	3 (15.0)	8 (16.3)	
	Uncomfortable	4 (13.8)	3 (15.0)	7 (14.3)	
	Broken	4 (13.8)	1 (5.0)	5 (10.2)	
	It doesn't help	4 (13.8)	6 (30.0)	10 (20.4)	

* = significant *p*-value (Chi square)

6.2.2.9. Colour vision

One hundred and thirty-five (24.3%) participants reported difficulty identifying colours, especially ripened cocoa pod, which is an indication of maturity and readiness of the cocoa pod for harvesting. There was no statistically significant difference between males and females regarding this difficulty (p=0.428, Fisher's exact). Following the assessment of colour vision among the participants, Red-Green colour defect was identified in 141 (25.4%) and 149 (26.8%) right and left eyes respectively, while Blue-Yellow colour deficiency was identified in 12 (2.2%) and 13 (2.3%) of the right eye and left eyes respectively **(Table 6.28).**

Among the colour defects identified, there were 9 (5.9%) and 10 (6.2%) protans in the right and left eyes respectively, while there were 16 (10.5%) and 12 (7.4%) deutans in the right and left eyes respectively. Similarly, there were 7 (4.6%) and 3 (2.0%) tritans and tertartans respectively in the right eyes, while there were 8 (4.9%) and 1 (0.6%) tritans and tertartans respectively in the left eyes. All others were unclassified, as they scored all the classification test plates and could not be classified as either R-G or B-Y.

Among the protans, 3 (17.7%) were mild, 3 (60.0%) medium while 3 (23.1%) were strong in the right eye. All participants who had tritans and tertartans in the right eye had strong defects. In the left eyes, 5 (62.5%) were medium protans, 8 (66.7%) mild deutans, while 7 (63.3%) were strong tritans, with others being shown in Table 6.29.

Table 6. 28: Colour vision anomalies

	Right Eye			Left Eye		
	Male	Female	Total	Male	Female	Total
Colour vision anomalies						
Normal	222(61.6)	125(63.5)	346(62.2)	215(59.9)	120(60.9)	335(60.3)
R-G	86(24.0)	55(27.9)	141(25.4)	92(25.6)	57(28.9)	149(26.8)
B-Y	10(2.8)	2(1.0)	12(2.2)	10(2.8)	3(1.5)	13(2.3)
Undetermined	42(11.7)	15(7.6)	57(10.3)	42(11.7)	17(8.6)	59(10.6)
Total	359(100)	197(100)	556(100)	359(100)	197(100)	556(100)
p-value			0.201			0.504
Type of defect						
Protan	5(5.2)	4(7.0)	9(5.9)	7(6.9)	3(5.0)	10(6.2)
Deutan	11(11.5)	5 (8.8)	16(10.5)	10(9.8)	2(3.3)	12(7.4)
Tritan	5(5.2)	2(3.5)	7(4.6)	6(5.9)	2(3.3)	8(4.9)
Tertartan	3(3.1)b	0(0.0)	3(2.0)	1(1.0)	0(0.0)	1(0.6)
Unclassified	72(75.0)	46(80.7)	118(77.1)	78(76.5)	53(88.3)	131(80.7)
Total	96(100)	57(100)	153(100)	102(100)	60(100)	162(100)

Table 6. 29 : Extent of colour vision anomalies

Defect	Extent of defect (OD)				Extent of defect (OS)			
	Mild	Medium	Strong	Total	Mild	Medium	Strong	Total
Protan	3(17.7)	3(60.0)	3(23.1)	9(25.7)	4(33.3)	5(62.5)	1(9.1)	10(32.3)
Deutan	14(82.4)	0(0.0)	2(15.4)	16(45.7)	8(66.7)	2(25.0)	2(18.2)	12(38.7)
Tritan	0(0.0)	0(0.0)	3(23.1)	7(20.0)	0(0.0)	1(12.5)	7(63.6)	8(25.8)
Tertartan	0(0.0)	0(0.0)	3(23.1)	3(8.6)	0 (0.0)	0 (0.0)	0 (0.0)	1 (3.2)
Total	17(100)	5(100)	13(100)	35(100)	12(100)	8(100)	11(100)	31(100)

6.2.2.10. Perception of distance and near vision

Most participants reported worse distance vision than their clinically determined distance vision (11.8% agreement, Kappa, K=0.002, p=0.429) **(Table 6.30).** For example, whereas only 49 participants reported very good distance vision, 434 participants had very good vision upon visual acuity measurement. The perception of poor near vision corresponded moderately to the clinically measured near vision, as there was a 28.4% agreement between reported near vision and that clinically measured among participants (Kappa, K = 0.04 , p =0.003) **(Table 6.31).**

Table 6. 30: Participants' perceptions of distance vision versus measured distance vision

Actual distance vision	Participants' perceptions distance vision n (%)					Total n (%)
	Very Good	Good	Fair	Poor	Very Poor	
Very Good	47(95.9)	143(95.3)	89(88.1)	127(64.5)	28(47.5)	434(78.1)
Good	2(4.1)	4(2.7)	9(8.9)	31(15.7)	5(8.5)	51(9.2)
Fair	0(0.0)	3(2.0)	1(1.0)	24(12.2)	18(30.5)	46(8.3)
Poor	0(0.0)	0(0.0)	0(0.0)	7(3.6)	1(1.7)	8(1.4)
Very poor	0(0.0)	0(0.0)	2(2.0)	8(4.1)	7(11.9)	17(3.1)
Total n(%)	49(100)	150(100)	101(100)	197(100)	59(100)	556(100)

Table 6. 31: Participants' perceptions of near vision versus measured vision

Actual near vision	**Participants' perceptions near vision n (%)**					Total n (%)
	Very Good	Good	Fair	Poor	Very Poor	
Very Good	19(38.0)	30(18.3)	21(13.6)	12(7.2)	0(0.0)	82(14.8)
Good	22(44.0)	93(56.7)	96(61.9)	83(50.0)	12(57.1)	306(55.0)
Fair	5(10.0)	33(20.1)	31(20.0)	55(33.1)	4(19.5)	128(23.0)
Poor	3(6.0)	6(3.7)	6(3.9)	10(6.0)	0(0.0)	25(4.5)
Very poor	1(2.0)	2(1.2)	1(0.7)	6(3.6)	5(23.8)	15(2.7)
Total n(%)	50(100)	164(100)	155(100)	166(100)	21(100)	556(100)

6.2.3 Objective 2: To determine the prevalence of ocular injuries among the cocoa farmers.

Several hazards exist on cocoa farms that threaten the ocular health of farmers and could lead to ocular injury. Ocular hazards reported by participants included ultraviolet radiation (94.1%) being the most common, followed by chemicals (64%), dust/sand and stones (47.1%) among others as indicated in **Figure 6.9.**

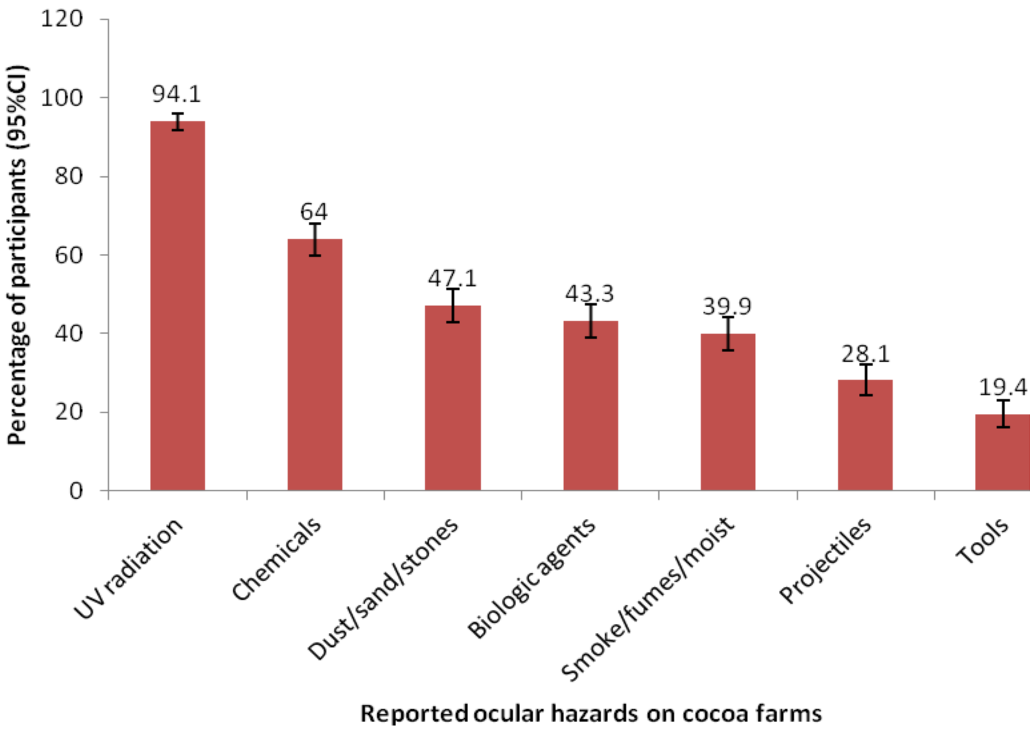

Figure 6. 9: Reported ocular hazards on farms

The crude prevalence of reported ocular injuries within the one year preceding this study was 143 (25.7%) among the study participants, with a mean loss of 3.4 (95% CI: 3.1-3.6) workdays due to eye injury **(Table 6.32).** Based on reported years worked in agriculture for all 556 workers, the sample had a total of 12 854.5 years worked on cocoa farms. The rate of eye injuries was 143/12 854.5 worker years or 11.3/1 000 worker years (95% CI 9.4, 31.0). Similarly, the rate of lost work time injuries was 137 injuries/12 854.5 worker years or 37.3/1000 worker years (95% CI: 34.1, 40.8), with three injuries resulting in permanent blindness in the affected eye that led to more than 14 days of lost work time.

Most of the injuries (n=62, 43.4%) had occurred within four months prior to the study, and occurred while participants were weeding (n=65, 45.6%), harvesting cocoa pods (n=39, 27.3%) and spraying with chemicals (n=27, (18.9%), among others **(Table 6.32).** The major causes of ocular injury among the participants were plants/branches (n=73, 51.1%), chemicals (n=27, 18.9%), cocoa pod/husk (n=14, 9.8%) and flying objects (n=13, 9.1%). All the injuries occurred in only one eye.

Table 6. 32: Ocular injury and causes

	Injury (one year)	Frequency n(%)
Yes		143 (25.7)
Loss work days (mean, 95% CI)		3.4 (3.1 - 3.6)
Period of injury (months)	< 4	62 (43.4)
	4 - 6	23 (16.1)
	7 - 9	12 (8.4)
	10 -12	46 (32.2)
Activity during which injury occurred	Weeding	65 (45.6)
	Harvesting of cocoa pods	39 (27.3)
	Spraying	27 (18.9)
	Pruning	11 (7.7)
	Bush burning	1 (0.7)
Cause of injury	Plant/branches	73 (51.1)
	Chemical	27 (18.9)
	Cocoa pod/husk	14 (9.8)
	Flying objects	13 (9.1)
	Sand/stone	11(7.7)
	Hand tool	4 (2.8)
	Insect	1 (0.7)

Using a scale of 1-10, participants indicated that the pain experienced during their eye injuries were very severe (n=72, 50.4%), severe (n=65, 45.5%) and not severe (n=6, 4.2%). Among these participants, only one (0.7%) reported using ocular protection at the time of injury **(Table 6.33).** Thirty-nine percent of the participants who reported having sustained ocular injuries sought medical intervention from chemical shops, while 37 (25.9%) visited hospitals or clinics for treatment within 4 to 7 days. Others (n=27, 18.9%) visited a herbal doctor and 21 (14.7%) self medicated with traditional medicine **(Table 6.33).**

Table 6. 33: Severity of injury and intervention sought

Factor	Responses	Frequency(%)
Severity of injury	Very severe	72 (50.4)
	Severe	65 (45.5)
	Not severe	6 (4.2)
Was using ocular protection at the time of injury		1 (0.7)
Place of intervention sought after injury	Chemical shop	55 (38.5)
	Hospital/clinic	37 (25.9)
	Herbal doctor	27 (18.9)
	Self medication (traditional)	21 (14.7)
	Nothing was done	3 (2.1)

Table 6.34 illustrates the causes of injury in conjunction with the activity during which they occurred.

Table 6. 34: Cause of injury versus farm activity

Cause of injury	Activity during which injury occurred n(%)					Total n(%)
	Weeding	Bush burning	Spraying	Pruning	Harvesting	
Plant/branches	49(75.4)	1(100.0)	0(0.0)	7(63.6)	16(41.0)	73(51.1)
Chemical	0(0.0)	0(0.0)	27(100.0)	0(0.0)	0(0.0)	27(18.9)
Cocoa pod/husk	0(0.0)	0(0.0)	0(0.0)	0(0.0)	14(35.9)	14(9.8)
Flying object	3(4.6)	0(0.0)	0(0.0)	3(27.3)	7(18.0)	13(9.1)
Sand /stone	11(16.9)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	11(7.7)
Hand tool	2(3.1)	0(0.0)	0(0.0)	0(0.0)	2(5.1)	4(2.8)
Insect	0(0.0)	0(0.0)	0(0.0)	1(9.1)	0(0.0)	1(0.7)

A bivariate analysis of factors that may have influenced the occurrence of ocular injuries indicated that hours worked per week, (OR 1.03, 1.00 - 1.04, p=0.003), perception of poor near vision (OR 1.26, 1.05 - 1.52, p=0.015), spraying chemicals (OR 2.58, 1.74 - 3.82, p <0.001) and harvesting of cocoa pods (OR 2.63, 1.27 -

5.44, p=0.009) were associated with eye injuries. However, adjusting for all factors, sex (OR 1.93, 1.07 - 3.48, p=0.028), hours worked per week (OR 1.02, 0.99 - 1.03, p=0.050), perception of poor near vision (OR 1.31, 1.08 - 1.59, p=0.007) and spraying of chemicals (OR 3.06, 1.77 - 5.23, p <0.001) remained significantly associated with eye injuries **(Table 6.35).**

Table 6. 35 : Factors influencing the occurrence of eye injury

Factor	**Bivariate regression (Unadjusted) odds ratio [95% CI]**	***p*-value**	**Multivariable regression (adjusted) odds ratio [95% CI]**	***p*-value**
Sex	0.72 [0.48 - 1.09]	**0.121**	1.93 [1.07 - 3.48]	**0.028***
Age	1.00 [0.98 - 1.01]	0.387	----- -----	---- ---
Education	1.00 [0.82 - 1.21]	0.981	----- -----	---- ---
Years of farming	1.00 [0.97 - 1.02]	0.859	----- -----	---- ---
Size of farm	1.01 [0.99 - 1.04]	0.234	----- -----	---- ---
BMI	1.02 [0.98 - 1.06]	0.435	----- -----	---- ---
Work hours/week	1.03 [1.00 - 1.04]	**0.003***	1.02 [0.99 - 1.03]	**0.050***
Alcohol use	1.46 [0.95 - 2.23]	**0.081**	1.28 [0.80 - 1.03]	0.302
Presenting DVA	0.80 [0.40 - 1.00]	0.404	----- -----	---- ---
Presenting NVA	0.97 [0.51 - 1.86]	0.927	----- -----	---- ---
Perception of DVA	1.02 [0.87 - 1.20]	0.820	----- -----	---- ---
Perception of NVA	1.26 [1.05 - 1.52]	**0.015***	1.31 [1.08 - 1.59]	**0.007***
Weeding	2.11 [0.45 - 9.54]	0.332	----- -----	---- ---
Bush burning	1.58 [0.80 - 1.20]	**0.192**	1.21 [0.58 - 2.52]	0.618
Fertilizing	1.51 [0.97 - 2.33]	**0.066**	1.03 [0.63 - 1.69]	0.841
Spraying	2.58 [1.74 - 3.82]	**<0.001***	3.06 [1.77 - 5.23]	**<0.001***
Pruning	1.82 [0.87 - 3.83]	**0.114**	1.00 [0.41 - 2.24]	0.922
Harvesting	2.63 [1.27 - 5.44]	**0.009***	1.63 [0.72 - 3.74]	0.244
Drying of seeds	5.72 [0.75 - 43.55]	**0.092**	2.48 [0.31 - 20.00]	0.393

* = significant *p* - value (Chi square), D=Distance, N=Near, VA= Visual Acuity

6.2.4 Objective 3: To examine the use of protective eyewear among the cocoa farmers in Ghana.

6.2.4.1 Use of ocular protective eyewear

The use of ocular protection among the participants was reported by 34 (6.1%) participants, with the main types being goggles (n=24, 70.6%), protective glasses (n=4, 11.8%) and others (n=6, 17.7%). Ocular protection was mainly used during chemical application (spraying) (n=31, 91.2%) **(Tables 6.36 and 6.37).** However, among those who reported using ocular protection, 28 (82.4%) often did not use devices **(Table 6.36).** There was a statistically significant difference between sex ($p < 0.001$), age ($p = 0.002$), education ($p < 0.001$) and use of protective eyewear. Males in the younger age group, as well as, those with high educational attainments were more likely to use protective eye wear.

Table 6. 36: Use of ocular protection

Factors	Use of ocular protection	Frequency n(%)
	Yes	34 (6.1)
Type of ocular protection used	Goggles	24 (70.6)
	Protective glasses	4 (11.8)
	Other	6 (17.7)
Activity during which eye protection is used	Spraying	31 (91.2)
	Weeding	1 (2.9)
	Harvesting of cocoa pods	1 (2.9)
	Bush burning	1 (2.9)
Frequency of eye protection use	Very often	3 (8.8)
	Often	3 (8.8)
	Not often	28 (82.4)

Table 6. 37: Farm activity versus ocular protection use

Farm Activity	Type of protection n(%)			Total n(%)
	Goggle	Protective glasses	Other	
Spraying	24(100.0)	1(25.0)	6(100.0)	31(91.2)
Weeding	0(0.0)	1(25.0)	0(0.0)	1(2.9)
Harvesting	0(0.0)	1(25.0)	0(0.0)	1(2.9)
Bush burning	0(0.0)	1(25.0)	0(0.0)	1(2.9)
Total	24(100.0)	4(100.0)	6(100.0)	34(100.0)

Similarly, a bivariate logistic regression analysis to examine other factors that may be associated with the use of ocular protection indicated that sex (OR 0.10, 0.02 - 0.44, p=0.002), age (OR 0.95, 0.92 - 0.98, p=0.004), education (OR 1.59, 1.08 - 2.33, p=0.018), perception of poor distance vision (OR 0.69, 0.51 - 0.94, p=0.017), the use of fertilizer (OR 4.69, 1.41 - 15.57, p=0.012) and spraying of chemicals (OR 9.98, 3.47 - 28.73, p <0.001) were associated with the use of ocular protection. However, adjusting for all other factors, only spraying of chemicals remained significantly associated with the use of ocular protection (OR 4.12, 1.11 - 15.24, p=0.034) **(Table 6.38).** Thus, participants involved in chemical spraying were 4.12 times more likely to use protective eyewear.

Table 6. 38: Factors influencing the use of ocular protection

Factor	Bivariate regression (Unadjusted) odds ratio [95% CI]	*p*-value	Multivariable regression (adjusted) odds ratio [95% CI]	*p*-value
Sex	0.10 [0.02 - 0.44]	**0.002***	0.38 [0.65 - 2.15]	0.271
Age	0.95 [0.92 - 0.98]	**0.004***	0.97 [0.93 - 1.01]	0.144
Education	1.59 [1.08 - 2.33]	**0.018***	1.38 [0.92 - 2.07]	0.121
Income	1.00 [1.00 - 1.00]	0.666	----- -----	---- ---
Years of farming	0.99 [0.95 - 1.02]	0.395	----- -----	---- ---
Size of farm	1.00 [0.95 - 1.04]	0.905	----- -----	---- ---
Work hours/week	1.00 [0.97 - 1.03]	0.964	----- -----	---- ---
Presenting DVA	0.03 [0.85 - 1.33]	**0.120**	1.04 [0.20 - 5.48]	0.963
Presenting NVA	0.38 [0.09 - 1.61]	**0.190**	1.7 1[0.20 - 14.77]	0.628
Perception of DVA	0.69 [0.51 - 0.94]	**0.017***	0.83 [0.57 - 1.20]	0.313
Perception of NVA	0.76 [0.54 - 1.06]	**0.107**	0.88 [0.60 - 1.29]	0.507
Weeding	0.84 [0.11 - 6.64]	0.871	----- -----	---- ---
Bush burning	1.96 [0.46 - 8.40]	0.364	----- -----	---- ---
Fertilizing	4.69 [1.41 - 15.57]	**0.012***	2.2 [0.61 - 7.70]	0.234
Spraying	9.98 [3.47 - 28.73]	**<0.001***	4.12 [1.11 - 15.24]	**0.034***
Harvesting	1.55 [0.46 - 5.20]	0.480	----- -----	---- ---

* = significant *p* - value (Chi square), D =Distance, N=Near, VA= Visual Acuity

6.2.4.2. Barriers to the use of protective eyewear among cocoa farmers

Several reasons were identified for the low rate of use of ocular protection among the study participants. These included the devices not being readily available (34.4%), lack of funds (24.9%) and ignorance/lack of training (22.6%). Other reasons are as shown in Figure 6.10.

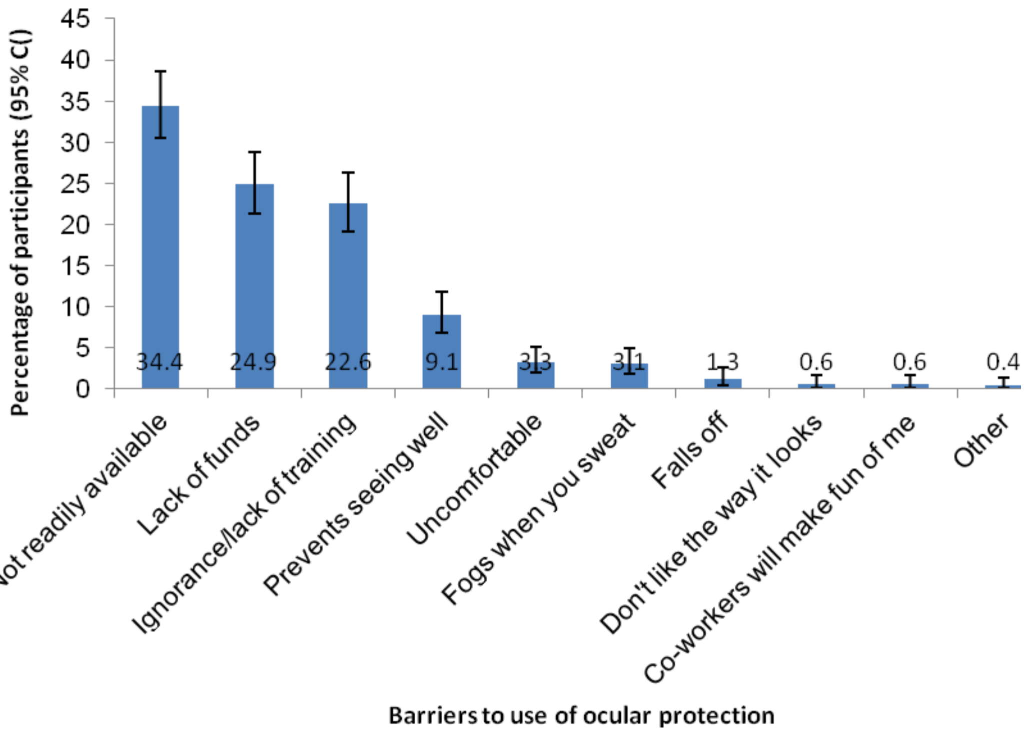

Figure 6. 10: Barriers to the use of ocular protection

Among the participants involved in this research study, 96.8% indicated that they would use ocular protection if it was given to them at no cost by the government. Similarly, 95.1% agreed to use ocular protection if it was made mandatory by law (data not indicated in a table).

6.2.5 Objective 4: To determine eye care seeking behaviour among cocoa farmers in Ghana.

Among the participants, 52.4% had never had an eye examination. However, 290 (52.2%) reported having had an eye problem within the last one year preceding this study, and 25% reported having sought eye care within the last one year prior to the study at a hospital or clinic. The most recent episodes resulting in the participant seeking eye care included symptoms of itching (n=81, 27.9%), 48 (16.5%) had red eye (n=48, 16.5%), eye injury 35 (12.1%), blurred vision 29 (10.0%), among others as shown in Table 6.39. Of the participants who reported an eye episode, 139 (47.9%) reported to the hospital or clinic for treatment and travelled mainly on commercial vehicles (n=133, 95.7%), with a reported average travel time of 82 minutes (SD: ±4.8) to reach the nearest eye facility (hospital/clinic) situated at an average of 19.3km away from their towns or villages. Among those who reported to the hospital/clinic, only 16 (11.5%) indicated that they were not satisfied with the treatment received due to unresolved complaints 7 (43.6%), long waiting time 6 (37.5%) and bad attitude of staff 3 (18.8%). Reasons cited as hindrances to seeking eye care at hospital/clinics included lack of funds (n=71, 47.0%), long distance to the hospital/clinic 29 (19.2%), long waiting time at the hospital/clinic 15 (9.9%), time constraints on the part of participants 12 (8.0%), among others as shown in Table 6.39.

Among the participants who did not visit a hospital or clinic, 66 (43.7%) reported to the pharmacy/chemist for assistance, 12(8.0%) visited the herbalist, 9(6.0%) self medicated and 1(0.7%) used breast milk for treatment **(Table 6.39)**. Forty-six (46.9%) of those who sought alternative eye care indicated that that the alternative forms of treatment was cheaper and 42 (42.9%) said it had less time constraints. Thirteen percent reported that they were not satisfied with the treatment they received at these alternative places due to unresolved complaints.

Table 6. 39: Ocular health seeking behaviour

Factor	Responses	No. (%)	Total
Recent eye episode in a year		290 (52.2)	
Eye episode (symptom) encountered	Itching	81 (27.9)	
	Red eye	48 (16.5)	
	Eye injury	35 (12.1)	
	Blurred vision	29 (10.0)	
	Foreign body sensation	25 (8.6)	
	Pain	24 (8.3)	
	Tearing	21 (7.2)	
	Discharge	14 (4.8)	
	Swollen eye	5 (1.7)	
	Burning sensation	5 (1.7)	
	Other	3 (1.0)	
Confirmed Hospital/Clinic attendance		139 (47.9)	
Travel means	Commercial vehicle	133 (95.7)	
	Own vehicle	2 (1.4)	
	Foot	4 (2.9)	
	Travel time/min (mean, SD, 95%CI)	82±4.8 (72.4 - 91.6)	
Lack of satisfaction with treatment at hospital/clinic		16 (11.5)	
Reason for non-satisfaction	Unresolved complain	7 (43.6)	
	Long waiting time	6 (37.5)	
	Wrong attitude of staff	3 (18.8)	
Barriers to visiting hospital/clinic	Lack of funds	71 (47.0)	151 (100.0)
	Long distance to hospital/clinic	29 (19.2)	
	Long waiting time at hospital/clinic	15 (9.9)	
	Time constraint	12 (8.0)	
	Simple disease	10 (6.6)	
	Lack of trust in the health service	9 (6.0)	
	Advised to use herbs	2 (1.3)	
	Other	3 (2.0)	
Alternative health seeking	None	53 (35.1)	151 (100.0)
	Pharmacy/chemist	66 (43.7)	
	Herbalist (herbal medicine)	12 (8.0)	
	Self medication (Orthodox)	10 (6.6)	
	Self medication (herbal)	9 (6.0)	
	Other (breast milk)	1 (0.7)	
Reason for choosing alternative health	Cheaper	46 (46.9)	98 (100.0)
	Less time constraint	42 (42.9)	
	Other	10 (10.2)	
Satisfaction with alternative health	No	13 (13.3)	
Reasons for non satisfaction	Unresolved complaints	13 (100)	

A bivariate logistic regression analysis of demographic factors associated with attendance to a hospital/clinic revealed that age (OR 1.04, 1.02 - 1.06, p<0.001), education, OR 0.72 (0.57 - 0.91, p=0.006), marital status, OR 1.37 (1.09 - 1.73, p=0.007), perception of poor distance vision, OR 1.26 (1.02 - 1.56, p= 0.035), and being registered with the NHIS, OR 4.33 (1.59 - 11.82, p=0.004) were associated with attendance at a hospital/clinic. However, multivariate logistic regression analysis indicated that only being registered with the NHIS remained significantly associated with attending a hospital/clinic. Hence, participants who were registered with the NHIS were more likely to attend a hospital/clinic for eye care services (OR=3.93, 1.40 - 11.06, p=0.009) **(Table 6.40).**

Table 6. 40: Factors influencing the use of hospitals/clinics for eye care

Factor	**Bivariate regression (Unadjusted) odds ratio [95% CI]**	**p-value**	**Multivariable regression (adjusted) odds ratio [95% CI]**	**p-value**
Sex	1.40 [0.87 - 2.27]	**0.165**	0.91 [0.51 - 1.62]	0.750
Age	1.04 [1.02 - 1.06]	**0.001***	1.03 [0.99 - 1.05]	0.060
Education	0.72 [0.57 - 0.91]	**0.006***	0.81 [0.63 - 1.04]	0.102
Marital status	1.37 [1.09 - 1.73]	**0.007***	1.23 [0.94 - 1.61]	0.133
Income	1.00 [1.00-1.00]	**0.167**	0.99 [0.99 - 1.00]	0.175
Perception of DVA	1.26 [1.02 - 1.56]	**0.035***	1.05 [0.82 - 1.34]	0.705
Perception of NVA	0.99 [0.80 - 1.23]	0.947	----- -----	---- ---
NHIS Registered	4.33 [1.59 - 11.82]	**0.004***	3.93 [1.40 - 11.06]	**0.009***

* = significant p - value (Chi square), D=Distance, N=Near, VA=Visual Acuity

6.3 PHASE 2: Ocular health education intervention

The purpose of Phase 2 was to investigate the knowledge, perceptions and beliefs of cocoa farmers on ocular health and safety practices, to develop an ocular health education and training manual, and implement its use in a training workshop. The post training evaluation analysis aided in finalising the training manual. This phase followed the complete assessment of the ocular health of cocoa farmers, as well as, reports on ocular injuries, use and barriers to utilization of protective eye wears and ocular health seeking behaviours.

6.3.1. Demographic profile of participants and farm characteristics

Phase 2 consisted of 200 participants, these being a subset of those who had participated in Phase 1, being made up of 129 (64.5%) males and 71(35.5%) females. The mean age of participants in this phase was 52.8 years (SD: ±12.0), with the mean age of 52.0 years (±11.4) for males and 54.1 years (SD: ±13.0) for females. There was no statistically significant difference between the mean ages of males and females (p=0.241) **(Table 6.41).** Fifty percent of the participants had attained middle/ junior high school education and 67 (33.5%) had no formal education with few, 12 (6.0%), having attained secondary or post-secondary education.

Participants in this phase had farmed for an average of 21.3 years (SD: ±12.0); 21.4 years (SD: ±11.6) for the males and 21.1 years (SD: ±13.0) for the females, with no significant difference between them regarding the mean years of farming (p=0.872). The participants worked for an average of 35.0 (±12.2) hours per week on their farms; 35.9 (SD: ±12.8) hours per week by the males and 33.3 (SD: ±10.9) by the females, with this difference not being significant. The use of mobile phones was reported by 128 (64.0%) participants, and despite this, access to internet facility was limited, with only a few, 2 (1.0%) reported having access **(Table 6.41).**

Table 6. 41: Demographic characteristics of participants in phase 2

Background characteristics	Sex		Total	
	Male n = 129	Female n =71	n = 200	p-value
Sex n(%)	129(64.5)	71(35.5)	200(100)	
Age/years (Mean, SD)	52.0 (11.4)	54.1 (13.0)	52.8 (12.0)	0.2414
Education n (%)				
No Education	32(24.8)	35(49.3)	67(33.5)	0.006
Primary	16(12.4)	5(7.0)	21(10.5)	
Middle/JHS	72(55.8)	28(39.4)	100(50)	
Sec/Post Sec	9(7.0)	3(4.2)	12(6.0)	
Farming yrs (Mean,SD)	21.4(11.6)	21.1(13.0)	21.3(12.0)	0.872
Hrs worked/week (mean, SD)	35.9(12.8)	33.3(10.9)	35.0(12.2)	0.137
Mobile phones n(%)				
Yes	97(75.2)	31(43.7)	128(64.0)	<0.001
No	32(24.8)	40(56.3)	72(36.0)	
Internet access n (%)				
Yes	1(0.8)	1(0.8)	2(1.0)	0.587[a]
No	127(99.2)	70(98.6)	197(99.0)	

[a] = Fisher's exact

6.3.2 Objective 5: To investigate the cocoa farmers' knowledge, perceptions and beliefs on ocular health and safety practices.

This section investigated the knowledge, perceptions and beliefs of participants on ocular health and safety practices. It covered five main areas; basic knowledge on eye health, perception and beliefs, injury and potential hazards, ocular protection and ocular first aid.

6.3.2.1 Basic knowledge on eye health, hazards and safety

Forty-two percent of the participants strongly disagreed with the statement that "I have basic knowledge about the structure of the human eye", while 55 (27.5%) disagreed with the statement **(Table 6.42).** More than half 110 (55.0%) of the participants either strongly disagreed or disagreed with the statement that "I am supposed to seek eye care at least once every two years". Most of the respondents (87.5%) believed that eating green leafy vegetables and carrots could help keep the eye healthy. Similarly, 65 (32.5%) strongly agreed and 95 (47.5%) agreed that exposure to pesticides and other chemicals can cause eye problems. However, while 138 (69.0%) either strongly agreed or agreed that alcohol intake has no effect on their eye, majority of the participants, 179 (89.5%) stongly agreed or agreed that smoking can affect their eye health **(Table 6.42).**

Among the participants, 65 (32.5%) and 73 (36.5%) strongly agreed or agreed, respectively to the statement that "early entry of sprayed farms cannot cause eye irritation", while 119 (59.5) either strongly agreed or agreed that radiations from the sun cannot cause cataracts. However, approximately two-thirds (66.0%) of the participants believed that excessive exposure to the sun’s radiations can cause eye problems, while most of the participants (92.5%) believed that wind, dust and sand can cause eye problems **(Table 6.42).**

Table 6. 42: Basic knowledge about eye health, hazards and safety

	Strongly Agree n(%)	Agree n(%)	Neutral n(%)	Disagree n(%)	Strongly Disagree n(%)
1. I have basic knowledge about the structure of the human eye	9(4.5)	24(12.0)	28 (14.0)	55(27.5)	84(42.0)
2. I am supposed to seek eye care at least once every two years	12(6.0)	61(30.5)	17(8.5)	75(37.5)	35(17.5)
3. Exposure to pesticides and other chemicals can cause eye problems	65(32.5)	95(47.5)	6(3.0)	25(12.5)	9(4.5)
4. Eating green leafy vegetables and carrots can help keep my eye healthy	87(43.5)	88(44.0)	9(4.5)	9(4.5)	7(3.5)
5. Alcohol intake has no effect on my eyes	43(21.5)	95(47.5)	15(7.5)	22(11.0)	25(12.5)
6. Smoking can affect my eyes	82(41.0)	97(48.5)	6(3.0)	12(6.0)	3(1.5)
7. Early entry of sprayed farms cannot cause eye irritation	65(32.5)	73(36.5)	10(5.0)	23(11.5)	29(14.5)
8. Radiations from the sun cannot cause cataracts	41(20.5)	78(39.0)	14(7.0)	41(20.5)	26(13.0)
9. Excessive exposure to the sun radiations can cause eye problems	35(17.5)	97(48.5)	18(9.0)	36(18.0)	14(7.0)
10. Wind, dust, and sand can cause eye problems	82(41.0)	103(51.5)	4(2.0)	9(17.5)	2(1.0)

6.3.2.2 Perceptions and beliefs

Seventy nine (39.5%) participants strongly agreed that "infections can be transmitted from plant to my eyes to cause diseases". In response to the statement "eye injuries are always avoidable or preventable when working on the farms", 76 (38.0%) strongly agreed. However, 65 (32.5%) participants strongly disagreed that their "chances of getting an eye injury at work on any given day is very low", while 53 (26.5%) strongly agreed that they would risk injury to their eyes in order to save time or to get more work done **(Table 6.43).**

Most participants (n=75, 37.5%) strongly agreed and (n=55, 27.5%) agreed that wearing eye protection would make them look funny. Other responses to this question were evenly distributed among the various categories. Similarly, 75 (37.5%) and strongly agreed and 62 (31%) agreed respectively that eye injuries are sometimes caused by the “gods” if one disobeys them. In spite of this, 97 (48.5%) and 86 (43.0%) participants strongly agreed and agreed respectively that safety glasses help protect the eyes when working in agriculture. Thirty percent of the participants disagreed ans 53 (26.5% strongly disagreed that they will change their protective eyewear only when they had money to do so, although 163 (81.5%) believed that purchasing and replacing protective eyewear frequently is a waste of resources. In spite of the earlier reported beliefs and misconceptions, 108 (54.0%) strongly disagreed seeing their co-workers undertaken activities that was risky for their eyes while working on the farm **(Table 6.43)**.

Table 6. 43: Perceptions and beliefs

	Strongly Agree n(%)	Agree n(%)	Neutral n(%)	Disagree n(%)	Strongly Disagree n(%)
11. Infections can be transmitted from plant to my eyes to cause diseases	79(39.5)	62(31.0)	9 (4.5)	27(13.5)	23(11.5)
12. Eye injuries are always avoidable or preventable when working on the farms.	76 (38.0)	50(25.0)	7(3.5)	34(17.0)	33(16.5)
13. My chance of getting an eye injury at work on any given day is very low	57(28.5)	56(28.0)	2(1.0)	20(10.0)	65(32.5)
14. Safety glasses help protect the eyes when working in agriculture	97(48.5)	86(43.0)	7(3.5)	7(3.5)	3(1.0)
15. I often risk injury to my eyes in order to save time or to get more work done.	53(26.5)	52(26)	0(0.0)	48(24.0)	47(23.5)
16. I think that wearing eye protection would make me look funny.	75(37.5)	55(27.5)	2(1.0)	35(17.5)	33(16.5)
17. I believe that eye injuries are sometimes caused by the gods if one disobeys them.	75(37.5)	62(31.0)	2(1.0)	27(13.5)	34(17.0)
18. I change my protective eyewear only when I have money to purchase one.	35(17.5)	51(25.5)	1(0.5)	60(30.0)	53(26.5)
19. I think purchasing protective eyewear frequently is a waste of resources	70(35.0)	93(46.5)	0(0.0)	15(7.5)	22(11.0)
20. I often see my co-workers doing something that is risky for their eyes.	3(1.5)	8(4.0)	1(0.5)	80(40.0)	108(54.0)

6.3.2.3 Injury and potential hazards

Fifty seven (28.5%) and 58 (29.0%) participants strongly disagreed and disagreed respectively that they were well informed on preventing eye injuries in the farm. Corroborating this assertion, almost half of the participants (47.5%) indicated that there are many jobs in agriculture where a worker does not need to wear safety glasses. Conversely, most of the participants, 76 (38.0%) and 88 (44.0%) strongly agreed and agreed respectively, that ocular protection was needed for every activity on the farm that has potential to cause injury **(Table 6.44).**

There was generally a good appreciation of potential ocular hazards on the farm. For example, 138 (69.0%) strongly agreed that all farm tools can cause injury to the eye, while 115 (57.5%) strongly agreed that branches, vines, bushes and thorns can cause eye injuries. Similarly, 150 (75.0%) strongly agreed that flying objects can cause injuries, and 147 (73.5%) participants agreed that there is potential for eye injury in any activity they undertake in the farm. One hundred and fifty seven (78.5%) participants strongly agreed that injury to the eye can lead to blindness **(Table 6.44).**

Table 6. 44: Injury and potential hazards

STATEMENT	Strongly Agree n(%)	Agree n(%)	Neutral n(%)	Disagree n(%)	Strongly Disagree n(%)
21. I am well informed on preventing eye injuries in the farm	11(5.5)	42(21.0)	32(16.0)	58(29.0)	57(28.5)
22. There are many jobs in agriculture where a worker does not need to wear safety glasses.	31(15.5)	64(32.0)	15(7.5)	53(26.5)	37(18.5)
23. Taking a rest when tired can help reduce injury	139(69.5)	59(29.5)	0(0.0)	1(0.5)	1(0.5)
24. I should consider my age before performing a task on the Farm	38(19.0)	51(25.5)	5(2.5)	64(32.0)	42(21.0)
25. I must wear ocular protection for every activity on the farm that has potential for causing injury	76(38.0)	88(44.0)	5(2.5)	26(13.0)	5(2.5)
26. All farm tools can cause injury to my eye	138(69.0)	57(28.5)	0(0.0)	2(1.0)	3(1.5)
27. Branches, vines, bushes and thorns can cause injury to my Eye	115(57.5)	78(39.0)	0(0.0)	3(1.5)	4(2.0)
28. Flying objects can cause injury to the eye	150(75.0)	49(24.5)	0(0.0)	0(0.0)	1(0.5)
29. There is potential for eye injury in any activity I undertake in the farm	53(26.5)	147(73.5)	0(0.0)	0(0.0)	0(0.0)
30. Injury to the eye can lead to blindness	157(78.5)	43(21.5)	0(0.0)	0(0.0)	0(0.0)

6.3.2.4 Ocular protection on the farm

The use of protective eyewear is a common practice in preventing eye injuries. In this study, 99 (49.5%) participants strongly disagreed that there are several types of ocular protection available to farmers apart from the ‘traditional goggles’. Forty-four percent (44.0%) strongly disagreed with the statement that "If my protective eyewear is old and I cannot afford a new one, I will continue using the old one". However, 66 (33.0%) participants disagreed that if they lost their safety glasses but need to do a job that is hazardous to the eyes it is important to get another pair before doing that job. In contrast, 113 (56.5%) agreed and 78 (39.0%) strongly agreed that it is important to wear eye protection when spraying chemicals **(Table 6.45).**

Among the participants, 57 (28.5%) and 68 (34.0%) strongly disagreed and disagreed, respectively, with the assertion that "spectacle wearers need additional ocular protection when working in the farm". However, 96 (48.0%) and 90 (45.0%) agreed and strongly agreed respectively, that hats can reduce the amount of sun radiation getting into my eye, while 92 (46.0%) and 54 (27.0%) agreed and strongly agreed that sunglasses reduce the amount of sun radiation entering the eye. In spite of this, 106 (53.0%) held the notion that sunglasses provide protection to the eye when working in the farm **(Table 6.45).**

Table 6. 45: Ocular protection

	Strongly Agree n(%)	Agree n(%)	Neutral n(%)	Disagree n(%)	Strongly Disagree n(%)
31. There are several types of ocular protection available to farmers apart from the "traditional goggles".	7(3.5)	6(3.0)	8(4.0)	80(40.0)	99(49.5)
32. If my protective eyewear is old and I cannot afford a new one, I will continue using the old one	11(5.5)	21(10.5)	5(2.5)	75(37.5)	88(44.0)
33. If I lost my safety glasses but need to do a job that is hazardous to my eyes it is important to get another pair before doing that job	26(13.0)	52(26.0)	10(5.0)	66(33.0)	46(23.0)
34. I must wear eye protection whenever I am spraying with chemicals	78(39.0)	113(56.5)	3(1.5)	6(3.0)	0(0.0)
35. It is important to wear safety glasses all the time while working on the farm.	50(25.0)	81(40.5)	10(5.0)	37(18.5)	22(11.0)
36. Spectacle wearers need additional ocular protection when working in the farm	22(11.0)	51(25.5)	2(1.0)	68(34.0)	57(28.5)
37. Hats can reduce the amount of sun radiation getting into my eye	90(45.0)	96(48.0)	3(1.5)	9(4.5)	2(1.0)
38. Sunglasses provide protection to the eye when working in the farm	48(24.0)	58(29.0)	10(5.0)	34(17.0)	50(25.0)
39. I can wear sunglasses to reduce the amount of sun radiation entering my eye	54(27.0)	92(46.0)	6(3.0)	28(14.0)	20(10.0)
40. I consider the quality of the protective eyewear before purchasing	5(2.5)	3(1.5)	8(4.0)	73(36.5)	111(55.5)

6.3.2.5 Ocular first aid

The treatment measures that are adopted when an ocular injury occurs are important for preserving and maintaining good eye health. Ninety-eight (49.0%) and 88 (44.0%) participants agreed and strongly agreed respectively that "If I get something in my eye, like a piece of sand, I should immediately wash it with clean water". While 105 (52.5%) agreed that they would wash their eyes out with clean water if they had a splash of chemicals in their eyes, 58 (29.0%) strongly agreed to this course of action, with the remaining 37(18.5%) not seeing this as appropriate. Furthermore, 78 (39.0%) and 49 (24.5%) participants strongly disagreed and disagreed with the statement that "If I get a cut or puncture in my eye, I can wash it with water". In the same vein, 95 (47.5%) agreed that if they had a cut or puncture to their eye they will bandage it and see a physician immediately. Most of the participants strongly disagreed (n=78, 39.0%) and disagreed (n=68, 34.0%) to the statement that "I am not allowed to rub my eyes if particles fall in it" **(Table 6.46).**

Seventy-nine (39.5%) participants agreed that if they got a blow to the eye, they could apply cold compresses, while 112 (56.0%) agreed that if it was hard enough to cause discoloration, they would first see a physician. However, 57 (28.5%) and 44 (22.0%) agreed and strongly agreed respectively that they would apply herbs if they sustained an eye injury. To the contrary, 51 (25.5%) and 74 (37.0%) strongly disagreed and disagreed respectively to the statement that "I can purchase eye medication from the chemical shop when I have an eye disease or injury". Almost half of the participants (n=90, 45.0%) underscored the need to have a first aid box in the farm to help deal with ocular emergencies, although 25.5% did not share in this assertion **(Table 6.46).**

Table 6. 46: Ocular First Aid

	Strongly Agree n(%)	Agree n(%)	Neutral n(%)	Disagree n(%)	Strongly Disagree n(%)
41. If I get something in my eye, like a piece of sand, I should immediately wash it with clean water	88(44.0)	98(49.0)	5(2.5)	7(3.5)	2(1.0)
42. If I splash my eyes with chemicals, the first thing I should do is wash my eyes out with clean water	58(29.0)	105(52.5)	15(7.5)	16(8.0)	6(3.0)
43. If I get a cut or puncture in my eye, I can wash it with water	25(12.5)	34(17.0)	14(7.0)	49(24.5)	78(39.0)
44. If I get a cut or puncture to my eye, I have to bandage it and see a physician immediately	62(31.0)	95(47.5)	10(5.0)	23(11.5)	10(5.0)
45. I am not allowed to rub my eyes if particles fall in it	27(13.5)	25(12.5)	2(1.0)	68(34.0)	78(39.0)
46. I can apply herbs if I sustain an eye injury	44(22.0)	57(28.5)	7(3.5)	49(24.5)	43(21.5)
47. If I get a blow to the eye, I can apply cold compresses	27(13.5)	79(39.5)	28(14.0)	56(28.0)	10(5.0)
48. If I get a blow to the eye hard enough to cause discoloration, I am supposed to see a physician.	69(34.5)	112(56.0)	1(0.5)	11(5.5)	7(3.5)
49. I can purchase eye medication from the chemical shop when I have an eye disease or injury	42(21.0)	31(15.5)	2(1.0)	74(37.0)	51(25.5)
50. It is important for me to get a first aid box in the farm	39(19.5)	90(45.0)	20(10.0)	37(18.5)	14(7.0)

6.3.2.6 Overall scores

The mean distribution of responses to individual questions revealed that participants generally had a fair idea about the issues pertaining to ocular health in relation to farming. **Figure 6.11** indicates that participants had a very good appreciation of the hazards and potential hazards that could affect their ocular health at work (questions 21-30). However, the mean score for questions on ocular protection (question 31- 40) and ocular first aid (questions 41-50) were generally low.

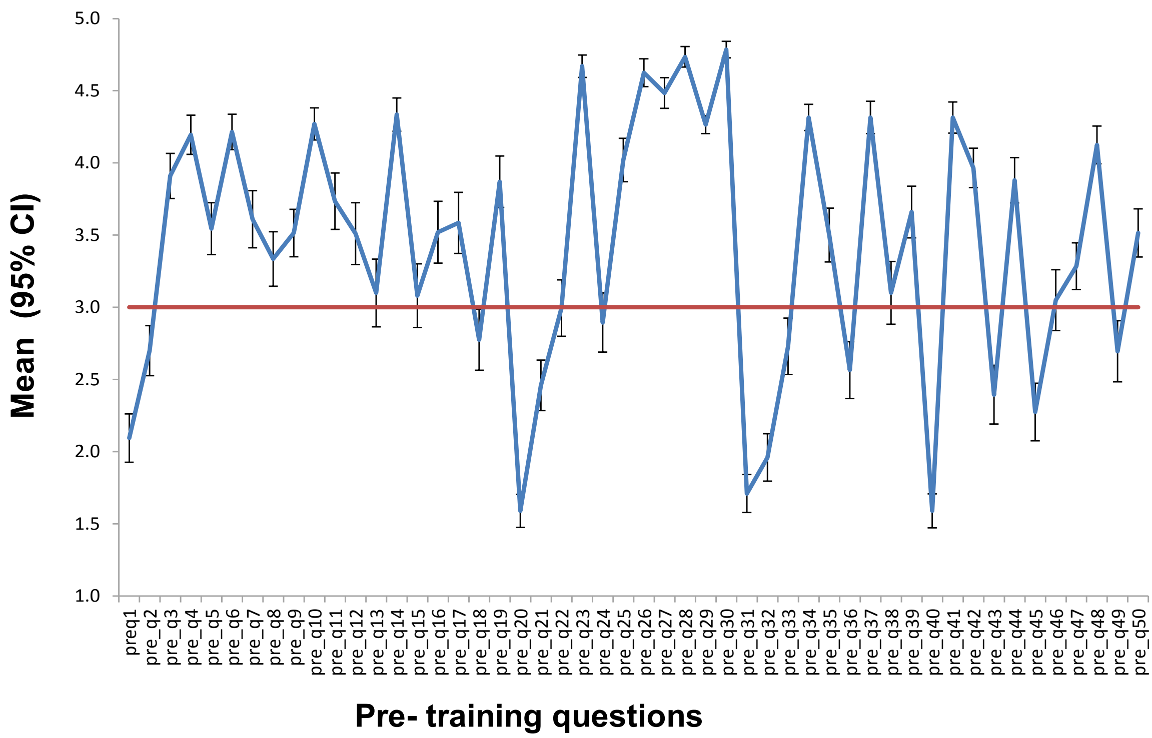

Figure 6. 11 : Mean distribution of pre- training responses

6.3.3 Objective 6: To develop an education training intervention to improve the cocoa farmers' knowledge on ocular health and safety practices

The development of the educational and training manual was undertaken using three main methods including a literature review, personal communication and observation of farm activities engaged in by cocoa farmers, and an understanding of the knowledge of participants on ocular health and safety following the pre-training responses. The literature review was undertaken as indicated in the methodology section.

The perception of ocular hazards faced by cocoa farmers from key persons within the cocoa industry in the districts selected for the study (i.e. agricultural extension officers, chief cocoa farmers and some officials of the Ghana Cocoa Board) were obtained through personal communications to shape the development of the manual. In addition, the principal investigator, who has lived his entire life in cocoa growing areas, also observed cocoa farmers for one week on their routine days at work on the farm to assess and understand the ocular health challenges they faced at work.

6.3.4 Objective 7: To implement a training intervention to improve the cocoa farmers' knowledge on ocular health and safety practices.

The training intervention was conducted by the principal investigator in groups of 10 cocoa farmers using the training manual. The training included a lecture using prepared power point slides from the training manual, interspersed with questions and discussions, as well as pictorial evidence of ocular conditions (diseases and injuries) recorded among farmers to aid their understanding. Hands-on practical sessions on handling ocular emergencies were also included in the training to enhance participants' understanding and appreciation of concepts that were being passed on as stated under the methodology chapter.

6.3.5 Objective 8: To establish changes in the cocoa farmers' knowledge, perceptions and beliefs on ocular health and safety practices.

This section investigated the knowledge, perceptions and beliefs of participants on ocular health and safety practices following the training intervention. The post training responses were compared to the pre-training ones and any changes were documented. It covered five main areas as indicated in objective 6.3.1.

6.3.5.1. Basic knowledge about eye health, hazards and safety

Comparing the pre-training composite scores to the post-training scores, for basic knowledge, there was a minimum of 10 points change in score with a pre-training median score of 36 (IQR: 33 - 38.5) and post-training median score of 46 (IQR: 44 - 47) **(Figure 6.12).** There was a statistically significant difference between the pre and post training scores in basic knowledge (p <0.001).

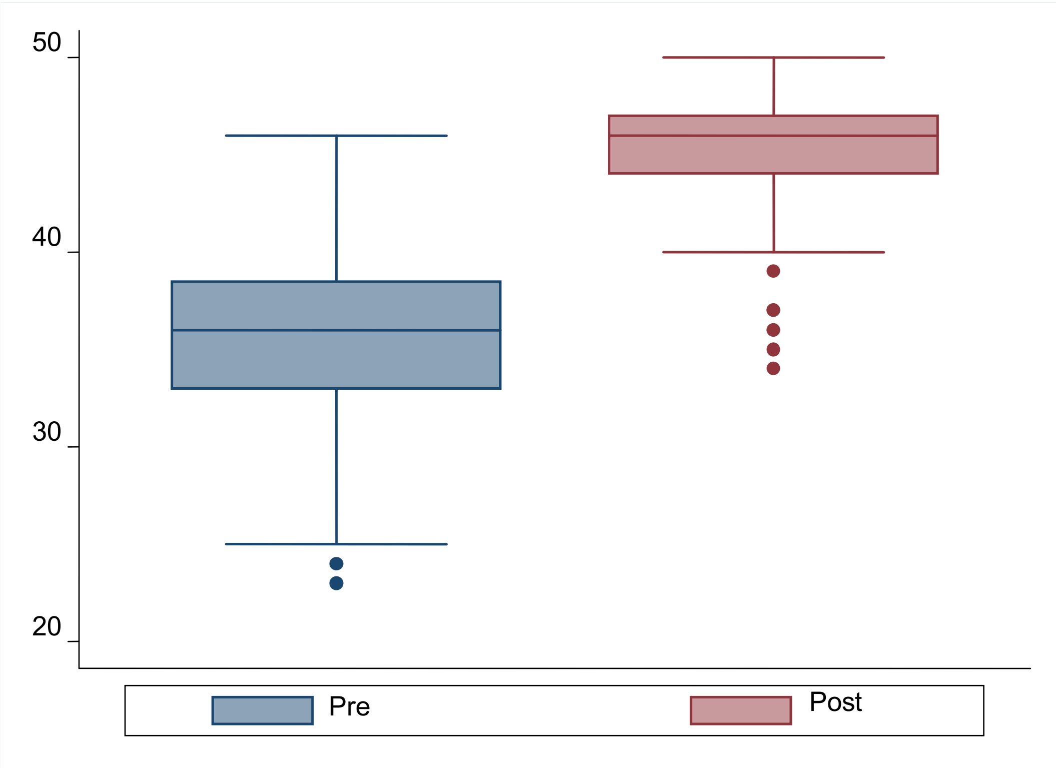

Figure 6. 12 : Pre-post training scores on basic knowledge

6.3.5.2. Perceptions and beliefs

After the training, there was a minimal change in scores on the perception and beliefs (2 points) about ocular health and safety practices, with a pre-training median score of 33 (IQR: 31 - 37) and a post-training median score of 35 (IQR: 32 - 37) **(Figure 6.13).** In spite of the minimal change in scores, there was a statistically significant difference between the pre- and post-scores ($p<0.001$).

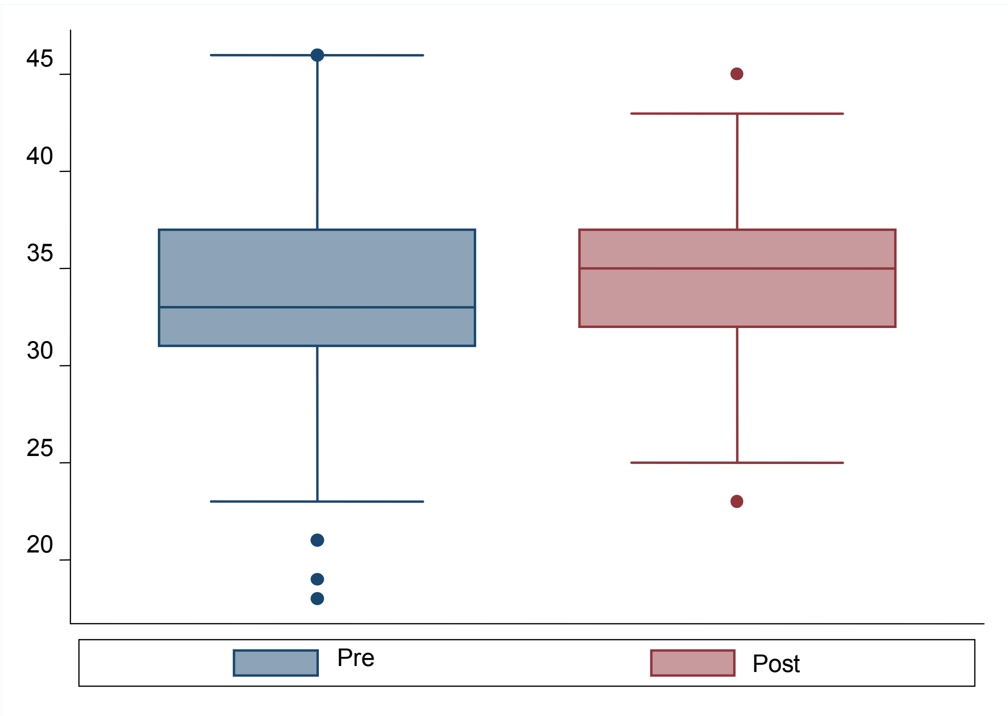

Figure 6. 13: Pre-post training scores on perception and beliefs

6.3.5.3. Injury and potential hazards

Participants had a good perception of injury and potential hazards on their work, with a pre-training median score of 40 (IQR: 38 - 42) and a post-training median score of 47 (IQR: 45 - 48). This resulted in a statistically significant difference between the pre-and post-training scores ($p<0.001$), with a seven point minimum change in score **(Figure 6.14).**

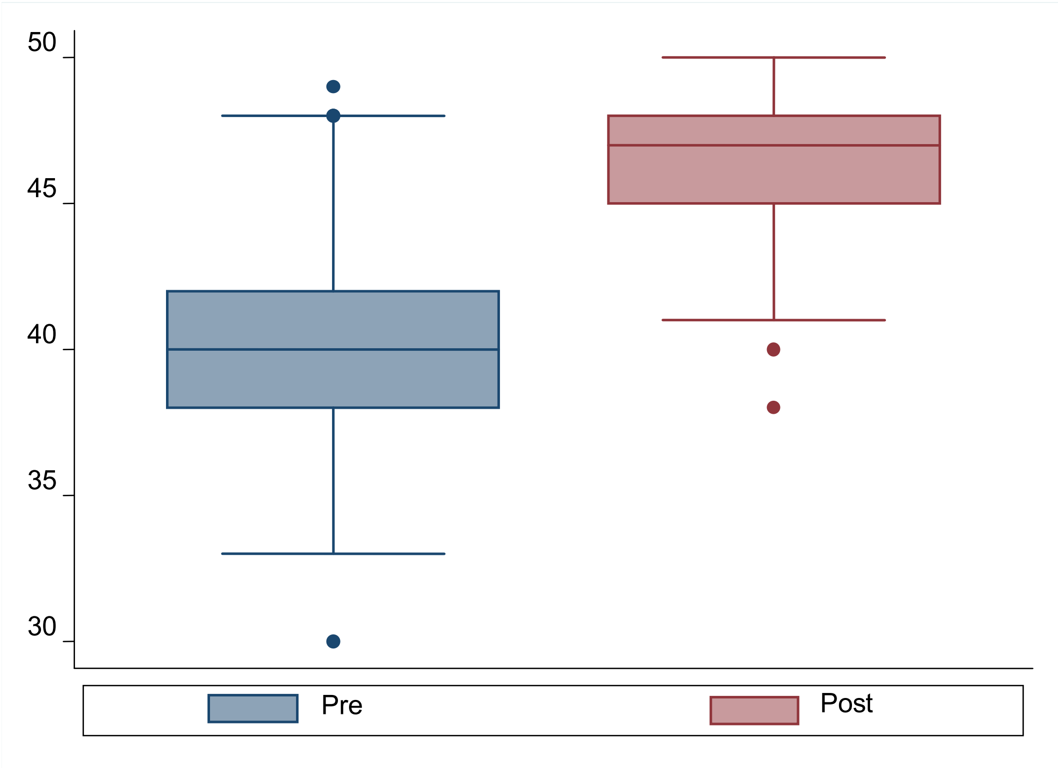

Figure 6. 14 Pre-post training scores on injury and potential hazards

6.3.5.4. Ocular protection on the farm

There was a 12 point increase from the median score of 30 (IQR: 27 - 31.5) in the pre-scores on ocular protection among farmers after the training, resulting in a post-training median score of 42 (IQR: 39 - 45) **(Figure 6.15).** There was a statistically significant difference between the pre- and post-training scores on ocular protection ($p<0.001$).

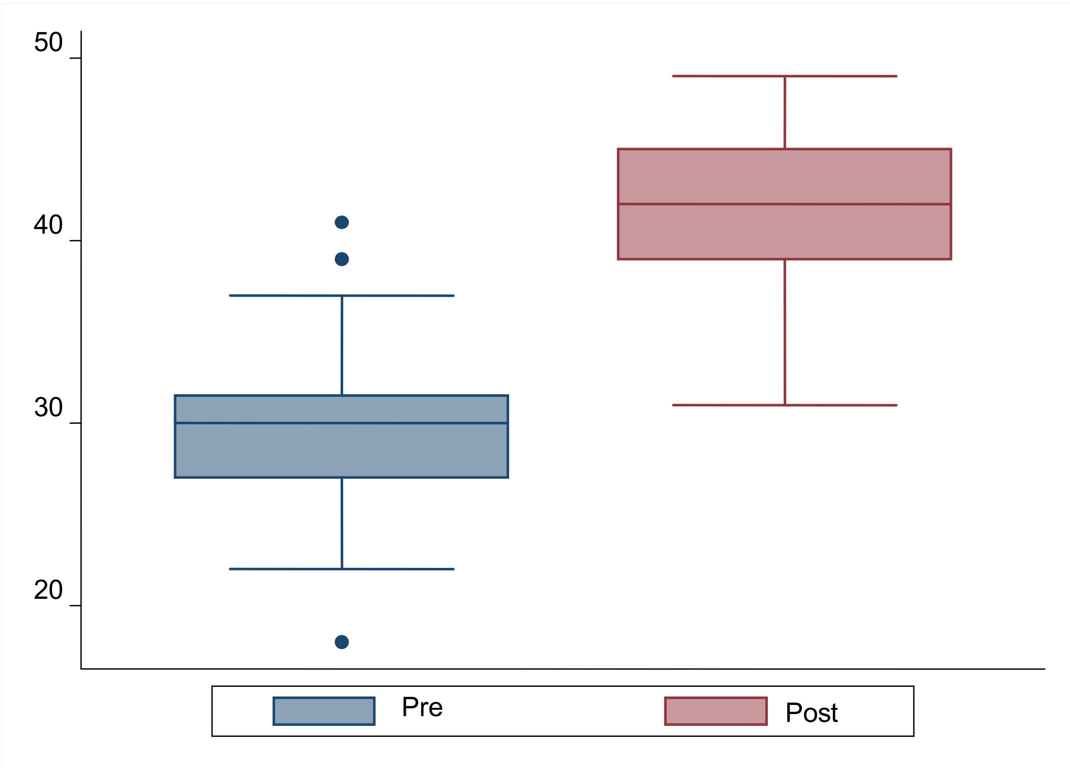

Figure 6. 15: Pre-post training scores on ocular protection

6.3.5.5. Ocular first aid

Participants improved their pre-training scores on ocular first aid by 11.5 points following the post-training intervention with the pre-training median scores of 33 (IQR: 31 - 36) increasing to 44.5 (IQR: 42 - 47) post-training. There was a statistically significant difference between the pre- and post-training scores on ocular first aid ($p<0.001$) **(Figure 6.16).**

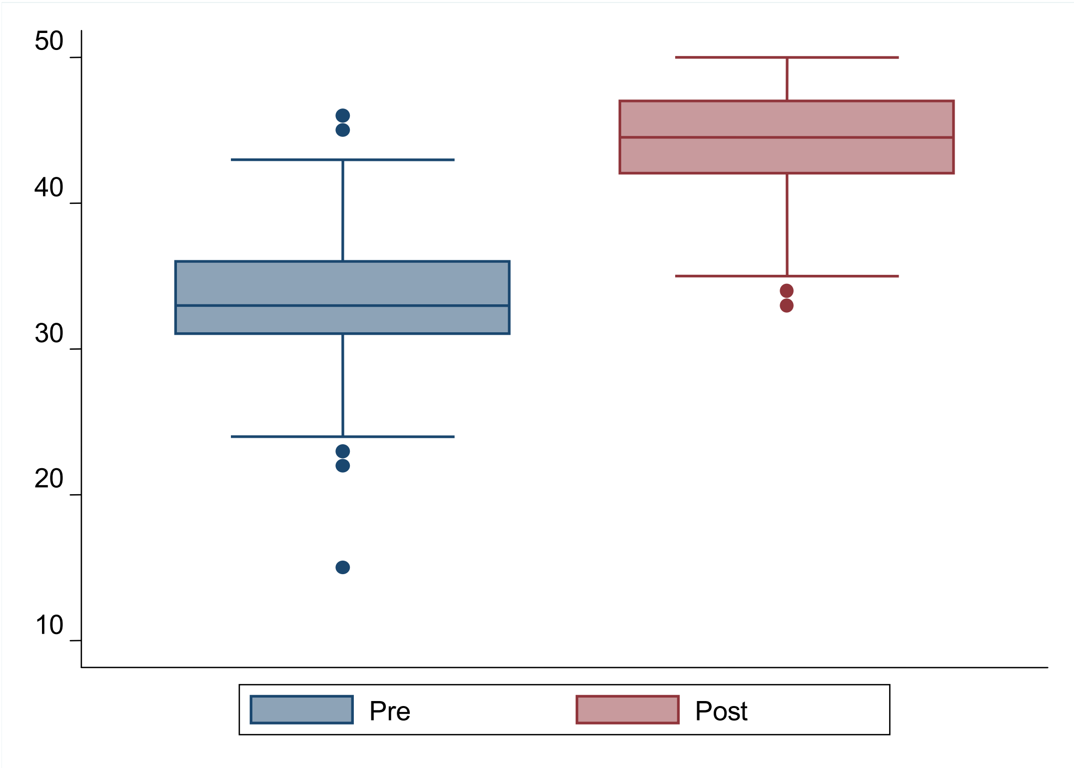

Figure 6. 16: Pre-post training scores on ocular first aid

6.3.5.6. Overall scores (composite)

A comparison of the pre-training to the post-training composite scores, showed that there was a minimum of 40 points change score with a pre-training median score of 172 (IQR: 164 - 177.5), and a post-training median score of 212 (IQR: 206 - 219.5). This change in the mean scores was statistically significant **(Figure 6.17 and Table 6.47).**

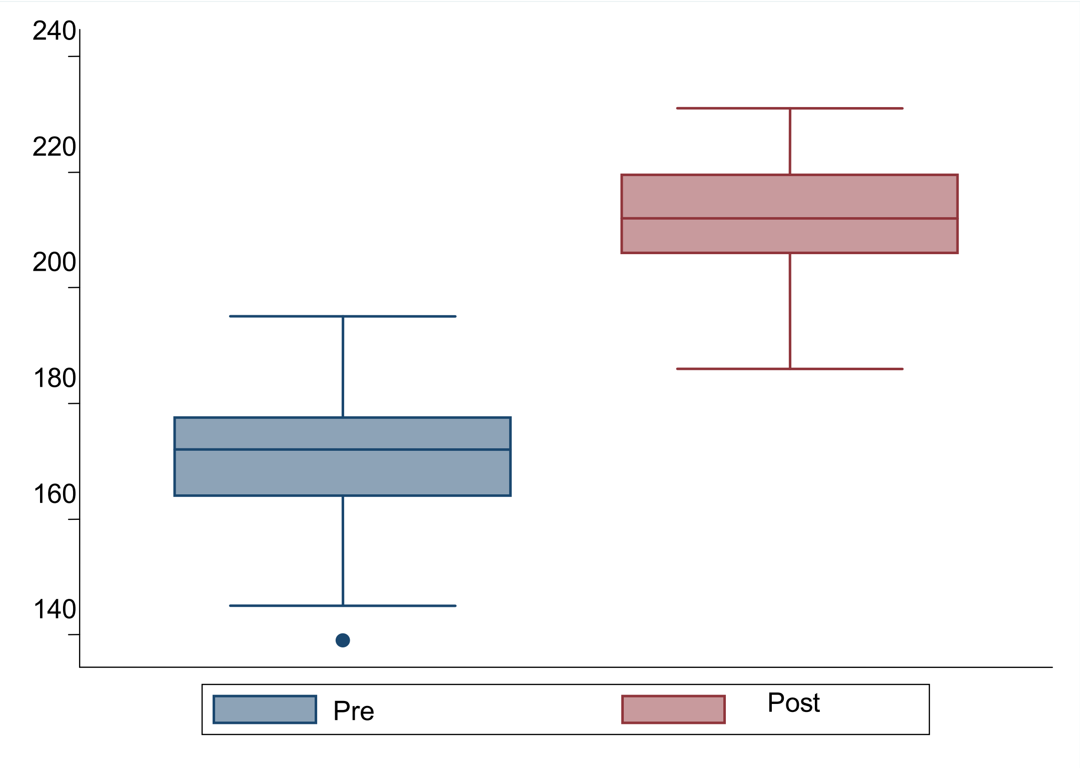

Figure 6. 17: Pre-post total (composite) scores

Table 6. 47: Pre-post training scores

Section	Median score pre training (plus IQR)	Median score post training (plus IQR)	p-value [i]
Basic knowledge	36 (33 - 38.5)	46 (44 - 47)	< 0.001
Perceptions and beliefs	33 (31 - 37)	35 (32 - 37)	< 0.001
Injury and hazards	40 (38 - 42)	47 (45 - 48)	< 0.001
Protection	30 (27 - 31.5)	42 (39 - 45)	< 0.001
First aid	33 (31 - 36)	44.5 (42 - 47)	< 0.001
Total score	172 (164 - 177.5)	212 (206 - 219.5)	< 0.001

[i] = Wilcoxon signed rank test

The mean distribution of the individual pre-post training scores for each question is presented in **Figure 6.18 and Table 6.48.** While **Figure 6.18** indicates a general improvement in the post-training responses, they were lower than the pre-training responses for statements 15, 16 and 17, all of which were related to perceptions and beliefs. For example, the pre- training mean score for statement 15 "I often risk injury to my eyes in order to save time or to get more work done" was 3.1 (95% CI: 2.9 - 3.3), while the post- training mean score was 2.0 (95% CI: 1.8 - 2.2). Similarly, the pre-training mean score for statement 16 "I think that eye protection would make me look funny" was 3.5 (3.3 - 3.7), while the mean post-training score was 3.0 (95% CI: 2.7 - 3.2). Finally, the pre-training mean score for statement 17 "I believe that eye injuries are sometimes caused by the gods if one disobeys them" was 3.6 (95% CI: 3.4 - 3.8), while the mean post-training score was 3.1 (95% CI: 2.9 - 3.3), indicating that participants may have unlearned, or were not been honest in their pre-training responses.

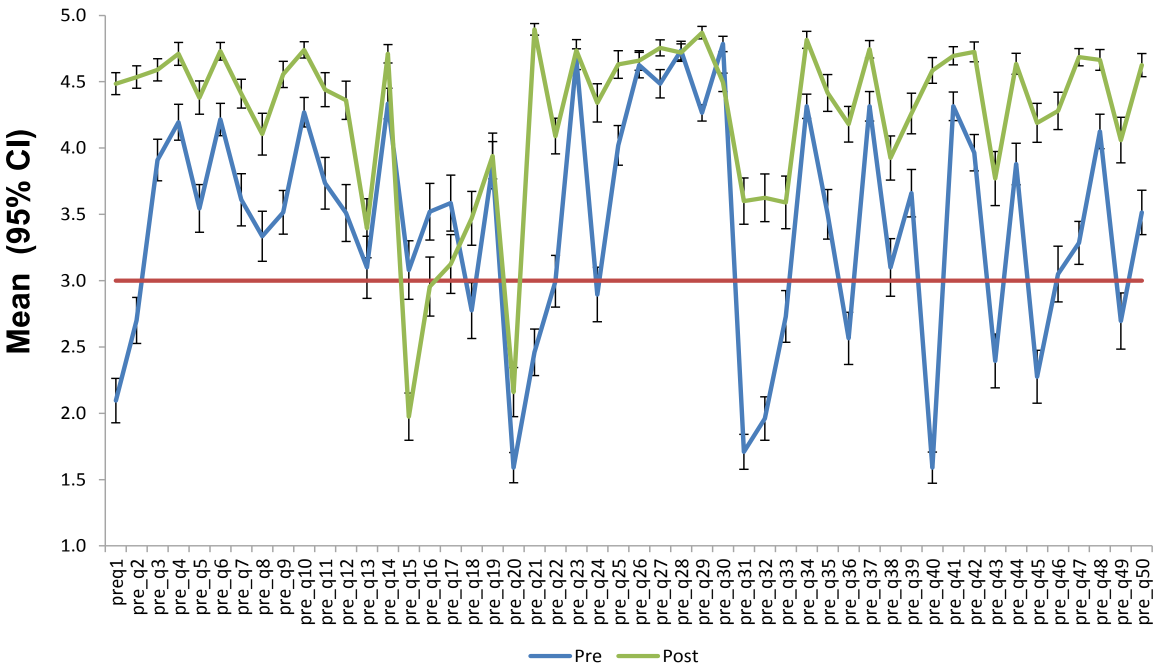

Figure 6. 18: Pre-post training mean score

Table 6. 48: Pre-post training mean scores

Question Number	Pre: Mean (95% CI)	Post: Mean (95% CI)
1.	2.1 (1.9 - 2.3)	4.5 (4.4 - 4.6)
2.	2.7 (2.5 - 2.9)	4.5 (4.5 - 4.6)
3.	3.9 (3.8 - 4.1)	4.6 (4.5 - 4.7)
4.	4.2 (4.1 - 4.3)	4.7 (4.6 - 4.8)
5.	3.5 (3.4 - 3.7)	4.4 (4.3 - 4.5)
6.	4.2 (4.1 - 4.3)	4.7 (4.7 - 4.8)
7.	3.6 (3.4 - 3.8)	4.4 (4.3 - 4.5)
8.	3.3 (3.2 - 3.5)	4.1 (3.9 - 4.3)
9.	3.5 (3.4 - 3.7)	4.6 (4.5 - 4.7)
10.	4.3 (4.2 - 4.4)	4.7 (4.7 - 4.8)
11.	3.7 (3.5 - 3.9)	4.4 (4.3 - 4.6)
12.	3.5 (3.3 - 3.7)	4.4 (4.2 - 4.5)
13.	3.1 (2.9 - 3.3)	3.4 (3.2 - 3.6)
14.	4.3 (4.2 - 4.5)	4.7 (4.6 - 4.8)
15.	3.1 (2.9 - 3.3)	2.0 (1.8 - 2.2)
16.	3.5 (3.3 - 3.7)	3.0 (2.7 - 3.2)
17.	3.6 (3.4 - 3.8)	3.1 (2.9 - 3.3)
18.	2.8 (2.6 - 3.0)	3.5 (3.3 - 3.7)
19.	3.9 (3.7 - 4.1)	3.9 (3.8 - 4.1)
20.	1.6 (1.5 1.7)	2.2 (2.0 - 2.3)
21.	2.5 (2.3 - 2.6)	4.9 (4.9 - 4.9)
22.	3.0 (2.8 - 3.2)	4.1 (4.0 - 4.2)
23.	4.7 (4.6 - 4.7)	4.7 (4.7 - 4.8)
24.	2.9 (2.7 - 3.1)	4.3 (4.2 - 4.5)
25.	4.0 (3.9 - 4.2)	4.6 (4.5 - 4.7)
26.	4.6 (4.5 - 4.7)	4.7 (4.6 - 4.7)
27.	4.5 (4.4 - 4.6)	4.8 (4.7 - 4.8)
28.	4.7 (4.7 - 4.8)	4.7 (4.7 - 4.8)
29.	4.3 (4.2 - 4.3)	4.9 (4.8 - 4.9)
30.	4.8 (4.7 - 4.8)	4.5 (4.4 - 4.6)
31.	1.7 (1.6 - 1.8)	3.6 (3.4 - 3.8)
32.	2.0 (1.8 - 2.1)	3.6 (3.4 - 3.8)
33.	2.7 (2.5 - 2.9)	3.6 (3.4 - 3.8)
34.	4.3 (4.2 - 4.4)	4.8 (4.8 - 4.9)
35.	3.5 (3.3 - 3.7)	4.4 (4.3 - 4.6)
36.	2.6 (2.4 - 2.8)	4.2 (4.0 - 4.3)
37.	4.3 (4.2 - 4.4)	4.7 (4.7 - 4.8)
38.	3.1 (2.9 - 3.3)	3.9 (3.8 - 4.1)
39.	3.7 (3.5 - 3.8)	4.3 (4.1 - 4.4)
40.	1.6 (1.5 - 1.7)	4.6 (4.5 - 4.7)
41.	4.3 (4.2 - 4.4)	4.7 (4.6 - 4.8)
42.	4.0 (3.8 - 4.1)	4.7 (4.6 - 4.8)
43.	2.4 (2.2 - 2.6)	3.8 (3.6 - 4.0)
44.	3.9 (3.7 - 4.0)	4.6 (4.6 - 4.7)
45.	2.3 (2.1 - 2.5)	4.2 (4.0 - 4.3)
46.	3.1 (2.8 - 3.3)	4.3 (4.1 - 4.4)
47.	3.3 (3.1 - 3.4)	4.7 (4.6 - 4.7)
48.	4.1 (4.0 - 4.3)	4.7 (4.6 - 4.7)
49.	2.7 (2.5 - 2.9)	4.1 (3.9 - 4.2)
50.	3.5 (3.3 - 3.7)	4.6 (4.5 - 4.7)

An analysis to investigate demographic and farm characteristics that may have contributed to, or associated with the change in scores following the training intervention revealed that participants who had attained higher education were 1.35 (95% CI: 1.07 - 1.71, p=0.012) times more likely to record a change in scores than others **(Table 6.49).**

Table 6. 49: Factors associated with change in scores

Factor	Bivariate ordinal regression (Unadjusted) Odds ratio [95% CI]	p-value	Multivariable ordinal regression (adjusted) Odds ratio [95% CI]	p-value
Sex	1.09 [0.65 - 1.81]	0.748	1.30 [0.75 - 2.25]	0.345
Age	1.00 [0.98 - 1.02]	0.951	1.01 [0.98 - 1.03]	0.406
Education	1.35 [1.07 - 1.71]	**0.012***	1.45 [1.12 - 1.87]	**0.005***
Farming years	1.00 [0.96 - 1.03]	0.913	1.00 [0.95 - 1.03]	0.727

* = significant p - value (Chi square)

The majority of participants (84.9%) indicated that the training was very beneficial, while 15.1% said it was beneficial. Participants expressed an interest in such educational programmes being organised at least an average three times in a year.

6.3.6 Objective 9: To finalise the ocular health and safety practices training manual for cocoa farmers.

The results of the post-training analysis were used to modify and finalize the education and training manual. This was done with an emphasis on perception and beliefs, which recorded the least change in scores following the training intervention. The finalized training manual appears as an **Addendum.**

CHAPTER 7: DISCUSSION

7.1 Introduction

This chapter discusses the results presented in the previous chapter in relation to the theoretical framework and literature reviewed. The discussion is presented in two parts, as per the study design and according to the objectives. Phase 1 comprises Objectives 1 - 4, which is the cross-sectional survey among cocoa farmers that investigated the extent of ocular conditions, refractive errors and visual impairment, ocular injuries, use and barriers to use of protective eyewear, and the ocular health seeking behaviour. Phase 2 consisted of Objectives 5 to 9, which investigated the knowledge, perceptions, and beliefs about ocular health and safety practices among cocoa farmers' and a pre-post-evaluation of knowledge score following the ocular health training intervention.

7.2 PHASE 1: Ocular health of cocoa farmers

This phase consisted of Objectives 1 - 4, the intention being to establish the nature and extent of ocular conditions and injuries among cocoa farm workers and the protective measures they use. Within this context, it sought to establish their ocular health seeking behaviour, this phase being in preparation for Phase 2, when the knowledge, perception and beliefs on ocular health and safety practices was assessed and intervention was conducted to documents its effect on their knowledge. The discussions on the demographics of the participants are presented followed by the discussion of the results for each objective.

7.2.1 Demographic profile of participants and farm characteristics

The male dominance in the cocoa industry as recorded in this study (64.6%) is consistent with reports in the literature (Aneani et al, 2011; Asuming -Brempong et al, 2006). This may be attributed to the fact that men are always given the preference to acquire land for cash crop farming, and that land is inherited through the male descendents (Hill, 1963). Since males are often the bread winners of families, any ocular incapacitation arising out of work on the farm may have dire social consequences. The 20.0% female proportion reported by Aneani et al (2011) suggests that females were well represented in this study, as the sample consisted of 35.6% women. Similarly, the age distribution of participants in this study reveals a relatively older generation of cocoa farmers, with 68.2% being 50 years or older, with a mean age of 54.9 years (± 11.2). This is consistent with the mean age of cocoa farmers reported by other authors (Aneani et al, 2011; Asuming -Brempong et al, 2006; Teal et al, 2006; Anim-Kwapong and Frimpong, 2004). For example, a mean age of 51.5 (SD: ±15.22) years, 55 years and 53 (SD: ±15) years have been reported by Aneani et al (2011); Anim-Kwapong et al (2004) and Teal et al (2006) respectively among cocoa farmers in Ghana. The high prevalence of ocular conditions such as cataract, glaucoma, presbyopia, among patients who are 50 years and above, such as those found in this study, underscores the relevance of ocular health assessment in this population (Naidoo et al, 2014; Budenz et al; 2013, Budenz et al, 2012).

Educational attainment among the sample population was low, as one out of every four participants had no formal education, with the highest being the Junior High School level. This is consistent with reports that cocoa farmers are mostly illiterates, with many being unable to read or write (Aneani et al, 2011; Teal et al, 2006). However, males were more likely to attain higher education than their female counterparts, this being a reflection of the general educational system in Ghana (Lugg et al, 2007).

Most of the participants had low annual income, with males earning higher than females, a finding corroborating the fact that males generally own the majority of the cocoa farms, work on them full time, and perform the more strenuous activities such as harvesting, therefore earning more (Aneani et al, 2011; Hill, 1963). The low income indicated by most participants support other reports that these farmers are generally poor as they are paid for their crops at the end of the farming season (Teal et al, 2006). The results of this study indicates that participants tend to have larger family sizes as the family is a major source of labour on cocoa farms (Asuming-Brempong et al, 2006; Larson et al, 2005).

The high use of mobile phones compared to internet access facilities among the study participants suggests that the former could be used to promote ocular health education among the farmers. However, as most of the participants have a low educational attainment and could not read and write, it may be useful to utilize voice mails rather than text in such health promotion activities to enable an understanding of the messages that may be sent and hence be more effective.

In terms of the farm characteristics, the results indicate that most of the participants have spent a greater part of their active years in cocoa farming (23.1 SD ±12.5 years of farming). The findings that more males had spent a greater number of years in the cocoa farming industry than females ($p<0.001$) may be a reflection of the male dominance in the industry (Asuming-Brempong et al, 2006; Teal et al, 2006). Females usually follow their male counterparts after the initial strenuous farming activities have been completed and the cocoa farm has been established. Another possible reason is that females concentrate on food crops and family responsibilities, and return to cocoa farming later in life. Similarly, the finding that men spend significantly more hours on the farm than females ($p<0.001$) suggests that men were more able to bear the strenuous cocoa farming activities than females. It may also be a reflection of the traditional roles played by females, where they leave the farm early to return home and prepare meals while their male counterparts continue to work on the farm. Despite this, the results suggest that both males and females worked on the farm all year round.

The smaller farm sizes reported by participants in this study, with males working on relatively large farms ($p<0.001$), equally affirms the dominance of males in the industry and also confirms reports by Aneani et al (2011), Asuming-Brempong et al (2006) and Anim-Kwapong and Frimpong (2004) that cocoa farms are usually small, ranging from 0.4 to 4.0 acres. It is important to note that smaller farm sizes, inadequate and inappropriate use of fertilizers could have led to the lower number of cocoa bags produced by participants recorded in this study, as has also been reported by Aneani et al (2011) and Adeogun and Agbongiarhuoyi (2009). The participants were involved in most of the farming activities such as weeding, planting, harvesting among others. This could be attributed to the fact that farmers operated on smaller farm sizes and hence did not need to specialize in any of the farm activities. However, labourers are used for some specific activities such as pesticides application and during peak cocoa seasons mostly on larger farms.

7.2.2 Objective 1: To determine the prevalence of ocular conditions, refractive error and visual impairment among cocoa farmers.

The main ocular complaints reported by the participants were poor distance vision, itching/redness, poor near vision, pain and tearing. These were similar to other studies conducted among farm workers that reported symptoms such as itching, blurred vision and ocular pain (Verma, 2010; Quandt et al, 2008; Taylor et al, 2006a; Quandt et al, 2001a; Villarejo et al, 2000). For example, Quandt et al (2008) found that 22% of migrant farm workers in North Carolina reported fair or poor eyesight, 41% complained of eye pain or burning, 43% of redness and 25% of itching. Similarly, Villarejo et al (2000) reported 23% of irritated or itchy eyes and 12% blurred vision among agricultural workers in California. It must be noted that while some of these complaints compared favourably with the results in this study, others varied. For example, the prevalence of itching reported by Quandt et al (2008) and Villarejo et al (2000) compared favourably with the 19.3% found in this study. Although this study recorded a slightly lower prevalence of itching than the previous studies cited, this may be due to the differences in exposure to allergens between the categories of farmers due to seasonal variations and differences in environmental and biological factors. Similarly, Tanle et al (2011) reported a prevalence of 20.0% itching among palm kernel processors who are exposed to similar hazards faced by cocoa farmers. However, the 33.3% prevalence of blurred vision found in this study was higher than that reported by Quandt et al (2008) and Villarejo et al (2000). The differences in results could further widen if poor near vision is combined to that of poor distance vision in the current study. This is an indication that there is generally a poor perception of vision among participants in the current study than among farm workers in studies mentioned earlier.

It must, however, be noted that the frequency of symptoms reported among participants in this study were much higher than those reported in a normal Ghanaian population by Ocansey et al (2014). Similarly, more farmers reported eye symptoms in the current study than those reported by farm workers in North Carolina (Quandt et al, 2008). Other symptoms of eye sensitivity, irritation, foreign body sensation or gritty sensation found in this study have also been reported among farm workers in previous studies (Threlfall and English, 1999; Omoti et al, 2009; Quandt et al, 2001a; Taylor et al, 2006a). In spite of the numerous ocular complaints, one out of every two participants had never had an eye examination; a finding that is corroborated by earlier reports that use of eye care services is low among farmers (Quandt et al, 2012; Verma et al, 2011; Verma, 2010; Quandt et al, 2008).

Approximately one out of every four participants in this study reported the consumption of alcohol, while one out of every 10 used tobacco. The similar use of these social drugs among farmers has been reported in earlier studies (Muilerman, 2013; Van den Broucke and Colémont, 2011), and could have negative implications for the ocular health of the participants (Bartlett and Jaanus, 2001; Oshika, 1995). For example, if alcohol is abused just before or during work, it could lead to poor hand eye coordination and judgment, which could predispose farmers to ocular injuries. Alcohol intoxication could also result in double vision, poor tracking of moving objects, reduced visibility due to inexact fixation, and blurring of near objects related to compromised accommodation, which could be problematic in workers requiring fine vision for task performance (Pitts and Kleinstein, 1993). Consistent with the literature (Muilerman, 2013), males dominated ($p<0.001$) in the use of both alcohol and tobacco. While alcohol use during work may be directly linked to injury on the farm, smoking may have an indirect link to injury occurrence due to distractions (when smoking occurs while working), but it has been directly linked to an increased risk of nuclear opacities and the severity of lens opacities (Klein et al, 1993), especially following prolonged use, as was the case for most participants in this study who had smoked for 10 years and above.

a. General health status

Approximately one out of every three participants in this study indicated that their health was poor or very poor, a marked contrast from the good health conditions reported by Latino dairy workers (Baker and Chappelle, 2012). This may probably be due to the differences in the nature of work, work environments, levels of exposure to work related opportunities for injury, as well as, access to healthcare between the participants of the two studies. In spite of their poor perception of their general health status, most participants had never undergone a medical examination and hence were not aware of their health condition about important systemic conditions. This could have negative implications for their ocular health because systemic diseases such as diabetes, hypertension and HIV/AIDS can have detrimental effects on the eye (Kanski, 2009). Particular attention should be given to hypertension among the farmers, as nearly half had elevated blood pressures, with only 3.1% being aware of this condition, this having implications for their general, as well as, ocular health. It is important to note that hypertension has been recorded among other farming populations, with the awareness levels of the condition recorded in this study being lower than in others (Luque et al, 2012).

The large number of participants (82.7%) registered with the National Health Insurance Scheme (NHIS) is an indication of a wide coverage and acceptance of the health policy in the sampled population of 556 cocoa farmers, compared to the national coverage of 33.3% of 24.6 million Ghanaians (Gajate-Garrido and Owusu, 2013). However, there is a need for continuous education to enroll more people as reasons cited by the few (20%) for not registering with the scheme (never falling sick, lack of funds, among others) could be overcome through education. The percentage registered with the NHIS is higher than that reported by Ocansey et al (2014), who recorded a 60.6% coverage among a normal population in the Cape Coast Metropolitan area in the Central Region of Ghana. The variation could be because participants in the urban Cape Coast study could afford private health insurance and were therefore not registered with the NHIS, which is accessible mostly in government health facilities and few private facilities. Conversely, it could be due to low acceptance of the NHIS among the urban dwellers due to the variability in urban population dynamics (Gajate-Garrido and Owusu, 2013).

b. Preliminary ocular health assessment

One out of every five participants (20%) in this study had difficulty with convergence, which could be a reflection of the age distribution of participants as there is evidence of muscle weakness with increasing age (Bruenech et al, 2012).

The prevalence of ocular deviations in similar populations has rarely been reported. However, the rate found in this study compared favourably with other populations (Shimauti et al, 2012; Ovenseri-Obgomo and Assien, 2010). For example, in this study, exotropia was a problem among 2.3% and 2.2% in the near and distance respectively, while Ovenseri-Ogbomo and Assien (2010) reported 2.0% of exotropia in the Swedru district of the Central region of Ghana. In spite of the low prevalence of deviations, their association with reduced vision and visual efficiency highlights the need for early detection and management.

The prevalence of tear film instability among the population studied was high (45.2%) as compared to the general populations in earlier reports (Schaumberg et al, 2009; 2003; Schein et al, 1997). This may be attributed to the relatively older age of participants in this study, as a unit increase in age is 1.02 times more likely to influence the occurrence of tear film instability. Tear film instability is known to occur among the older generations (Sharma and Hindman, 2014). The occurrence of tear film instability could also be a function of the number of years participants have been involved in farming activities (OR: 1.01, 95% CI: 1.00-1.02; p=0.044). The longer a person has worked on a cocoa farm, the higher their exposure to hazards such as ultraviolet radiations, dust and chemicals (high ambient air pesticide concentrations in immediate farm areas) among others, which affects the anterior segment surface and could result in tear film instability (Luque et al, 2012; Sahai et al, 2005; Schaumberg et al, 2009; 2003).

c. Eye conditions: Anterior surface

Several eye disorders have been reported among agricultural workers (Luque et al, 2012). In the current study, anterior surface disorders diagnosed among participants were mainly preventable, having been exacerbated by long-term exposure to ultraviolet radiations, conditions including cataract and pterygia. Other work-related conditions included corneal scar/opacity and fungal keratitis due to injuries and infections. It is important to note that one out of every four participants was diagnosed with some form of cataract, confirming that this remains the leading cause of visual impairment in developing economies (Bastawrous et al, 2014; WHO, 2012b). This could also be a reflection of the relatively older population in this study coupled with the constant exposure to ultraviolet radiations due to the nature of their work, requiring them to be outdoor for most of their working life, as well as, exposure to chemical fumes (Boadi-Kusi et al, 2014; Kearney et al, 2013).

The prevalence of pterygium compared favourably with 23% of cases of pterygia recorded among North Carolina farm workers in telemedicine examinations in a population-based sample (Retzlaff and Hopewell, 1996). The prevalence of conjunctivitis found in this study was comparable to that reported by Verma (2010), but lower than that found in the Migrant Clinicians Network survey (Retzlaff and Hopewell, 1996), which reported a 42% prevalence of conjunctivitis in a farming population. The difference could be due to seasonal variations in which the two studies were conducted and also due to the current study being population-based one compared to the later which was a hospital-based study. The occurrence of fungal keratitis found in this study has also been highlighted in the literature among other agricultural workers (Geethakumari et al, 2011; Tilak et al, 2010; Bharathi et al, 2009; Kanski, 2009; Thylefors, 1992).

The results of this study suggest that more attention should be given to males during ocular health education in an effort to reduce the occurrence of anterior surface eye disorders since men were more prone to corneal opacities/scars (p=0.025) as a result of ocular injuries with resultant pupillary defects (p=0.038) when compared to their female counterparts. Similarly, a unit increase in age was 1.03 times (OR) more likely to influence the development of an anterior segment eye disorder. The association between age and the occurrence of eye disorders has been reported in the literature (Budenz et al, 2013). Therefore, ocular health educational campaigns should stress the need to adopt preventive measures to limit such disorders and reduce ocular discomforts in the field of work in the early periods of the working life of farmers.

d. Posterior segment

The major posterior segment disorders diagnosed among participants in this study were glaucoma and macular disorders. The results of this study suggest that males are more likely to develop macular disorders (p=0.014) and glaucoma (p=0.007) compared to females. These findings are consistent with the report by Budenz et al (2013), which indicate that glaucoma prevalence is higher among men in Ghana than women. However, Ntim-Amponsah et al (2004) found no gender difference in the occurrence of glaucoma in the Akuapim South district of Ghana. There is a need for public health awareness and education in this regard, as these diseases contribute significantly to the global burden of eye diseases and visual impairment (Zampatti et al, 2014; Lim et al, 2012).

The inverse relationship found between the use of chemicals (insecticides and fertilizers) and macular degeneration among the study population could be due to the low number of participants who were involved with heavy chemical use compared to fungicides applicators and pesticides workers reported by Kamel (2000) and Kirrane et al (2005) respectively. However, other known risk factors for the occurrence of macular degeneration, such as smoking, hypertension, alcohol consumption, obesity, sunlight exposure, and darker iris pigmentation were documented in the study population (Zampatti et al, 2014; Lim et al, 2012; Kirrane et al, 2005). Further investigations are needed among a larger group of heavy chemical users or applicators on cocoa farms, as some individuals (work gangs) have been trained solely for this task by the government of Ghana as part of their mass cocoa spraying programme (Abankwa et al, 2010; Asuming-Brempong et al, 2006).

The diagnosis of diabetic and hypertensive retinopathies among the study population, although similar to earlier reports (Quandt et al, 2008; Taylor et al, 2006a; Villarejo and Baron, 1999), is a reason for public health concern. These are indications of long-term systemic conditions that in most cases are not treated (as in the case of cocoa farmers in this study), and if being managed, patients are not referred for the necessary ocular health assessments. This calls for closer collaboration between health professionals to implement a good referral policy that incorporates eye care for patients with such systemic conditions, this having not been developed in Ghana.

Several factors were identified to be associated with the occurrence of posterior segment eye conditions. The unadjusted odds ratio indicated that age, alcohol consumption, tobacco use, years of farming, number of hours worked on the farm and use of agro chemicals were all associated with this disorder. However, the adjusted odds ratio indicates that a unit increase in age results in a 1.08 fold chance of developing a posterior segment disorder, with the tobacco use by participants resulting in a 2.64 times more likelihood ratio. These findings are supported by earlier reports in the literature (Cheng et al, 2000; Klein et al, 1993; Christen et al, 1992). There is the need therefore to highlight the work related activities that are associated with the occurrence of posterior segment disorders, as well as, the need to take precautions to mitigate their occurrence in ocular health education or interventions designed for cocoa farmers.

e. Visual impairment

Visual impairment presents a significant impediment to task performance among any working population, with 16.7% of the study population being moderately to severely visually impaired (MSVI). This population presents a significant injury threat or risk, as they are likely to injure themselves or their co-workers due to poor vision while working on the farm, which subsequently could also lead to loss of productivity (Myers et al, 2009). The injury could result from poor hand-eye coordination, poor judgement, poor depth perception and/or falls, which could affect not only the eye but other parts of the body as well. Few participants (4.9%)

were legally blind and yet continued to work on the farm. Most of the participants in this category admitted they had challenges going to work and undertaking their task, but were managing their way around the farm because they are familiar with their daily routine. Others indicated they were no longer involved in the most strenuous activities in the farm. Irrespective of the coping mechanisms adopted by these participants, they present a considerable risk to themselves and their co-workers on the farm (Quandt et al, 2008), for which reason they should be discouraged from undertaking any farm activities. They should be encouraged to find other means of survival that does not necessarily put their lives and that of others at risk.

The prevalence of visual impairment and blindness found in this study is higher than those reported in previous studies (Verma, 2010; Davila et al, 2009) in similar populations. For example, Davila et al (2009) reported a prevalence of 15.4% visual impairment in a group of farmers in the United States. A major reason for this difference could be due to the participants in the current study being older than those in the previous studies. This is supported by the positive association between age and visual impairment in this study (p=0.001), and as reported by other authors (Naidoo et al, 2014; WHO, 2007). It could also be related to the poor health seeking behaviour of participants, as the main causes of visual impairment in this study were mainly preventable or avoidable. Similarly, the prevalence of MSVI was higher than that (4.1%) reported for the West African sub-region by Naidoo et al (2014) and the (4.4%) in older Ghanaian patients (Guzek, 2005). However, the prevalence of visual impairment in this study compared favourably with the 17.1% findings in the Tema Eye Health survey in Ghana

(Budenz et al, 2012), an indication that the burden of visual impairment remains a challenge in the Ghanaian population, but may be higher among the workers such as farmers. The prevalence of blindness, however, was higher in the current study population than in the Tema eye health survey (Budenz, 2012). It is important to note that the posterior segment disorders identified in this study confirms the report by Bastawrous et al (2014) that apart from cataract, glaucoma, macular degeneration, diabetic and hypertensive retinopathies remain a significant cause of visual impairment in Sub-Saharan Africa.

The finding that males were more likely to be visually impaired contradicts several reports that females dominate in visual impairment (Khairallah et al, 2014; Naidoo et al, 2014; Mganga et al, 2011; Oduntan, 2005; WHO, 2007; Lewallen and Courtright, 2001), although Budenz et al (2012) confirms our findings. The contradictions may be due to the male dominance in the cocoa farming industry (Asuming-Brempong et al, 2006). However, Budenz et al (2012) reported similar results to this study (although the population dynamics was opposite to that of this study; male:39.7%, Female:60.3%) among participants who were 40 years and above. It is also important to note that the prevalence of legal blindness in this study population is higher than the national prevalence of 0.70% in Ghana (Oduntan, 2005; Moll et al, 1994), the 4.4% moderate to severe bilateral blindness reported in people 40 years and above in the Volta Region of Ghana (Guzek et al, 2005), and the 1.2% blindness rate reported by Budenz et al (2012) in the Tema Eye Health survey in Ghana. This call for a concerted effort by stakeholders in the agricultural and health industries to address the eye care needs of the cocoa farming population who contribute greatly to the growth of the Ghanaian economy but unfortunately may also be contributing to the national burden of blindness and visual impairment.

The major causes of visual impairment in this study (cataract, uncorrected refractive errors and posterior segment disorders mainly glaucoma, retinal and macular disorders) are consistent with reports by earlier studies (Boadi-Kusi et al, 2014; Naidoo et al, 2014; WHO, 2012b, WHO, 2007; Guzek et al, 2005; Moll et al, 1994). An assessment of the main causes of visual impairment reveals that most can be corrected or managed (Budenz et al, 2012; Moll et al, 1994). For example, cataracts can be managed through surgical intervention by ophthalmologists, while visual impairment from uncorrected refractive errors can be reversed by simple spectacle prescriptions (Naidoo et al, 2014; Budenz et al, 2013; Guzek et al, 2005). Similarly, most posterior segment disorders could be managed if identified earlier to avoid visual impairment or to slow down the progression of the diseases. It is worth mentioning that the rate of MSVI reduced by 7.4% following correction of refractive errors among the current study population. This gives credence to the fact that uncorrected refractive errors remain the leading and yet most preventable cause of visual impairment (Naidoo et al, 2014; Budenz et al, 2012; Pascaloni and Mariotti, 2010; Guzek et al, 2005).

The fourth leading cause of visual impairment among the study population was corneal opacity (non-trachomatous) due to injuries on the farm. The prevalence of corneal opacity (10.9%) as a cause of visual impairment found in this study is higher than those reported among the general population (Isawumi et al, 2014; Kumah et al, 2013; Guzek et al, 2005; Moll et al, 1994). Similar to the other causes of visual impairment in this study, work-related corneal opacities could be avoided if precautionary measures were adopted by the farmers. The fact that males, who dominate the industry, suffer significantly more from the various causes of impairment than females is a major concern, as it has serious implications for the sustainability of the cocoa industry and for the national economy.

The causes of visual impairment identified in this study prompt the need for a public health education program or intervention to inform participants about these causes and their implication for their health, as well as, their co-workers. Such an interventional campaign should highlight the fact that these causes are avoidable, treatable or preventable, provided the appropriate health interventions are sought or provided, and positive lifestyles are adopted.

f. Refractive errors

Refractive errors remain a major public health concern worldwide. However, refractive errors are often not corrected due to limited availability and low utilization of eye care services, poor uptake of spectacle prescription, and lack of funds, among others (Naidoo et al, 2014; Budenz et al, 2013; Ovenseri-Ogbomo and Assien, 2010). The situation leaves uncorrected refractive errors as one of the major causes of visual impairment and the second leading cause of avoidable blindness in the general population (Naidoo et al, 2014; Pascaloni and Mariotti; 2011; Ovenseri-Ogbomo and Assien, 2010). Among the participants in this study, 67.6% had some form of distance refractive errors with only 19 (5.1%) using their distance prescription at the time of the study. Most the them were hyperopic than myopic, a situation that could have contributed to the low use of distance correction as hyperopic patients tends to be less symptomatic. The high prevalence of refractive errors confirms the report by Retzlaff and Hopewell (1996) that refractive errors are a common eye problem among farmers.

The finding that there was no difference between the various sexes contradicts earlier reports that women dominate in uncorrected refractive errors due to poor access to eye care services and low income (Isawumi et al, 2014; Naidoo et al, 2014; He et al, 2012; Varma et al, 2004). It must however be noted, that age was found to be associated with refractive errors ($p<0.001$), as participants in the younger age groups had fewer uncorrected refractive errors compared to the older age groups, similar to reports in earlier studies (Isawumi et al, 2014; Naidoo et al, 2014; Budenz et al, 2012; WHO, 2007; Varma et al, 2004). Despite the high uncorrected refractive errors, the prevalence of spectacle use among the study population was lower among the study population although it was similar to the 5.1% reported among agricultural workers in North Carolina (Quandt et al, 2008). It is important to note that most of the participants (±90%) achieved a visual acuity of ≥6/18 after correction of their errors. There was also a 7.4% reduction in visual impairment following refraction. There is therefore the need to increase awareness on the uptake of refractive error services among the study population.

The prevalence of presbyopia found in this study (83.1%, CI: 79.7 - 86.1) is higher than that reported by Verma et al (2011) in a farming population. It is also higher than that reported in a normal population by He et al (2012) at seven international sites, excluding Madurai (country) and Durban (South Africa), which showed a prevalence of 83.0%, this being similar to the current study, and also compared favourably with a study by Sapkota et al (2012) in rural Nepal. However, the prevalence of presbyopia in the current study was also higher than the 77.0% found in Durban by Naidoo et al (2013). The high prevalence of presbyopia in this study may be due to an older age population than that reported in other studies (He et al, 2012). Refraction significantly improved the vision of participants at near (< 0.001, Exact McNemar test), and highlights the need for increased service delivery to rural areas and the need for a change in the attitudes of participants towards improved uptake of spectacle use. To achieve this, greater efforts will have to be made by eye care professionals, with support from government and stakeholders in the agricultural industry. In this regard, a national refractive error prevention strategy may be needed for agricultural workers' to help improve their quality of life. Such a policy should be geared towards improving uptake of spectacle wear, as only 24.5% of those with near visual impairment reported the use of near spectacles at the time of the study, whereas only 5.1% wore distance prescriptions. Similar health education should also address spectacles maintenance, as some participants reported poor use due to scratches.

g. Colour vision

Colour vision defects remain a challenge among most working populations that rely on colour discrimination (Pitts and Kleinstein, 1993). Although most of the participants were trichromats, participants reported that colour defects had an impact on their work, as they had difficulty harvesting matured cocoa pods, which can be identified by their colour. The occurrence of red-green and blue-yellow colour defects raised concern for the early screening and identification among farmers to make them aware of their condition so as not to waste cocoa pods when they are not matured for harvesting. Alternatively, farmers who are aware of their colour vision defects could ask for assistance during harvesting or avoid harvesting cocoa pods.

The high prevalence of red-green colour deficiency in the current study population could be due to the increased age of participants. Increase age is associated with eye diseases such as macular degeneration, glaucoma, diabetic retinopathy, among others. These conditions interfere with the retinal integrity and hence reduces the ability of the eye to identify certain colours. It could also be due to the occupational exposure chemicals among the participants (Rodrigues et al 2008). The high prevalence could also be attributed to the ability of the test instrument, HRR to detect both congenital and acquired colour defects. In spite of the high prevalence, the dominance of males with this defect is consistent with the literature (Feitosa-Santana et al 2008).

Colour vision was tested using the Hardy-Rand-Rittler (HRR) pseudo-isochromatic plate. The HRR pseudoisochromatic plate is capable of revealing both congenital and acquired defects as opposed to the Ishihara pseudoisochromatic plate which is only sensitive to congenital defects (Ryan, 2013). It must however, be noted that the HRR is not the most accurate instrument available for detecting colour vision defects as others such as the Farnsworth test has proved much more robust in classifying colour vision defects (Kim et al, 2014).

7.2.3 Objective 2: To determine the prevalence of ocular injuries among the cocoa farmers.

Work-related eye injuries and traumas remain a major cause of visual impairment and blindness (Shashikala et al, 2013; Thompson and Mollan, 2009; Xiang et al, 2005). Impairment from injuries limits farmers' abilities to perform specific tasks, which lead to loss of productivity (Myers et al, 2009). Agricultural workers are exposed to several ocular hazards that make agricultural work one of the riskiest occupation for the eye (Carrabba et al, 2012; Arcury et al, 2010; Liebman and Augustave, 2010; Quandt et al, 2008). Corroborating these suggestions, participants in the current study reported they are exposed to radiations from the sun, chemicals, dust, sand and stones and farm tools, as indicated in other studies (Quandt et al, 2012; Van den Broucke and Colémont, 2011; Verma et al, 2011, Quandt et al, 2008).

The crude prevalence of eye injuries among participants in the current study (n=143, 25.7%) was higher than the reported eye injuries (5.6%) among migrant farm workers in North Carolina (Quandt et al, 2012), the 3.3% among Latino farmers (NIOSH, 1995), the 8.4% among Iowa farmers (Sprince et al, 2008) and the 19.6% in farmers in a hospital based study in Ghana (Gyasi et al, 2007). However, it was lower than another hospital based study in Ethiopia, which reported a prevalence of 65% eye injuries among farmers (Addisu et al, 2011), and the 82.0% eye injuries reported among cocoa farmers in a recent report in Ghana (Muilerman, 2013).

The rate of eye injuries in this study with respect to worker years and lost work time was higher than the 23.8/10,000 worker years (95% CI: I7.5-55.9) loss work-time injury reported by Quandt et al (2012). The above findings represent a considerable difference in injury prevalence among cocoa farmers as opposed to other farmers in the United States and elsewhere. The lost work time due to ocular injury from agricultural activities, with its attended fewer lost workdays of restricted activities (3 days), is similar to the finding of studies reported in the literature (McCurdy et al, 2013).

The high prevalence of ocular injuries among cocoa farmers in this study may be due to the wide variety of ocular hazards they face in their daily activities on the farm, as well as, the high level of manual labour involved in cocoa farming (Shashikala et al, 2013; Verma et al, 2011; McCall et al, 2009). The prevalence of eye injury was however lower than the hospital based study in Ethiopia, which only reported cases at a health facility (Addisu et al, 2011). The difference between eye injury prevalence in the Ethiopian study and a similar population reported by Muilerman (2013) compared to the current study is probably due to differences in the definition of eye injury. Whereas the latter was not specific about what constituted eye injury, and included debris falling into the eye, the current study followed a specific definition that conforms to that in the literature (Thompson and Mollan, 2009; McCurdy and Carroll, 2000; McGwin et al, 2000).

Ocular injuries were a major cause of corneal/ opacity or scars in this study and led to three people going blind in one eye each. Blinding conditions among migrant farm workers in North Carolina was lower than that found in this study (Quandt et al, 2008), and underscores the severity of eye injuries on cocoa farms in Ghana. Attempts to address the high prevalence of ocular injuries among cocoa farmers should take into consideration the main causes and activities during which eye injuries took place, such as weeding, harvesting and chemical (pesticides) application. Ocular health education should therefore encourage farmers to use ocular protection in all activities that have the potential to cause ocular injury (Verma et al, 2011; Forst et al, 2006), other than only promoting the use of ocular protection during chemical or pesticides application among cocoa farmers (Tettey et al, 2009).

The major causes of ocular injuries in this study (plants/branches, chemicals, cocoa pod/husk and flying objects) is similar to other reports (Quandt et al, 2012; Quandt et al, 2008). It highlights the need to enforce the use of ocular protection in most of the activities undertaken on the farm, as injuries arising out of these causes, though diverse, can be prevented or avoided (Xiang et al, 2005). Injuries from chemicals in this study were about eight times higher than those reported by Quandt et al (2008) among North Carolina agricultural workers. The disparity may be due to the extensive use of chemicals among cocoa farmers in Ghana. In the light of this, promoting the use of goggles (Tettey et al, 2009) among farmers during the application of chemicals needs to be a priority.

The results of this study suggest that chemical shops provide an important resource for participants to assist in managing the ocular injuries sustained on the farm in rural communities. This is due to the chemical shops being situated within the communities in which farmers live and work, compared to hospitals or clinics that are usually situated several kilometers away. These shops could serve as a conduit for the provision of ocular first aid and subsequent referrals to the hospital/clinics for appropriate remedies. The farmers also reported the use of herbal medicine upon sustaining ocular injuries, this having been reported to be widespread in rural communities in Ghana (GSS, 2010). The prevalence of use of herbal medicine upon eye injury was also higher among farmers in this study than that reported among the general population in the Central Region of Ghana (Ocansey et al, 2014). In the absence of readily available clinics, the culture of using herbal medicine for a variety of problems is evident in many African countries (Eze et al, 2009). Late attendance to hospitals/clinics was evident in this study, a practice which must be discouraged in health promotion campaigns, as this could hinder efforts to save the injured eye from impairment or blindness.

Males were 1.93 times (OR) more likely to sustain ocular injuries compared to females, this having also been reported in several other studies (Chae et al, 2014; Shashikala et al, 2013; McCurdy et al, 2013; Shen et al, 2013; McCall et al, 2009; Xiang et al, 2005; 1999: Ferguson et al, 2005). The likely reason is the male dominance in this industry, with the work activities providing opportunities for injury (McCall et al, 2009; Koehler, 2001). Also the nature of the task that males are involved in differ from their female counterparts, hence the risk for ocular injuries.

Furthermore, the probability of an ocular injury occurring was greater for individuals working more hours (1.02 OR) on cocoa farms, similar to that reported by other authors in agricultural health studies (Chae et al, 2014; Shen et al, 2013; Maltais, 2007; Ferguson et al, 2005). An interesting finding in this study is the fact that participants who had poor perception of near vision had a higher probability (1.31 OR) of sustaining ocular injuries. This is an indication that negative perception could adversely influence hand eye coordination, among other consequences, which may lead to ocular injury.

Engagement in some farm activities predisposed farmers to ocular injury more than others (Van den Broucke and Colémont, 2011). For example, farmers who were directly involved in the application (spraying) of chemicals had a higher probability of sustaining eye injuries (OR 3.06, 1.77 - 5.23, p <0.001), whereas those who were engaged in harvesting of the cocoa pod had a likelihood of 2.63 fold (1.27 - 5.44, p=0.009) of sustaining ocular injuries. Work-related chemical injuries have been highlighted in the literature (Shashikala et al, 2013; Quandt et al, 2008) as have ocular injuries from harvesting crops (Quandt et al, 2012; Forst et al, 2006). There is therefore the need to highlight the influence of these farm activities in ocular health education among cocoa farmers in Ghana.

Other studies have suggested the influence of education and farm sizes on the occurrence of ocular injuries among farmers (Shen et al, 2013; Van den Broucke and Colémont, 2011; Adeogun and Agbongiarhuoyi, 2009; McCurdy and Carroll, 2000; Virtanen et al, 2003; Hoskin et al, 1988). However, this study did not find evidence to support this association, which was similar to the report by Quandt et al (2012). This may be due to the generally low levels of educational attainment in the current study, as well as the relatively small farm sizes worked on by the participants.

The demographic and farm characteristics associated with injury in this study are useful for identifying farmers at increased risk who could benefit from ocular health education or measures aimed at reducing ocular injury (McCurdy et al, 2013). Similarly, the wide range of exposures, tasks associated with ocular injuries, as well as the varied causes of injury confirm that a multifaceted approach is required in efforts aimed at reducing ocular injury in cocoa farms. The implication is that education alone may be insufficient to reduce agricultural injuries and illnesses, therefore alternatives preventive measures must be implemented (Calvert et al, 2012; Blanco-Muñoz and Lacasaña, 2011). It is important to note that these measures will be most effective when there is collaboration with governments and key stakeholders, such as the cocoa marketing companies, the Ghana Cocoa Board and Ghana health services as well as, the "active co-operation among producers, researchers and farm health and safety advocates" (Conway, 2010: 180).

7.2.4 Objective 3: To examine the use of protective eyewear among the cocoa farmers in Ghana.

Ocular protection is recommended for anyone who is exposed to ocular hazards at work, as nearly 90% of eye injuries can be avoided through the use of such protection (Quandt et al, 2012; Verma et al 2011; Verma, 2010; Quandt et al, 2008; Forst et al, 2006). The use of ocular protective devices is recommended for farming activities that have the potential of causing injury to the eye, such as spraying chemicals, cutting and grinding, weeding, pruning and harvesting (Tettey et al, 2009; Forst et al, 2006). However, among the participants in this study, few (n=34, 6.1%) reported the use of ocular protection in spite of the numerous ocular hazards they face while undertaking farm activities. Of the farmers (n=31, 91.2%) who reported the use of ocular protection, most used goggles occasionally (n= 28, 82.4%) during pesticide application.

The low use of ocular protection among the study population appears to be the trend among agricultural workers in the literature, as similar findings have been reported elsewhere (Kearney et al, 2013; Blanco-Muñoz and Lacasaña, 2011; Verma et al, 2011; Quandt et al, 2008; Forst et al, 2006; Quandt et al, 2001a). For example, Verma et al (2011) reported that only 8.3% of Latino farm workers in North Carolina used ocular protection, while in a similar Latino farm population, 8.9% were reported to use ocular protection (Quandt et al, 2008). Much lower prevalences of 2.0%, 1.6% and 0.6% were reported by Blanco-Muñoz and Lacasaña (2011), Quandt et al (2001a) and Forst et al (2006) respectively.

The findings in this study support the evidence that males, younger farm workers and those with higher educational attainment are more likely to use ocular protective devices (Quandt et al, 2012; Verma et al, 2011). Farmers involved in applying chemicals (pesticides and fertilizers) were also more likely to use ocular protection, which may be due to their perceived hazardous nature. However, there is the need to educate participants on other equally hazardous exposures that pose a threat to the eyes that require the use of ocular protection.

Several reasons have been put forward in the literature regarding the low use of ocular protection among farmers and farm workers. These include eye protection interfering with work, discomfort such as fogging, cosmetic, economic, misconceptions, ignorance of eye protective device, low education and training

(Verma et al, 2011; Quandt et al, 2008; Forst et al, 2006; Quandt et al, 2001a). Other reasons for the low use of ocular protection include the lack of awareness of the risks associated with farm activities and not being concerned about complying with instructions or policies on the use of such devices where they exist (Diamantopoulou, 2003). In this study, the main reasons cited for the low use of ocular protection were non-availability of appropriate devices, lack of funds, and ignorance or lack of training. In developed economies, barriers to use are mainly associated with the quality of protective devices that are used by most farmers (Quandt et al, 2012; Verma et al, 2011; Quandt et al, 2008; Forst et al, 2006), while in this study (developing economy), the barriers to use were related to supply, cost and poor education. However, few of the farmers cited reasons relating to quality of the product, such as fogging when one sweats and comfort, with anti-fog safety glasses being needed if this issue is to be overcome (Forst et al, 2006).

The above mentioned reasons indicate that it is important for public health optometrists to advocate for key stakeholders in the industry to supply protective eye devices among cocoa farmers (e.g. Ghana COCOBOD, Ministry of Food and Agriculutre). Such an advocacy should be complemented by a large-scale ocular health education initiative to increase awareness on the benefits of using ocular protection while working on cocoa farms. The educational messages should also deal with misconceptions about the use of such protective devices, such as "it prevents seeing well enough to do a job" and “co-workers will make fun of me", as these tend to reduce the use of such protective devices, leading to an increase in ocular injuries. The health and economic costs of such ocular injuries to the

Ghanaian economy, as well as, the individual and his family are considerable, as productivity and the quality of life are reduced (Pitts and Kleinstein, 1993).

Very few participants in this study reported using hats and sunglasses for ocular protection, these being indicated in studies elsewhere (Quandt et al, 2012; Verma et al, 2011; Schmid-Kubista et al, 2010). Ocular health education among the participants should stress that the use of such equipment does not guarantee adequate ocular protection (Pitts and Kleinstein, 2003; Good, 2001). At best, even though they reduce the amount of UV radiations entering the eye, but farmers could be injured by projectiles or any other hazards that hits the eye with a high impact (Wyman, 2000).

The low use of ocular protection coupled with the high level of eye injuries among the participants suggests the need for a deliberate ocular health policy to enforce the use of appropriate measures on cocoa farms. The policy should consider the provision of ocular protective devices to the farmers as part of their annual bonuses, as there is evidence that the provision of personal protective equipment (PPE) including ocular protection on a large scale increases its usage (Chatterjee et al, 2012; Lipscomb, 2010; Strong et al, 2008) and most participants highlighted the non-availability of a suitable product as a major barrier to protecting their eyes. However, it has also been reported that the knowledge, attitudes and beliefs of farmers influence the use of PPEs (Fiske and Earle-Richardson, 2013). Even if these devices were readily available in retail shops, there is little evidence that farmers will purchase them on their own, as it has been reported that demand for safety related products is low, especially when they are not novel (Fiske and Earle-

Richardson, 2013). The participants indicated that purchasing such devices on their own was a problem due to a lack of funds and a lack of awareness of their importance.

It is important to note that, "improving workers protection is multifaceted and requires effort from all stakeholders" (Leibman and Augustave, 2010:195). Therefore, there may be the need for the Ghana Cocoa Board to consider covering the cost of such devices through the bonuses of the farmers or providing them at no cost at the initial stages of a programme and the cost can be offloaded gradually to the farmers. This initiative is meant to increase the use of ocular protection among the farmers. This may be beneficial as most participants in this study indicated they will use the devices if they were provided at no cost to them by the government or made mandatory as reported by other authors (Verma et al, 2011). This is further supported by the assertion by Calvert et al (2012: 333) that "combining educational interventions with financial benefits appear to increase their effectiveness in reducing injury and illness". However, further studies are needed to establish the circumstances, other than the ones mentioned in this study that will motivate the use of ocular protective devices among farmers. It is anticipated that if farmers were made aware of the benefits of their use regarding preventing eye injuries and diseases, they would be more likely to use them (Fiske and Earle-Richardson, 2013). All these efforts should aim at promoting a safe and healthy agricultural workplace (Calvert et al, 2012).

Finally, the indication by most of the participants that they would use ocular protection if it was made mandatory highlights the need for an occupational health policy that caters for the needs of farmers (Amponsah-Tawiah and Dartey-Baah, 2011; Clarke, 2005). Such a policy must be a combination of the recommendations of the ILO Convention 184 on occupational health and safety for agricultural workers (ILO, 2001), and local policies which is expected to best solve their peculiar ocular health challenges.

7.2.5 Objective 4: To determine eye care seeking behaviour among cocoa farmers in Ghana.

A major impediment to the various efforts aimed at eliminating blindness across the globe is limited access to quality eye care services (Ntim -Amponsah et al, 2004), specifically in developing economies, where it has been reported that less than 10% of people receive appropriate eye care due to limited access (Holden, 2007). The barriers are varied and ranges from issues such as cost, transportation, fear of the doctor and attitude of hospital staff among others (Gyasi et al, 2007). Some of these barriers force people to seek alternative eye care that may include the use of traditional medicine (medicinal plants) and consultation with specialized traditional healers (Ocansey et al, 2014).

More than half of the participants had never seen an eye care professional in their life time. Similar findings has been reported by other authors (Quandt et al, 2012; Verma et al, 2011; Verma, 2010; Quandt et al, 2008; Quandt et al, 2001a; Villarejo et al, 2000). Quandt et al (2008) reported that over 38% of farm workers had never seen an eye care professional in their working life compared to the 52.4% found in this study. Villarejo et al (2000) reported that two-thirds of farm workers surveyed in California had never had an eye examination, as did Quandt et al

(2012) in a study in North Carolina. The main reasons for this situation were lack of funds and long travel distances to the hospital/clinics, the average being 19.2km, this being longer than the average distance travelled by rural dwellers to a health facility which is 16km in Ghana (Ocansey et al, 2014; Baker and Chappelle, 2012; Salisu and Prinz, 2009). The participants who reported having sought eye care in the year preceding this study (25.0%) compared favourably to the farming population in North Carolina (Quandt et al, 2008).

It is important to note that the eye care seeking behaviour in this study was limited to the 290 (52.4%) participants who experienced an eye episode in the year preceding the study to reduce the rate of recall bias. The major episodes experienced among the farmers in the preceding year were itching, redness and eye injury. These symptoms were more prominent among the cocoa farmers studied as compared to the findings among the urban population in Cape Coast, Ghana (Ocansey et al, 2014). These symptoms were reported to the hospitals/clinics mainly because they were considered sight threatening (Ocansey et al, 2014). It is important to note that no eye injury was reported among an urban Cape Coast population of Ghana. Hospital or clinic attendance among those who had eye episodes among the cocoa farmers was relatively higher than those reported among other farming populations (Quandt et al, 2012; Quandt et al, 2008) and in an urban population in Ghana (Ocansey et al, 2014). The most probable reason for the high hospital attendance among the cocoa farmers in this study may be due to the relatively older generation who are likely to seek eye care as age was positively associated with utilization of hospital/clinics.

The reasons cited as barriers to seeking eye care services among those who experienced eye episodes and did not utilize hospital facilities were include a lack of funds (low income), long distance to hospitals and clinics and long waiting time at the hospital or clinic, these being similar to those indicated by other agricultural workers (Verma, 2010; Quandt et al, 2008; Quandt et al, 2001a). However, lack of health insurance and limited access to transportation that featured prominently among farm workers in the United States (Verma, 2010; Quandt et al, 2008) were not mentioned as barriers among the participants in the current study.

The findings of the current study did not find any evidence to support a gender disparity in hospital or clinic utilization as reported in other studies (Naidoo et al, 2014, Ocansey et al, 2014). This may be due to most of the participants being registered with the NHIS, through which they can seek eye care. Similarly, the age structure of the participants could have influenced utilization of hospital/clinics, as a unit increase in age was positively associated with utilization of an eye facility (hospital/clinic). Increasing age is associated with the natural deterioration of vision and it is therefore likely to trigger an increase in the utilization of eye care facilities (Ocansey et al, 2013). Closely related to an increase in age is the perception of poor distance vision reported by participants, which was positively associated with the utilization of eye care facilities in this study. This could imply that participants were more worried about their distance vision than their near vision, a finding that corresponds to the high complaints of poor distance vision among participants in the current study. This study also found evidence to support the fact that being married was positively associated with the utilization of eye care services (hospitals/clinics), as reported by other authors (McNamara et al, 2013; Iwashyna and Christakis, 2003). This may be due to spousal influence.

Finally, the finding that being registered with the NHIS was the most significant factor positively influencing the use of eye care facilities gives credence to the relevance of the NHIS in the Ghanaian health care system. Once they have paid their annual registration fee (premium) to belong to the scheme at an approximate cost of US$7.0 to $10.0, insurance holders are able to access health care free, but need to pay for their own transport costs to the hospital facility (Gajate-Garrido and Owusua, 2013). There is the need to continuously educate farmers and rural dwellers on the benefits of this scheme to ensure that they maintain their membership, as this would address the reasons given by some participants for not accessing eye care services.

The findings in the current study suggest that local chemical shop attendants and traditional healers play a major role in delivering eye care services, as has been mentioned in earlier studies (Ocansey et al, 2014; Omolase et al, 2008; Poss et al, 2005). These practices may not constitute the best form of eye care and could have negative consequences for the vision of farmers (Arcury et al, 2010; Cathcart et al, 2008). As in the current study population, the Latino farm workers reported "using various traditional and home remedies to treat and prevent illness, including herbs, chlorine bleach, milk, and medicine purchased at small local stores" (Arcury et al, 2010: 5). Attendance at local chemical shops and traditional healing facilities in the current study was higher than those reported in an urban Ghanaian population (Ocansey et al, 2014). This may be due to the close proximity of these facilities to the communities in which participants live and work, as none cited distance as a barrier. It could also be due to the dominance of traditional healers in rural communities in Ghana (GSS, 2010) as well as, the low cost and fewer time constraints associated with visiting these facilities. Self-medication, including the use of breast milk in curing conjunctivitis, is also practiced among the population studied, as has been reported in other farming populations (Quandt and Arcury, 2001; Arcury et al, 2010). There is therefore the need to educate cocoa farmers on the harmful effects of inappropriate eye care seeking behaviour and treatment options.

7.3 PHASE 2: Ocular health intervention

This phase involved the administration of the pre-training questionnaire that investigated the participant's knowledge, perceptions and beliefs on ocular health and safety practices on the farm prior to an ocular health educational intervention. A post training assessment using the same questionnaire used in the pre-assessment was used to assess participants knowledge, perceptions and beliefs on ocular health and safety practices on the farm following the intervention as indicated in the chapter on methodology.

7.3.1 Demographic profile of participants and farm characteristics

Two hundred participants drawn from the previous sample in Phase 1 were involved in this phase of the study with males dominating, as is characteristic of many cash crop industries in developing countries (Aneani et al, 2011; Quandt et al, 2008; Asuming -Brempong et al, 2006; Teal et al, 2006). However, in the

AgSafe trainings in California, gender equality among participants was reported (Lee et al, 2010), most probably because participants enrolled in the study on their own. The mean age of the study population in the current study sample was 52.8 years (SD: ±12.0), and reflects a relatively older generation of cocoa farmers (Aneani et al, 2011; Asuming -Brempong et al, 2006). Over one-third of the participants had no formal education and only half had attained middle or junior high school, this being another characteristic of farmers in Ghana (Asuming - Brempong et al, 2006). There was no statistically significant difference between males and females in the number of years farmed and hours worked on the farm per week. The deviation from the general population selected from Phase 1 in this regard could be due to the smaller sample size in this phase of the study, as males generally work more hours than females. Nearly two-thirds of this population owned a mobile phone, a finding very relevant to ocular health education and promotion, as participants could be reached through such a medium.

7.3.2 Objective 5: To investigate the cocoa farmer's knowledge, perceptions, and beliefs on ocular health and safety practices.

Understanding what farmers know, believe and practice is crucial to develop effective training packages and interventions (Ahmad, 2006), as this helps to incorporate the participants' perspective into the educational intervention. The study therefore aimed at understanding the cocoa farmers' knowledge, perception and beliefs as captured under five main themes:

a. basic knowledge on eye health, hazards and safety
b. perceptions and beliefs,
c. injury and potential hazards,

d. ocular protection and

e. ocular first aid.

A five point likert-scale was chosen for this study (Kearney et al, 2013) as previous studies (Forst et al, 2004; Verma et al, 2011) that used dichotomized style of questions reported skewed agreement to questions, with participants providing socially accepted responses, and an inconsistency in the answers (Verma et al, 2011).

a. *Basic knowledge on eye health, hazards and safety*

The cocoa farmers had diverse opinions on basic eye health, hazards and safety, with great limitations in the effect of some hazards on eye health. An overwhelming majority of the participants agreed that eating green leafy vegetables and carrots rich in vitamins could helps maintain good eye health. In spite of this positive response, more than half of the participants disagreed or strongly disagreed that it was necessary for them to seek eye care at least once every two years, while many of the participants (69.5%) indicated they had no basic knowledge about the structure of the human eye. These findings suggest that farmers were less likely to seek eye care regularly (Quandt et al, 2012, Verma et al, 2011), and highlights the need for them to be educated on the basic structure and the devastating implications of sustaining injury to certain parts of the eye.

Participants also had a good knowledge about hazards on the farm that pose a challenge to their ocular health. This was evident in the fact that most participants agreed that excessive exposure to the sun's radiation could cause eye problems. Similarly, an overwhelming majority indicated that wind, dust and sand could cause eye problems, as reported among the Latino farm workers (Verma et al, 2011). To the contrary, most participants held the notion that early entry of sprayed farms cannot cause eye irritation (Blanco-Muñoz and Lacasaña, 2011; Strong et al, 2008; Salvatore et al, 2008), while more than half of the participants did not believe that exposure to the sun could cause cataracts, a finding similar to that reported by Verma et al (2011). Furthermore, while most of the participants indicated that smoking of tobacco has the potential of negatively affecting eye health, they did not believe same for alcohol consumption. These findings suggest the need for ocular health education among the farmers to increase awareness on the dangers posed by continuous exposure to the sun's radiations and to other hazards that have negative effects for the ocular health of farmers such as consumption of alcohol (Arcury et al, 2010).

b. *Perceptions and beliefs*

The perceptions and beliefs associated with risk behaviour among cocoa farmers on eye health can influence the occurrence of ocular injuries and diseases. Among the participants in this study, two-thirds believed that infections could be transmitted from plants to the eye and lead to a disease (Arcury et al, 2010). Similarly, nearly two-thirds believed that eye injuries are always avoidable or preventable while working on the farm. However, over half of the participants indicated that their chances of sustaining an eye injury at work on any given day were low. The number of those who indicated this was lower than that reported among Latino farm workers (81%) (Verma, 2010), an indication that only a few cocoa farmers perceived that the nature of their job predispose them to ocular injuries. However, the difference between those who reported that eye injuries are avoidable and those who indicated that their chances of sustaining an eye injury are low could be due to the fact that farmers may not perceive the ocular health risk associated with all jobs, as well as, susceptibility to ocular injuries to be equal, and may therefore not always use ocular protection (Verma et al, 2011; Forst et al, 2006). This position is supported by the fact that nearly half (47.5%) of the participants indicated that there are many jobs in agriculture where a worker does not need to wear ocular protection. However, the various causes of ocular injuries among the study population in the Phase 1 do not seem to support this assertion. Ocular protection should therefore be made mandatory for all such activities implicated in causing ocular injuries (Forst et al, 2006).

Another reported risky behaviour reported by participants is that nearly half of the farmers would risk injury to the eye to get more work done. Such a practice will obviously hinder efforts aimed at reducing the high rates of eye injuries among them. In spite of these negative perceptions, 91.5% believed that ocular injuries sustained as a result of these risky behaviours could be avoided through the use of ocular protection while working on the farm. This is an indication that with the right education and positive re-enforcement, participants are likely to accept and use ocular protection.

The perception of cocoa farmers on the occurrence of ocular injuries is also deeply rooted in some religious and cultural beliefs and misconceptions, as over two-thirds of the participants indicated that ocular injuries may be caused by the 'gods' if someone disobeyed them. This finding is similar to what some authors have referred to as "'Hispanic fatalism', in Mexico, the perception that individuals have little control over whether they develop injuries or die" (Blanco-Munoz and Lacasana, 2011: 124). This has also been reported as a reason for the low use of personal protective equipment (PPEs), their use being seen as a sign of weakness in a cultural context (Blanco-Munoz and Lacasana, 2011). Similarly, over two-thirds of the participants believed that wearing ocular protection would make them look funny. There is therefore the need to educate cocoa farmers on such negative perceptions, as they have considerable implications for the ocular health (injuries and diseases), especially as it relates to religion, culture and misconceptions. This is particularly important as farmers are less likely to prompt their colleagues or co-workers when they are seen to be engaging in risky behaviour, as reported by about half of the participants in the current and in other studies (Verma et al, 2011, Quandt et al, 2008).

c. *Injury and potential hazards*

The data suggests that the participants had good appreciation of the ocular hazards they faced on cocoa farms. For example, apart from chemicals and exposure to the sun reported earlier, most participants were aware that they could sustain ocular injuries from farm tools, branches of trees, vines, bushes and thorns, as well as, flying objects. Although participants agreed that there is potential for eye injury in all activities they undertake, more than half indicated that they were not well informed on prevention measures, which is similar to reports by Verma et al (2011). This suggests the need for ocular health education among cocoa farmers to increase their awareness on how to prevent ocular injuries.

d. *Ocular protection*

The study also assessed participants' perceptions about the use of protective eye wears, with most not being aware of ocular protections other than the 'traditional goggles'. This is an indication that farmers are most likely to purchase only goggles for all types of activities on the farm if they had the opportunity to do so. This confirms the type of ocular protection used by the farmers, with most reporting the use of goggles during spraying in Phase 1. However, it also represents the apparent lack of protective eyewear available, and the lack of education on the types of ocular protection available for use for various tasks on the farm.

Although few participants indicated that they would continue to use their old protective eyewear if they could not afford a new one, over half said that if their ocular protection got lost and they need to do a risky job, they would continue without protection if none was available. These represent an apparent lack of self-efficacy for avoiding risky behaviour (Verma et al, 2011). Hence, there is the need for an ocular health education addressing their continuous use of old and damaged protective eye wear as it could impair vision and lead to injury, as would undertaking a risky job without ocular protection. In spite of these risky behaviours, most participants indicated that there was the need to wear ocular protection when applying pesticides and other chemical, a finding consistent with earlier findings in this study (Phase 1) and as reported in the literature (Tettey et al, 2009). However, it is important to educate farmers not only to use ocular protection when using pesticides but for all other activities that have the potential of causing damage to their eyes (Forst et al, 2006).

Another misconception reported by more than half (62.5%) of the farmers, was the belief that spectacle wearers did not need any ocular protection while working in the farm. Similarly, 53.0% indicated that sunglasses offer protection to the eye when working on the farm. The need for ocular health education on these misconceptions is apparent, as spectacles and sunglasses do not offer ocular protection from most of the hazards experienced by cocoa farmers (Good, 2001; Wyman, 2000; Pitts and Kleinstein, 1993). At best, they may offer some level of protection again ultraviolet rays, depending on the material for manufacturing the lens (Kearney et al, 2013), as was agreed by most of the participants.

e. *Ocular first aid*

Participants' knowledge on ocular first aid may be very useful in maintaining the integrity of the eye upon sustaining an eye injury. While most of the participants indicated that they will first wash out their eye with water if they had sand or splash of chemicals in their eyes, nearly one-third indicated that they will do same if they got a cut or puncture in their eye with only a few (16.5%) disagreeing with the need to bandage the eye and seeing a physician. It is important to underscore the appropriateness of rinsing the eye out with water when affected by chemicals or sand (Verma et al, 2011; OSU, 2004). However, the same cannot be said if a cut or puncture is sustained or when a foreign body pierces the eye, as this could spill out the vitreous gel, as well as, damage other tissues of the eye, which could lead to a complete loss of the eye (Verma et al, 2011; MacCwin, 2005).

Rubbing the eyes with the bare hands when particles get into the eye seemed to be a common practice among the participants, as nearly two-thirds were in favour of such a practice. However, less than half were in favour of purchasing eye medications from local chemical shops, while more than half were in favour of using herbal medicines to treat eye injuries or diseases if they occurred. It is important to stress the harmful effect of such practices as in most cases they hinder patients reporting timeously to a health facility to seek appropriate intervention. This could further compound efforts to prevent blindness from such injuries and diseases. The use of herbal medicine could also be very detrimental to eye health (Ocansey et al, 2014), and should be discouraged as much as possible among the farming populations through ocular health education.

These findings provide useful insight into crafting ocular health educational messages for cocoa farmers in Ghana and elsewhere with similar practices. The inconsistencies found in some of the related responses could be due to the fact that participants provided more socially accepted responses rather than what they believe in or practice. However, the inconsistencies identified in this study were less than those found in the dichotomized questions used by Verma et al (2011) and Forst et al (2004). Therefore the limitations in the inconsistencies should be taken into consideration in applying the results to other populations. The inconsistencies could also be due to the lengthy nature of the questions used in assessing the knowledge of participants. Modification of the questionnaire to reduce the number of questions and areas accessed should be considered in future research endeavours.

In spite of the above, it is important to note that education alone cannot eliminate injuries and illnesses in agriculture (Calvert et al, 2012; Rautiainen et al, 2008), as farmers are usually aware of the ocular hazards they face on the farm, but are unwilling to amend their ways for several reasons, such as time constraints and lack of funds (Calvert et al, 2012; Thu et al, 1998). Combining education with other methods of disease and injury prevention as well as stakeholder involvement may prove to be more effective (Liebman and Augustave et al, 2010).

7.3.3 Objective 6: To develop an education training intervention to improve the cocoa farmers' knowledge on ocular health and safety practices.

According to Arcury et al (2010: 238) "designing appropriate occupational safety and health training for agricultural workers requires having an accurate knowledge of the occupational injuries and illnesses that agricultural workers experience", as well as, understanding of their perception and knowledge levels on ocular health and safety. The data on the perceptions, beliefs and knowledge levels, the ocular health and safety practices, as well as, the determined knowledge on the ocular health status and prevalence of eye injuries among the participants, provided a basis for developing an ocular health education manual for cocoa farmers. This was supplemented with information from the literature, as well as, inputs from key stakeholders in the cocoa industry through personal communications, as there is evidence that "community member input is essential to developing successful interventions" (Carrabba et al, 2012: 342). The major themes and deficiencies in the participants' responses were highlighted to ensure that they were well informed on issues affecting their ocular health.

The manual consisted of three main sections:

- Introduction: occupational health and safety in agriculture within the context of the ILO Convention No. 184 on Safety and Health in Agriculture 2001 (ILO, 2001), definitions of ocular hazards and risks, and a brief classification of ocular hazards.
- basic information for trainers: issues affecting the ocular health of cocoa farmers, the basic structure of the eye, potential ocular hazards and risk exposures in agriculture. The use, misconceptions and barriers to using ocular protection, common ocular conditions among farmers, ocular health seeking behaviour, perceived barriers to seeking eye care, as well as, how to handle ocular emergencies were also discussed. These were developed to equip trainers to adequately prepare themselves to undertake education interventions among farmers. It was also designed as a source of knowledge for farmers who could read, to whom copies were made available.

- simulation exercises: these were provided to enable participants to discuss and demonstrate the knowledge received through the training. Guidelines on preparations and materials needed for the training were provided to ensure that the training was well executed (Lee et al, 2010). An evaluation form was also attached to enable trainers to assess the knowledge gained and to obtain feedback in future from trainees to guide a periodic review of the training programme.

7.3.4 Objective 7: To implement a training intervention to improve the cocoa farmers' knowledge on ocular health and safety practices.

The training intervention was conducted among recruited participants as discussed in Chapter 5. The training was conducted in groups of 10 participants by the principal researcher using power point slides and other training materials outlined in the training manual.

The training was conducted in the local language common to participants to prevent any misunderstanding that could have negatively impacted on the outcome. It also helped to meet the diversity in the educational background of the participants, as some had no formal education (Arcury et al, 2010). Key words in the text were appropriately translated with the help of some faculty members of the Department of Ghanaian Languages in the University of Cape Coast. Therefore, the training was conducted in a "linguistically and literacy-appropriate" (Arcury et al, 2010: 237) context to improve the knowledge of participants on ocular safety and health among agricultural workers. The simulation questions were then administered to enable participants to recap the lessons learned from the training and to give them the opportunity to practice addressing a few ocular emergencies.

It is important to note that the training was conducted among farmers or employees and not employers. There is therefore the need to consider training for employers who generally have the purchasing power and make decisions regarding safety and health on the farm.

7.3.5 Objective 8: To establish changes in the cocoa farmers' knowledge, perceptions and beliefs on ocular health and safety practices.

The results of the study indicate that the educational intervention was successful at improving participants' perceptions, knowledge and beliefs on ocular safety and health issues in the farm. This was evident as participants significantly improved their general composite scores by 40 basis points following the training interventions from a pre- median score of 172 (IQR: 164 - 177.5) to 212 (IQR: 206 - 219.5, $p<0.001$, Wilcoxon sign rank test). Similar reports of improvements in the pre- and post-evaluation scores were reported earlier (Verma et al, 2011; Grzywacz et al, 2009, Forst et al, 2004). Although several enabling factors, including socio-cultural and religious beliefs and mode of delivery of the training, could have impacted on the training outcome, the only demographic factor that was significantly associated with the change in knowledge scores was education, as participants with high educational attainment were 1.45 times (95%CI: 1.12 - 1.87, $p = 0.005$) more likely to record a change in score than other participants. This is because participants with higher level of education found it much easier to grasp the lessons in the training.

The effectiveness of the training intervention in improving participants' knowledge could also be due to the appropriateness of the training materials, as they were culturally acceptable to participants (Carrabba et al, 2012; Carruth et al, 2010). This is supported by the assertion by Oakley et al (1995:311) that "health education that builds on an accurate understanding of the beliefs and knowledge about health of the target group is probably more effective than strategies which lack this foundation." Another probable reason is because the intervention was delivered by the researcher who understood the socio-economic and demographic dynamics of participants', and was also very involved in developing the manual. Furthermore, the training was done within the same communities in which the participants lived and worked which made it easier for participants to associate and identify with the training as locally developed and not imported from another country. Similarly, the inputs of the cocoa industry's key stakeholders such as purchasing clerks, chief cocoa farmers, regional and district managers in the cocoa industry, in the manual's development, may have contributed to the participants easily identifying with the project, contributing to its success.

The combination of methods used in the ocular health educational intervention in this study seemed to be efficient, and may have contributed to the success recorded. A combination of lectures, power point slides, simulation questions, discussions and hands on demonstrations was employed, which may have impacted on the different categories of persons who were involved in the study (Carrabba et al, 2012; Burke et al, 2006). Effective training goes beyond "handing out pamphlets, viewing videos, or lectures" (Lee et al, 2010:303), and is enhanced by practical experience, as employed in this study. Finally, the use of a local language common to all participants in the training and discussions may have impacted positively on the outcome of the training, as it offered participants the chance to fully comprehend the didactics and follow the lessons that were being passed, a situation which has been absent and hampered training modules used elsewhere (Lee et al, 2010).

In spite of the overall change in scores, there were some variations in the degree of change between the pre- and post-evaluation scores within the questionnaire. The section on perceptions and beliefs recorded the least variation between the pre-post evaluation scores, with only two basis points despite the change being significant ($p < 0.001$). The least variability was probably due to the beliefs associated with some of the questions, which are deeply rooted in religion and culture (Arcury et al, 2010). These could not be changed in just a single training session. Such cultural and religious beliefs have been acquired over years and have become part of the doctrines associated with the people who work and live in such rural and farming communities. According to Carruth et al (2010: 380) "these values and beliefs guide the thinking, decisions, and actions of people in a patterned way". Fewer variabilities were also found to be associated with some misconceptions that were held onto by farmers even after the training. There is therefore the need to modify the aspects that deal with misconceptions and beliefs in the manual, and much emphasis placed on it in subsequent training.

Although the section on ocular protection recorded the least pre-score, it also recorded the highest post evaluation score, with 12 basis points. This lowest pre-score on ocular protection give credence to the fact that participants were uninformed about the use of ocular protection, even though they were well aware of the ocular hazards associated with cocoa farming. The post-training evaluation on ocular protection indicated that participants were well informed on the use of ocular protection following the training intervention. However, because ocular protection equipment was not provided nor its compliance assessed in this study, there is the need to consider this in future research studies, although the findings of the current study indicate that the knowledge gain on use of ocular protection was substantial.

Similarly, the pre-evaluation scores on ocular first aid gave an indication that participants were initially less informed but improved significantly in their knowledge score under this section ($p < 0.001$). This may have been influenced by the hands-on demonstrations undertaken in the training, which helped participants to retain knowledge after the intervention. However, the translation of the knowledge gained into actual experiences on the farm when injury is sustained cannot be guaranteed, as this could not be assessed in this study.

Most participants indicated that the training was very beneficial and relevant to their work. They suggested that the training sessions be held at least three times a year to equip them with the relevant skills and knowledge that will enable them deal with the ocular health and safety challenges they face at work. The training intervention and manual has laid a foundation for developing comprehensive training modules and re-thinking the ocular health of cocoa farmers, as they constitute a crucial workforce in the Ghanaian economy. Efforts should therefore be made to bring issues on ocular health and safety to these farmers (Lee et al, 2010), as preventable and avoidable eye conditions and blindness are prevalent among them. However, until ocular safety training is institutionalized by occupational health regulations, it will be difficult to enforce such trainings, and only a few farmers may benefit from such packages, as funding remains a challenge. Similarly, the protective nature and benefits of the training will remain available to only a few farmers, and many more will remain unskilled and deprive the nation from the economic benefits derived from health training or interventions (Luque et al, 2012; Dzugan, 2010), as "being safe equates to being profitable" (Lee and Hair, 2011:233).

7.3.6 Objective 9: To finalise the ocular health and safety practices training manual for cocoa farmers.

The limitations of the training interventions following the post evaluation assessment and an analysis of the response patterns from the participants were used to modify the training manual **(Addendum).** This could be used to train cocoa farmers in Ghana and countries that rely on the services of cocoa farmers to build their national economies. There may be the need to use the manual for further training to facilitate periodic evaluation and modification (Lee and Hair, 2011) leading to a complete ocular health and safety module for cocoa farmers. The possibility of breaking the training into days rather than a single day's event should also be explored.

Finally, trainings on ocular health and safety should be encouraged among farmers, as it seeks to improve the quality of life and reduces the burden of eye diseases and injuries among them. They also reduce the burden on national economies through workers compensation claims, as a reduction in injuries and diseases reduces utilization of eye care services and insurance claims arising out of such work-related injuries (Amponsah-Tawiah and Dartey-Baah, 2011). Trainings also ensure that the workplace is safe for farmers to undertake their activities. This is essential, as a country whose workplaces are without efficient policy to ensure the health and safety of its workers is likely to experience economic loss (Rantanen, 1994). Further, this has social responsibility implications.

7.3.7 Summary

The findings of this study indicate that several hazards exist on cocoa farms that threaten the ocular health of cocoa farmers in Ghana leading to high rates of ocular injuries and work-related eye diseases. In spite of these injuries, the use of ocular protection is low among cocoa farmers, although there are several barriers to the use of such ocular protective devices. Similarly, utilization of appropriate eye care services is low within the population studied, and farmers use alternative forms of eye care, such as local chemical stores and consulting herbalists or using herbal medicines.

Participants also had relatively low levels of knowledge on ocular health and safety issues, as well as varying perceptions and beliefs on ocular health and safety, and ocular first aid. However, they showed signs of improvement in knowledge scores following an intervention using a training manual developed for that purpose. The ocular health and safety training manual, the first of its kind in Ghana, is therefore recommended for use for further trainings and health education among cocoa farmers. This will facilitate the development of a complete training module for trainers and farmers within the cocoa industry in Ghana and in other countries whose economy relies on the cocoa industry.

CHAPTER 8: CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

There is little documentation on the eye health of agricultural workers, specifically cocoa farmers in Ghana. The few studies (Muilerman, 2013; Anim-Kwapong and Frimpong, 2004) that have been conducted reported broad perspectives on eye irritations, undefined eye injuries and use of personal protective equipment; and often have been part of some general studies. As a result, the magnitude and characteristics of eye diseases, eye injuries, ocular safety practices, ocular health seeking behaviour, as well as, the perceptions and risk beliefs on eye health among cocoa farmers were not known. In addition, no occupational health policies have been developed to guide the activities of farm workers, specifically cocoa farmers. As a result, the extent of their knowledge and practice about good eye care is unknown.

The absence of this information makes it difficult to develop training interventions that address their specific needs, and to therefore improve their knowledge about eye health and safety. The role of occupational and environmental health optometrists in this regards is crucial. The aim of this study was to understand the factors that affect the ocular health of cocoa farmers in Ghana in order to improve their ocular health status and knowledge on ocular health and safety practices through a training intervention.

8.2 Conclusions from findings

The findings from this study indicate that males dominate in the cocoa industry (64.6%) as reported in the literature. The industry is made up of relatively older generation of farmers with a mean age of 54.9 years (± 11.2), while educational attainment was very low among the study participants. Most of the participants had low annual income, with males earning higher than females. The results indicate that most of the participants have spent a greater part of their active years in cocoa farming (23.1 SD ±12.5 years of farming). Males had spent more years in the cocoa farming industry than females ($p<0.001$) and also spent more hours on the farm than females ($p<0.001$). Participants generally worked on smaller farm sizes with males working on relatively large farms ($p<0.001$) and were involved in most of the farming activities such as weeding, planting, harvesting among other.

With respect to Objective 1, the extent and nature of ocular conditions, refractive error and visual impairment among cocoa farmers in Ghana, participants reported poor distance and near vision, itching/redness, pain and tearing as major complaints. Anterior surface disorders diagnosed among participants were mainly preventable. Those exacerbated by long-term exposure to ultraviolet radiations and work-related conditions included pterygia, corneal scars/opacities and fungal keratitis due to either injuries or infection. Allergic conjunctivitis, entropion/ectropion, pupillary disorders and band kerathopathy were also found. Age was significantly associated with the occurrence of anterior segment disorders. The major posterior segment disorders diagnosed among participants in this study were cataracts, glaucoma and macular disorders. Diabetic and hypertensive retinopathies which are systemic disease related were also observed amongst others in the study population. The occurrence of most posterior segment diseases were significantly associated with age, use of alcohol and tobacco, years of farming and number of hours spent on the farm.

Similarly, in addressing the last two items under Objective 1, moderate and severe visual impairment (MSVI) was a challenge among 16.7% of the population studied, while 4.9% were legally blind. This was mainly due to cataracts, uncorrected refractive errors and posterior segment disorders, primarily glaucoma, retinal and macular disorders. Uncorrected refractive errors remain a major challenge among the study population, being recorded among 67.6% of the participants, with only 5.1% using their distance prescription. The rate of MSVI reduced by 7.4% following correction of refractive errors among our study population. Presbyopia was also a challenge among 83.1% (CI:79.7 - 86.1) of the participants, with 24.5% reporting the use of near vision spectacles.

Objective 2 sought to determine the prevalence of ocular injuries among the cocoa farmers. The rate of eye injuries in this study was 143/12 854.5 worker years or 11.3/1 000 worker years (95% CI: 9.4-31.0), which led to a lost work time injuries of 137 injuries/ 12 854.5 worker years or 37.3/1000 worker years (95% CI: 34.1-40.8). The injuries were mainly caused by plants/branches, chemicals, cocoa pod/husk and flying objects, and occurred during weeding, harvesting cocoa pods and spraying with chemicals. The findings of this study indicated that male participants, those who had poor perception about near vision as well as those who were involved in the application of chemicals, were more likely to sustain ocular injuries.

The study found a low use (6.1%) of ocular protection among cocoa farmers under Objective 3, which sought to examine the use and barriers to utilization of protective eyewear among the cocoa farmers. The few who reported using ocular protection, used it mainly during the application of chemicals (pesticides). Chemical application was the most predictive factor influencing the use of ocular protection among the farmers though age (younger groups) and higher educational attainments were also contributing factors. In this study, major reasons cited for the infrequent use of ocular protection were non- availability of ocular protective devices, lack of funds, ignorance or lack of training. Few of the farmers cited reasons relating to quality of the product such as fogging when one sweats and comfort as barriers to use of ocular protection.

With respect to Objective 4, to determine eye care seeking behaviour among cocoa farmers in Ghana, more than half of the participants had never consulted an eye care professional in their life time. The reasons cited as barriers to seeking eye care services among those who experienced eye episodes and did not utilize hospital facilities included a lack of funds (low income), long distance to hospitals and clinics, and long waiting times to see clinic staff. The findings based on the odds ratio, suggest that males were 1.4 times more likely to visit the eye clinic or utilize a hospital facility. This study also found evidence to support the fact that being married was positively associated with the utilization of eye care services (hospitals/clinics). Registration with the NHIS was the most significant factor positively influencing the use eye care facilities. The results suggest that local chemical shop attendants and traditional healers be informed and appropriately trained as they play major role in the delivery of eye care to cocoa farmers.

In addressing Objective 5, to investigate the cocoa farmer’s knowledge, perceptions, and beliefs on ocular health and safety practices, participants reported good knowledge on basic eye health, hazards and safety. In spite of this, two-thirds admitted they had no knowledge of the basic structure of the eye and did not agree to having their eyes checked at least once every two years. Although participants had good knowledge of ocular hazards they face on the farm they had limitation on the effects of these hazards on eye health. For example, two-thirds did not believe that continuous exposure to the sun's radiation could lead to cataract formation. Participants had diverse perceptions and beliefs on ocular health and safety, with religious beliefs and misconceptions playing a central role. For example, over two-thirds indicated that ocular injuries may be caused by the "gods" if someone disobeyed them, while a similar proportion believed that wearing ocular protection would make them look funny.

Considering other issues under Objective 5, risky behaviour related to ocular health and safety was recorded among the study participants. However, most were not aware of the existence of ocular protection other than the "traditional goggles". Risky behaviour relating to the use of ocular protection was also indicated among participants. For example, over two-thirds would continue with a risky task even if their ocular protection was lost or not available. Most participants underscored the need for ocular protection use in preserving their ocular injuries while working on the farm, although nearly two-thirds indicated that eye protection was not necessary if one was wearing spectacles. Finally, participants had fair knowledge of ocular first aid, although they believed in some dangerous practices such as washing the eye with water if a cut or puncture was experienced in the eye, and using herbal medicine when an injury is sustained.

A training manual was developed to meet Objective 6, which sought to develop an education training intervention to improve their knowledge on ocular health and safety practices. The implementation of the training manual under Objective 7, which sought to implement a training intervention to improve the cocoa farmers knowledge on ocular health and safety practices, proved to be effective in improving the knowledge scores of participants on ocular health and safety in agriculture. This was evident in the overall 40 points change in knowledge score from a pre- median score of 172 (IQR: 164 - 177.5) to 212 (IQR: 206 - 219.5) following the pre- and post-evaluation of the training intervention under Objective 8. This training aimed to establish changes in the cocoa farmers knowledge, perceptions and beliefs on ocular health and safety practices. Higher educational attainment was found to be positively associated with change in knowledge scores, although factors such as socio-cultural and religious beliefs may have played a role. The training manual, which was modified following the pre- and post-evaluation under Objective 9, to finalise the ocular health and safety practices training manual for cocoa farmers, is recommended for use among cocoa farmers in Ghana to provide information both for trainers and farmers alike.

The findings in this study, compared favourably with other studies in the literature although there were some variations due to the peculiar nature of the cocoa farming industry in Ghana. This study gives credence to the Occupational Safety and Health in the workplace model, which recognizes work organizations, work conditions and occupational health and safety systems in the workplace that interacts with individual workers to influence vision, safety and health outcomes. Similarly, as propounded by the Health Belief Model, the perceptions and beliefs on ocular health and safety of participants were related to the ocular health and safety practices, which participants are engaged in on the farm. The barriers to seeking eye care and utilization of ocular protection also provided a basis to enhance the understanding of the health seeking behaviour and ocular safety measures adopted by participants.

8.3 Study strengths and limitations

Undertaking a comprehensive eye examination was a major strength of this study, as most agricultural health studies have concentrated either on hospital records or self-reported eye injuries and symptoms through the use of questionnaires (Quandt et al, 2012; Verma et al, 2011; Verma, 2010; Quandt et al, 2001a). Combining both survey and clinical data enabled the presentation of a more accurate and fair report on the complaints and diseases of participants compared to studies that reported findings using only one method (Luque et al, 2012). The study sample was from different regions and districts in Ghana, and could be considered a fair representation of cocoa farmers in Ghana. The combination of several approaches to achieve active participation among trainees and change in knowledge scores was also seen as a major strength of this study. The training conducted with the manual is the first ever documented ocular health and safety training among cocoa farmers in Ghana.

What is already known on these subjects

1. Cocoa farmers are exposed to numerous ocular hazards.
2. Although there are challenges with the definitions of ocular injuries, it is believed that the rate of eye injury and irritation are high among cocoa farmers.
3. Ocular symptoms and disorders may be common among cocoa farmers

What this study adds

1. Confirmed that eye diseases (anterior and posterior segments) are common among the study population. These diseases are influenced by both socio-demographic and farm characteristics of participants.
2. Refractive errors, visual impairments and blindness are high among cocoa farmers in Ghana. The major causes are cataract, uncorrected refractive errors, posterior segment disorders and cornea opacities.
3. The rate of ocular injuries was high among cocoa farmers (143/12 854.5 worker years or 11.3/1 000 worker years (95% CI 9.4, 31.0), while the rate of lost work time injuries was 137 injuries/12 854.5 worker years or 37.3/1000 worker years (95% CI: 34.1, 40.8). The ocular injuries are associated with the nature of farm work farmers are engaged in such as weeding, harvesting and chemical application. Similarly, the injuries are influenced by demographic and farm characteristics such as sex, hours worked per week, and chemical application.
4. The use of protective eye wear (PEW) is low (6.1%) among cocoa farmers in Ghana, however, being male, young and of higher educational attainment was associated with higher odds of PEW use. Also, the perception of good

distance vision and application of fertilizer and pesticides were associated with higher odds of PEW utilisation.

5. Barriers to the use of PEW among cocoa farmers include non-availability of devices, lack of funds and ignorance/lack of training.
6. Farmers make insufficient use of eye care facilities as only one out of every four participant sought eye care annually. Being registered with the National Health Insurance Scheme (NHIS), positively influenced the utilization of eye care facilities in hospitals. Farmers make use of alternative eye care services such as visiting the pharmacy/chemists, consulting herbalists, using herbal medicines (self-medication) among others.
7. Cocoa farmers are engaged in risky behaviour on the farm that predispose them to poor ocular health outcomes.
8. Farmers have varied perceptions on farm practices with implications for ocular health and safety. Some of these perceptions and practices are rooted in cultural and religious beliefs.
9. The study highlights the importance of ocular health education among cocoa farmers in Ghana, and the need to enact an occupational health policy for agricultural workers.
10. An ocular health and safety educational manual to be used for training intervention among cocoa farmers evolved out of this study.

In spite of the above strengths, the study had some limitations. As with many other agricultural health surveys (Quandt et al, 2012; Verma et al, 2011; Quandt et al, 2001a), eye injury was based on self-reports, which could potentially have introduced an element of recall bias. However, this was managed by limiting the period of injury report to one year prior to this study. A follow up at the hospitals where such injuries were reported could not be done to ascertain the diagnosis that were made, as that was outside the scope of this study. In addition, many people did not report to hospitals, which means that there would not have been any documented verification or proof of their diagnosis and management.

Since there was no control group, one could argue that the observed changes after the training could be due to other factors. However, the changes observed could largely be attributed to the training intervention. This is based on the fact that none of the participants had undergone such a training prior to our intervention and neither did they undergo any such training within the duration after the training and the time the post training data was collected since such interventions do not exist among the study population.

Similarly, the true impact of the ocular safety and health training on the job (objective) could not be ascertained, as monitoring the workers on the job was not practical, given that they worked on different farms across the selected districts. Furthermore, as no physical interventions such as goggles and safety glasses or first aid boxes were provided, the actual change in attitude in this regard and its impact in reducing the occurrence of ocular injuries could not be ascertained. The low education level of the participants did not favour objective assessment. Although the results could have been influenced by participant's desire to demonstrate the expected change, they were not explicitly informed of the outcome and the need to demonstrate a change. Hence, the influence of the desire to demonstrate a change if any, was minimal. Further studies will therefore be needed in this area among cocoa farmers.

The post training data measured in this study satisfied a change in knowledge with the short term. Interpretation of the results of the training results, should take this into consideration. The attrition rate in the change in knowledge in the medium to long term could reduce the margin of change in knowledge recorded in the short term.

8.4 Recommendations

The findings from this study, prompts the need for broader consultations and collaboration among stakeholders (Government of Ghana, Ghana COCOBOD, Ministry of Health, Ministry of Food and Agriculture, Cocoa Marketing Companies, etc) to work towards improving the ocular health of cocoa farmers, as they are afflicted with avoidable eye conditions and injuries due to the nature of their work. Such collaborations should aim at improving access to eye care facilities to the farmers by locating health clinics with, appropriate eye care professionals within the communities in which farmers live.

Eye health professionals need to be encouraged to extend outreach services to rural communities where these farmers live. Similarly, there is the need to increase education and awareness on eye conditions that affect these farmers and provide advice on precautionary measures to limit or prevent their occurrence. The educational campaigns should also aim at improving the uptake of proper eye care services and interventions that may be provided as a result. It is recommended that programmes be developed to provide eye care services and education to cocoa farmers to enhance their quality of life. In light of the above, the training manual on ocular health developed and used in this study needs to be adapted for use by agricultural extension officers who can convey information as part of their routine activities.

Similarly, there is the need for government to enact an occupational health policy for agricultural workers, as stipulated by the ILO Convention 184 on occupational health for agricultural workers to which Ghana is a signatory. However, such a policy must place emphasis on the ocular health and safety of farmers following the high prevalence of ocular injuries and eye diseases among cocoa farmers, as found in this study. It should seek to enforce the use of ocular protection by farmers while working on cocoa farms and also give clear guidelines on the supply of ocular protection to farmers. Guidelines for tracking, reporting and validating agricultural related ocular injuries and diseases should also be considered. This will assist in proper planning of interventional strategies to reduce the occurrence of eye injuries and dieases among agricultural workers.

It is also important for cocoa farmers to take charge of their own ocular health, as they remain a key component of any interventions that may be implemented among them. For example, it will be difficult to change the lifestyle and risk behaviour if farmers continue to use remedies based on religious and cultural beliefs or refuse to seek appropriate eye care once the relevant eye care services are provided.

The following suggestions are made for consideration in future research studies in this area:

- include farmers' perspectives on the effect of the absence of any regulatory policy for agricultural workers on their work and the absence of any enforceable laws on ocular protection.
- evaluate the effect of atmospheric concentration of pesticides on the eye following pesticides application on cocoa farms.
- estimate the economic cost of ocular injuries sustained on cocoa farms and other work related eye diseases to enable employers and government to fully appreciate the burden of such eye conditions to the national economy.
- evaluate the levels of ocular hazards and exposure during the main and off cocoa farming seasons to ensure that appropriate measures are adopted to deal with them.

8.5 Significance of the study

This study sought to understand issues affecting the ocular health of cocoa farmers in Ghana. The documentation of the ocular health status of cocoa farmers, as well as, the visual hazards and ocular injuries on cocoa farms has provided evidence which could be used for making informed decisions on providing quality eye care for cocoa farmers.

The study has also provided an understanding of the relationship between the nature of work of cocoa farmers and the type of eye diseases and injuries they suffer from. The information provided could guide the formulation of a health policy in promoting good ocular health and safety practices among cocoa farmers and workers. This will help employers and governments to maximize the profits gained from this group of workers, and to work towards reducing the economic losses made through eye injuries and diseases due to farmwork among cocoa farmers.

Finally, an understanding of the knowledge, perceptions and risk beliefs on ocular health and safety among cocoa farmers has provided useful information to enable an understanding of the attitudes of farmers regarding ocular health and safety in agriculture. The evidence that there is an improvement in the knowledge gained following an interventional training provides a basis for sustained efforts to educate farmers on the need to protect the eye and prevent needless avoidable injuries, diseases and blindness.

8.6 Conclusion

This study has provided evidence that visual hazards on cocoa farms are considerable, and the burden of eye diseases and injuries remain a major challenge to cocoa farmers in Ghana. In spite of this burden, preventive measures adopted by these farmers, including the use of ocular protection and utilization of appropriate eye care services, are limited. However, the study showed evidence of improved knowledge among participants on ocular health and safety following a training intervention.

As asserted by Segerist cited in Abbrams (2001:72), *"The doctor of the future will not wait for his fellow men to become sick but will teach them how to remain in good health and will be with them in the factories, on the farms, in offices, wherever people live and work and are exposed to illness and injury."* It is therefore essential that in the face of the evidence provided in this study, eye care professionals, including optometrists and ophthalmologists, take steps to reduce the burden of visual disorders faced by workers such as cocoa farmers among those who already have disease conditions, and to educate those without the diseases to reduce or prevent their occurrence.

This study has provided evidence to fill the gaps in knowledge on issues relating to the ocular health of cocoa farmers in Ghana, particularly as it relates to eye diseases, refractive errors, visual impairments, blindness and ocular injuries. The study also underscores the relevance of improved eye care delivery services to cocoa farmers as it has the potential to improve their vision and subsequently improve their quality of life. Finally, the study provided evidence that health promotion could impact on the knowledge of participants on ocular health and safety. This must be a continued activity to improve the gains obtained from such ocular health promotions/interventions among workers who sustain the economy of nations.

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Appendices

Appendix I: INFORMATION DOCUMENT

UNIVERSITY OF KWAZULU-NATAL™
INYUVESI YAKWAZULU-NATALI

Date:………………………….

Good day participant,

My name is Dr. **Samuel Bert Boadi -Kusi** from Discipline of Optometry, School of Health Sciences, University of KwaZulu- Natal (UKZN), South Africa. My telephone number is **020-8752876** and my email address is **sbertk@yahoo.com**

You are being invited to consider participating in a research study on the topic **"Ocular health of cocoa farmers in Ghana: an assessment and intervention study"**.

Purpose of the study

The aim of this research study is to **evaluate the ocular health status and ocular safety practices among cocoa farmers in Ghana**. The study is expected to enrol about 576 participants from four districts within the cocoa regions demarcated by the Ghana Cocoa Board. About 150 participants will be recruited from each of the districts.

Procedure

The study will involve the following procedures.

- the administration of a questionnaire (3 different periods).
- a comprehensive eye examination.
- training on ocular health and safety practices.

Duration

The duration of your participation if you choose to enrol and remain in the study is expected to be a maximum of 5 days; administration of the main questionnaire a would last for 45 - 60 minutes while the eye examination will also last for a maximum period of about 60 minutes. A maximum of 5 hours will be used for the ocular safety training while the pre and post training assessment of knowledge, attitudes and perceptions on ocular health and safety practices will last for a maximum period of 40 minutes each. Each of the procedures will take place on separate days. You will be contacted six weeks after the training intervention by a member of the research team for the post assessment interview.

Benefits

In this study, your eyes will be fully examined and this will help you to know and understand the status of your eye and vision.

Risks

All the procedures involved in the eye examination are non-invasive and will not cause any harm to your eyes. In order to have your eyes properly examined, some eye drops will be instilled in your eyes. You are assured that all the necessary precautions will be taken to ensure that there are no adverse effects from the instillation of these eye drops on you. The instillation of these drops and the techniques performed with them are within the scope of optometry, and for which the researcher is suitably qualified. All other procedures in the eye examination will pose minimal or no risk to your health since they are standard procedures you will go through if you visited an eye clinic.

Costs

You will be given eye medications and spectacles if required after the eye assessment at no cost to you. You are however, entitled to choose other forms of treatment other than what the researcher will provide at your own expense. You will also be referred to an appropriate eyecare facility should there be the need. You will be expected to cover the costs for transportation to and from your home to the referred eye facility. The cost of consultation and medication arising out of this referral will be free if you are registered with the National Health Insurance Scheme, otherwise, you will be expected to cover these costs.

This study has been ethically reviewed and approved by the UKZN Biomedical research Ethics Committee (approval number BE: 201/13) and the Ghana Health Service Ethics Committee (GHS-ERC-02/09/13).

In the event of any problems or concerns/questions you may contact the researcher at the **Department of Optometry, University of Cape Coast, Cape Coast, Ghana,** and the UKZN Biomedical Research Ethics Committee or the Supervisor, contact details as follows:

BIOMEDICAL RESEARCH ETHICS ADMINISTRATION

Research Office, Westville CampusGovan Mbeki Building

Private Bag X 54001

Durban 4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604769 - Fax: 27 31 2604609

Email: BREC@ukzn.ac.za

SUPERVISOR'S DETAILS

Dr R Hansraj

Discipline of Optometry

School of Health Sciences

University of KwaZulu-Natal

Durban, 4000 - South Africa

Tel: (031) 2607089

Email: hansrajr@ukzn.ac.za

Participation in this research is voluntary and you may withdraw at any point. You will not be penalized should you decide to withdraw. However, you will not be entitled to any treatment options should you withdraw before the entire procedures involved in the comprehensive eye examination are completed since we may not have arrived at any diagnosis. However, if you decide to withdraw on your own, kindly inform the researcher via phone or in person.

You are assured that you will not incur any cost by participating in this study. If you have to travel to the site of the eye examination centre, your transportation fee will be paid to you.

Confidentiality

All personal and clinical information obtained about you in this research will be kept confidential. Your data will only be known to people involved in this study. Your name will not be revealed or used in any reports. The questionnaires and other clinical information will be shredded 5 years after the completion of this study.

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

Appendix II: CONSENT FORM

I ……………………………………………………………………… have been informed about the study on the topic, "Ocular health assessment of cocoa farmers in Ghana" by Dr. Samuel Bert Boadi -Kusi.

I understand the purpose and procedures of the study. I have been given an opportunity to ask questions about the study and have had answers to my satisfaction.I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any treatment or care that I would usually be entitled to. I have been informed about any available compensation as a result of study-related procedures.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at the **Department of Optometry, University of Cape Coast, Cape Coast Ghana or on 020- 8752876 or the Supervisor; Dr R Hansraj, at the Discipline of Optometry, University of KwaZulu-Natal or on 031- 2607089.**

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact: **BIOMEDICAL RESEARCH ETHICS ADMINISTRATION, Research Office, UKZN, Westville Campus on** Tel: 27 31 2604769 - Fax: 27 31 2604609 or Email: BREC@ukzn.ac.za

………………………………………………………….. **……………………………..**

Signature of Participant **Date**

………………………………………………………… **……………………………….**

Signature of Witness (Where applicable) **Date**

……………………………………………………….. **………………………………..**

Signature of Translator (Where applicable) **Date**

Appendix III

SCHOOL OF HEALTH SCIENCES

DISCIPLINE OF OPTOMETRY

QUESTIONNAIRE

Protocol Title	Ocular Health of Cocoa Farmers in Ghana: An Assessment and Intervention Study

Signature of Principal Investigator: Dr Samuel Bert Boadi-Kusi

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Interviewer - Administered Questionnaire

Region: ___________________________________

District: ___________________________________

Village/Town: _______________________________

Date of Administration: _____/_____/_____

Participant's Code ___________________________

Interviewer's Code___________________________

SECTION A: SOCIO-DEMOGRAPHIC VARIABLES

Kindly tick [✓] the appropriate box provided for the necessary information

1. SEX: M [ ] [ ]
2. Date of Birth: dd/mm/yr ____/____/19___
3. Place of birth______________Region______________ Country ________________
4. Marital status: [ ] Never married [ ] Married [ ] Living together [ ] Divorced [ ] Separated [ ] Widowed
5. What is the size of your nuclear family involved in cocoa farming?_________________
6. What is your highest level of formal education [ ] None [ ] Primary [ ] Middle/JHS [ ] Secondary [ ] Tertiary [ ] Other (specify)_____________________________
7. How much on the average do you earn yearly from your farm? [ ] GHc 0 – 999 [ ] GHc 1,000 -1,999 [ ] GHc 2000 – 2,999 [ ] GHc 3,000 – 3,999 [ ] ≥ GHc 4,000
8. Do you have a personal mobile phone? [ ] Yes [ ] No
9. Do you have access to internet at home? [ ] Yes [ ] No

SECTION B: FARM CHARACTERISTICS

10. How many years have you been engaged in cocoa farming? _______________________
11. What size of cocoa farm (acres) do you have under cultivation?_____________________
12. How many bags of cocoa did you harvest during the last farming season?_____________
13. What is your status as a farmer? [ ] Owner [ ] Caretaker [ ] Sharecropper [ ] Family farm [ ] Other (specify)____
14. What labour do you use on your farm? [ ] Hired [ ] Family [ ] Sharecroppers [ ] Caretakers [ ] Other (specify)_____________________________________
15. Are you a full time cocoa farmer? [ ] Yes [ ] No **If Yes GO TO 17**
16. If **No** in **15**, what other work do you do?_____________________________________
17. How many months do you actively work on your farm in a year?__________________
18. How many times do you go to farm in a week?_________________________________
19. How many hours do you spend on the farm in a day?____________________________

SECTION C: OCULAR HEALTH STATUS/ HEATH SEEKING BEHAVIOUR

20. Do you have difficulty recognizing a friend at a distance? ☐ Yes ☐ No

21. Do you have difficulty reading at near or working at a close range? ☐ Yes ☐ No

22. Do have difficulty recognizing ripe/matured cocoa pods? ☐ Yes ☐ No

23. How will you rate your distance vision? ☐ Very good ☐ Good ☐ Fair ☐ Poor
    ☐ Very poor

24. How will you rate your near vision? ☐ Very good ☐ Good ☐ Fair ☐ Poor
    ☐ Very poor

25. Have you ever had an eye examination before? ☐ YES ☐ No. **If yes, go to 27**

26. If No in 25, provide a reason...

27. If Yes in **25**, when was your last examination? ☐ 1-3yrs ☐ 4- 6 yrs ☐ 7-9yrs
    ☐ Other (specify)____

28. Have you ever had any eye episode within the last one year? ☐ Yes ☐ No **If No, Go to 40**

29. What episode did you experience? ☐ Pain ☐ Redness ☐ Eye injury ☐ Tearing
    ☐ Burning sensation ☐ Foreign body sensation ☐ Poor near vision ☐ Other (specify)_______

30. Did you visit the hospital/clinic for treatment? ☐ Yes ☐ No **If Yes, Go to 32**

31. If **No in 3,** why did you not go to the hospital? ☐ Lack of money ☐ Time constrain
    ☐ Not important ☐ Advised use herbs ☐ Other (Specify)____________**Go to 35**

32. How did you travel to the hospital? ☐ Own Vehicle ☐ Commercial Vehicle
    ☐ Relative Offered to take me ☐ Bicycle/foot

33. How long did you travel to the hospital?______________________km

34. Were you satisfied with the treatment you received ? ☐ Yes ☐ No If No, why?________

35. If you did not report to the hospital/clinic for management, where did you report to?
    ☐ Pharmacy/chemist or chemical shop ☐ Herbal medicine ☐ Self-medication (Herbal)
    ☐ Self-medication (Orthodox) ☐ Nothing was done

36. Why did you choose this form of eye care? ☐ Cheaper ☐ Less time constraint
    ☐ Long distance ☐ Other (specify)__________________________________

37. How did you travel to the destination? ☐ Own Vehicle ☐ Commercial Vehicle

☐ Relative Offered to take me ☐ Bicycle/foot

38. How long did you cover in reaching your destination of seeking eye health?.............km

39. Were you satisfied with the treatment you received ? ☐ Yes ☐ No

SECTION D: OCULAR INJURY

40. Have you experienced any ocular injury on the farm in the last one year? ☐ Yes ☐ No **If NO, GO TO 51**

41. How many times have you sustained such ocular injuries within the last one year?______

42. When was the most recent ocular injury sustained ? ☐ <4 months ☐ 4-6 months

☐ 7 -9 months ☐ 10-12 months

43. Were you wearing ocular protection at the time of the most current injury? ☐ Yes ☐ No

44. During which activity on the farm did you sustain your most current injury? ☐ Weeding ☐ Bush burning ☐ Planting ☐ Fertilizing ☐ Spraying ☐ Pruning ☐ Plucking ☐ Breaking of pod ☐ Drying ☐ Other (specify)____

45. What caused the ocular injury? ☐ Plant/tree/branches ☐ Hand tool ☐ Chemical

☐ Sand/dust ☐ Flying object ☐ Cocoa pod/husk ☐ Insect ☐ Other (specify)________

46. How will you classify the severity of the injury you sustained? ☐ Very severe ☐ Severe

☐ Not severe

47. a. Where did you seek help after the injury? ☐ Hospital or Clinic ☐ Chemical Shop

☐ Traditional medicine doctor ☐ Self-medication (orthodox) ☐ Self-medication (Traditional)

☐ Nothing was done ☐ Other (specify)_________________________

b. Within how many days did you seek help? ☐ <1day ☐ ≤ 1day ☐ 2-3 days ☐ 4-7 days

☐ > 7days

48. How many days did you lose from work on the farm as a result of the injury? ☐ <1 ☐ 1-3

☐ 4-7 ☐ ≥7 days

49. Apart from the last one year, have you ever sustained an eye injury on the farm? ☐ Yes ☐ No

50. When was the last time such an injury occurred? ☐ 2- 5years ☐ 6-9years ☐ ≥ 10 years

SECTION E: SELF-REPORTED USE OF OCULAR PROTECTION AND FACTORS PREVENTING THE USE OF OCULAR PROTECTION

51. Do you wear eye protection of any kind on the farm? ☐ Yes ☐ No. **If NO GO TO 54**

52. If YES in **51** which type of eye protection do you wear? ☐ Sunglasses ☐ Face shield ☐ Protective glasses ☐ Goggles ☐ Hat ☐ Other (specify)_____________________

53. How often do you wear eye protection on the farm? ☐ Always ☐ Sometimes ☐ Not at all

Please tick the appropriate box

FARM ACTIVITY	54. Are you involved? [YES[NO]	55. FREQUENCY OF USE OF PROTECTION		
		Always	Sometimes	Not at all
Bush burning	[ ] [ ]	[ ]	[ ]	[ ]
Weeding	[ ] [ ]	[ ]	[ ]	[ ]
Planting	[ ] [ ]	[ ]	[ ]	[ ]
Fertilizing	[ ] [ ]	[ ]	[ ]	[ ]
Spraying	[ ] [ ]	[ ]	[ ]	[ ]
Pruning	[ ] [ ]	[ ]	[ ]	[ ]
Plucking	[ ] [ ]	[ ]	[ ]	[ ]
Splitting of pods	[ ] [ ]	[ ]	[ ]	[ ]
Drying	[ ] [ ]	[ ]	[ ]	[ ]
Other(Specify)……	[ ] [ ]	[ ]	[ ]	[ ]

56. Do you feel that the protective eyewear is effective in protecting your eyes? ☐ Yes ☐ No

57. If No in **56**, why?____

58. How often do you replace your protective eye wear? ☐ Always ☐ Sometimes ☐ Not at all. **If Always Go To 60**

59. Which of the following factors prevents you from using eye protection if you don't use it always?

☐ Uncomfortable ☐ Fogs when you sweat ☐ Falls off ☐ Prevents seeing well enough to do the job ☐ Expensive To purchase ☐ Not readily available ☐ Do not like the way it looks ☐ Co-workers or friends would make fun of them ☐ Other (specify_____________________

60. Would you wear protection always if they were distributed for free by government?

☐ Yes ☐ No ☐ Not sure

61. Would you wear protection always if it was made mandatory by law? ☐ Yes ☐ No ☐ Not sure

SECTION F: CHEMICAL USE (PESTICIDES)

62. Are pesticides/ fertilizers used on your farm? ☐ Yes ☐ No **If NO, go to 79**

63. Which chemicals are used? ☐ Akati Master ☐ Asasewura ☐ Cocofeed ☐ Condemn

☐ Confidor ☐ DDT ☐ Funguran ☐ Kocide 2000 ☐ Ridomil ☐ Sidalco

☐ Nordox ☐ Champion ☐ Aktara ☐ Gramozone ☐ Roundup ☐ Other (Specify)___

64. Are you personally involved with mixing, loading and spraying of chemicals?

☐ Yes ☐ No.

65. If NO in **64**, who does the spraying? ☐ Family ☐ Labourer ☐ Caretaker ☐ Gang

☐ Other specify____

66. How long have you been involved in spraying?_______________years

67. How often do you spray the farm yourself in a year? ☐ 1 ☐ 2x ☐ 3x

☐ Other(specify)____

68. How many hours do you spend in spraying your farm per session? ☐ 3 hrs ☐ 5hrs

☐ 7 hrs ☐ Other (specify)_______________________________________

69. Do you wear ocular protection during loading/chemicals application? ☐ Yes ☐ No

70. Which eye protection do you wear during loading/chemical application? ☐ Sunglasses

☐ Face shield ☐ Protective glasses ☐ Goggles ☐ Hat ☐ Other (specify)________

71. Have you ever experienced eye injury in the course of loading/spraying within the last farming season? ☐ Yes ☐ No

72. Were you wearing ocular protection at the time of injury? ☐ Yes ☐ No

73. How will you classify the injury? ☐ Very severe ☐ Severe ☐ severe

74. What did you do to remedy the situation? ☐ Hospital or Clinic ☐ Chemical shop

☐ Traditional medicine doctor ☐ Self-medication orthodox ☐ Self-medication (Traditional)

☐ Nothing was done ☐ First aid ☐ Other (specify)______________________________

75. Have you ever experienced any eye complication immediately after spraying your farm or fertilizer application? ☐ Yes ☐ No

76. What was the problem? ☐ Burning sensation ☐ Irritation ☐ Redness ☐ Pain ☐ Other specify____

77. How did you remedy the situation? ☐ Hospital/Clinic ☐ Self-medication (Orthodox) ☐ Self-medication (Tradition) ☐ Nothing was done ☐ First aid ☐ Chemical Shop ☐ Other (specify)___________________________________

78. Have you received any training on handling of pesticides use in the farm? ☐ Yes ☐ No

SECTION G: ALCOHOL INTAKE AND SMOKING STATUS

79. Do you currently take in alcohol? ☐ Yes ☐ No. **If No go to 84**

80. For how long have you been drinking alcohol?________months/___________years

81. What quantity do you take in a day? ___________________________ml

82. Did you start drinking alcohol due to stress from farming? ☐ Yes ☐ No

83. Do you drink alcohol before or during work on cocoa farm? ☐ Yes ☐ No

84. Do you currently smoke tobacco or cigar? ☐ Yes ☐ No **If YES GO TO 106**

85. If **No in 84** have you ever smoked? ☐ Yes ☐ No. **If No go to 90**

86. Did you start smoking due to stress from cocoa farming? ☐ Yes ☐ No

87. For how long have you been smoking?__________months/________________years

88. How many sticks do you smoke on the average in a week? _______________________

89. Do you smoke while working on your cocoa farm? ☐ Yes ☐ No

SECTION H: OCULAR SAFETY TRAINING AND EDUCATION

90. Have you ever had any educational training on ocular protection as a farmer? ☐ Yes ☐ No. **If NO go to 98**

91. If YES in **112**, when was your last training? ☐ 1-3 yrs ☐ 4-6 yrs ☐ 7- 9 yrs ☐ ≥10 yrs

92. Who organised the training?____

93. How did you assess the training? ☐ Very beneficial ☐ Beneficial ☐ Not Beneficial

94. If it was not beneficial why do you say so?_______________________________________

95. Do you think training on ocular safety will help reduce injury on farms? ☐ Yes ☐ No

96. Would you attend safety training programme if it is organized? ☐ Yes ☐ No

97. How often would you want a training organised in a year? ☐ 1 ☐ 2x ☐ 3x ☐ Other (specify)____

SECTION I: GENERAL HEALTH (To be administered by a professional)

98. How will you rate your general health status? ☐ Very good ☐ Good ☐ Fair ☐ Poor ☐ Very poor

99. Do you have history of any of the following?

100. Hypertension ☐ Yes ☐ No ☐ Not sure ☐ Don't want to answer

101. Diabetes ☐ Yes ☐ No ☐ Not sure ☐ Don't want to answer

102. Sickle Cell disease ☐ Yes ☐ No ☐ Not sure ☐ Don't want to answer

103. HIV ☐ Yes ☐ No ☐ Not sure ☐ Don't want to answer

104. Are you currently on any medication? ☐ Yes ☐ No. If Yes specify_______________

105. How often do you go for routine medical check-up in a year? ☐ 1 ☐ 2x ☐ 3x ☐ Other (specify)____

106. When was your last medical examination? ☐ ≤ 1yr ☐ 2-5 yrs ☐ 6- 9 yrs ☐ ≥10yrs

107. Are you registered with the National Health Insurance Scheme? [ ]Yes [ ] No

108. If you are not registered, why?____

SECTION J: BASIC OCCUPATIONAL EYE HEALTH SURVEY

109. Which of the following hazards are you exposed to on the farms? ☐ UV Radiation

☐ Chemicals ☐ Smoke/fumes/moist/ ☐ Dust/sand ☐ Biologic (fungi, bacteria)

☐ Projectiles ☐ Tools ☐ Other (Specify)________________________________

110. Do you have any hobbies that expose you to chemicals, dust, fumes, heat or other hazards you face in the farm? ☐ Yes ☐ No

111. What is your longest held job apart from cocoa farming?________________________

112. At what age did you start this job?____

113. How long did you do this job?____________months/___________________years

114. Which hazards were you exposed to on this job? ☐ UV Radiation ☐ Chemicals

☐ Smoke/fumes/moist ☐ Dust/sand ☐ Biologic (fungi, bacteria) ☐ Projectiles

☐ Tools ☐ Other (Specify) ____

115. Do you believe that any of your eye problems (signs and symptoms) are related to exposure to the hazards at your longest held job? ☐ Yes ☐ No

Thank you for your participation

Appendix IV

UNIVERSITY OF KWAZULU-NATAL™
INYUVESI YAKWAZULU-NATALI

OCULAR HEALTH EXAMINATION FORM

Protocol Title	Ocular health of cocoa farmers in Ghana: an assessment and intervention study

Signature of Principal Investigator: Dr Samuel Bert Boadi-Kusi

---

Examination Station

Region: ___________________________________

District: ___________________________________

Village/Town: _______________________________

Date of Assessment: _____/_____/_____

Participant's Code ___________________________

Section A: Brief Case History

1. What eye problems (signs and symptoms) do you currently have? ☐ Pain ☐ Redness
   ☐ Burning sensation ☐ Foreign body sensation ☐ Tearing ☐ Poor near vision
   ☐ Poor distant vision ☐ Other (Specify)________________________________
2. Date of onset:--
3. Do you think you have these symptoms due to your involvement is cocoa farming?
   ☐ Yes ☐ No
4. History of trauma? ☐ Yes ☐ No
5. Have you ever worn glasses? ☐ Yes ☐ No
6. Do you currently wear glasses? ☐ Yes ☐ No
7. What is the reason for wearing the glasses? ☐ Near ☐ Distance ☐ Both
8. How often do you wear glasses? ☐ All the time ☐ Most of the time ☐ Sometimes
   ☐ Hardly ever ☐ Only when the eyes feel tired
9. Do the glasses work well for you? ☐ Yes [1] No If No, why?_______________________
10. Have you ever had an eye surgery? ☐ Yes ☐ No
11. Any Allergies? (Specify)--
12. Any other relevant information---

Section B: Vital Signs

B1: Blood pressure:……………… mmHg

B2: Height:………………………. cm

B3: Weight:…………………….. kg

Section C: Visual Assessment

C1: Visual Acuity (VA)

	Unaided			Aided			Pinhole VA VA <6/12		+ 1.50D VA≥6/6	
	OD	OS	OU	OD	OS	OU	OD	OS	OD	OS
Distance (4m)										
Near (40cm)										

C2: Visual Acuity cannot be determined ☐ Reason:---------------------------------------

Section D: Binocular Motor Vision Assessment

D1: Near point of convergence

NPC:........../...........cm

D2: Cover test at 40 cm fixation ☐

Unilateral…………………………… Alternate…………………………

☐ None ☐ Esotropia ☐ Esophoria ☐ Exotropia ☐ Exophoria ☐ Vertical ☐ Undetermined

Measured deviation: ....

D3: Cover test at 6m cm fixation ☐

☐ None ☐ Esotropia ☐ Esophoria ☐ Exotropia ☐ Exophoria ☐ Vertical ☐ Undetermined

Measured deviation: ....

D4: Amplitude of Accommodation

AOA (optional) OD………………/OS………………………/OU.....................................

Section E: External / Anterior Segment Examination

E1 ☐ Normal ☐ Abnormal ☐ Undetermined

Structure	Normal	Abnormal	Undetermined
Eyelids/lashes			
Conjunctiva			
Cornea			
Pupils			
Other anterior segment			

If abnormal: ☐ Corneal opacity/scar ☐ Chalazion ☐ Ptosis ☐ Stye ☐ Arcus senelis

☐ Entropion or Ectropion ☐ Allergic conjunctivitis ☐ Bacterial conjunctivitis ☐ Keratitis

☐ Other Conjunctivitis (Specify)…………………….. ☐ Pterygium ☐ Keratoconus

☐ Subconjunctival Haemorrhage ☐ Trichiasis ☐ Poliosis ☐ Other (specify)………………

E2: Tear film

OD ☐ TBUT: ---------Sec ☐ Undetermined (Reason):-----------------------------------

OS ☐ TBUT: ----------Sec ☐ Undetermined (Reason):----------------------------------

E3: **Intraocular Pressure (IOP),** Applanation tonometer

OD......................... mmHg

OS........................ mmHg

Time…………….. GMT

Section F: Interior segment (Lens, Vitreous and Fundus)

F1: ☐ Normal ☐ Abnormal ☐ Undetermined

Structure	Normal			Abnormal			Undetermined		
	OD	OS	OU	OD	OS	OU	OD	OS	OU
Lens									
Vitreous									
Fundus									
Vessels									
Macula									
Disc (VCDR)									
Periphery									

If Abnormal: ☐ Vitreous haemorrhage ☐ Uveitis ☐ Glaucoma/Suspect ☐ Optic Atrophy

☐ Toxoplasmosis ☐ Macula scar ☐ Retinopathy (specify)----------------- ☐ Cataract

☐ Other (specify)------------------------------- ------------------------------- -------------------------------------

Section G1: Refraction

Eye	**H1: Subjective**			**VA**	**ADD**	**VA**
	Sphere	**Cylinder**	**Axis**			
OD						
OS						
OU						
	H2: Objective					
	Sphere	**Cylinder**	**Axis**			
OD						
OS						
OU						

G2: Indicate type of refractive error

☐ Myopia (≥ - 0.50D) ☐ Hyperopia (≥ + 0.75DS) ☐ Astigmatism (Cyl ≥ 0.50DC)

G4: Presbyopic status

☐ Presbyopic ☐ Non- presbyopic

SECTION H: Colour vision (HRR) with SRx

OD: ☐ Normal ☐ Abnormal (Specify)……………………………………………………..

OS: ☐ Normal ☐ Abnormal (Specify)……………………………………………………..

(Attach recording sheet)

Section I: Cause of Visual impairment

☐ Refractive error (UCVA $\leq$ 6/18)

☐ Cataract

☐ Retinal degeneration

☐ Glaucoma

☐ Other pathology (Specify)---

☐ Undetermined cause

SECTION J: Action taken

☐ None indicated ☐ On-site eye medication ☐ Spectacle for reading

☐ Spectacle for distance ☐ Referred for specialist attention

Appendix V : REFERRAL LETTER

PRIVATE BAG X54001 DURBAN

4000

SOUTH AFRICA

UNIVERSITY OF KWAZULU-NATAL

INYUVESI YAKWAZULU-NATALI

Name_______________________________________ Age__________ Sex

The Optometrist ☐ OR Ophthalmologist ☐

Please kindly attend to the above mentioned cocoa farmer that requires your urgent attention after undergoing eye examination as part of a research study.

Unaided V/A: OD: ____/____ OS: ____/____

Aided V/A: OD: ____/____ OS: ____/____

Fundus (CDR) OD: ____/____ OS: ____/____

Other pertinent results of examination: ____

____

Reason for referral: ____

Your cooperation will be highly appreciated.

Yours faithfully

Dr. Samuel Bert Boadi-Kusi (020-8752876)

_____________________________ _____/_____/_____

Signature of Principal investigator Date

Appendix VI (a & b)

TRAINING EVALUATION FORM

Protocol Title	Ocular Health of Cocoa Farmers in Ghana: An Assessment and Intervention Study

Signature of Principal Investigator: Dr Samuel Bert Boadi- Kusi

---

Pre/Post – Training Evaluation

Region: ____________________________________

District: _____________________________________

Village/Town: _________________________________

Date of Assessment: _____/_____/_____

Participant's Code ____________________________

SA = Strongly Agree, A = Agree, N =Neutral, D = Disagree, SD = Strongly Disagree

Please indicate [√] the most appropriate answer

STATEMENT	SA	A	N	D	SD
Basic knowledge about eye health, hazards and Safety					
1. I have basic knowledge about the structure of the human eye	5	4	3	2	1
2. I am supposed to seek eye care at least once every two years	5	4	3	2	1
3. Exposure to pesticides and other chemicals can cause eye problems	5	4	3	2	1
4. Eating green leafy vegetables and carrots can help keep my eye healthy	5	4	3	2	1
5. Alcohol intake has no effect on my eyes	5	4	3	2	1
6. Smoking can affect my eyes	5	4	3	2	1
7. Early entry of sprayed farms cannot cause eye irritation	5	4	3	2	1
8. Radiations from the sun cannot cause cataracts	5	4	3	2	1
9. Excessive exposure to the sun radiations can cause eye problems	5	4	3	2	1
10. Wind, dust, and sand can cause eye problems	5	4	3	2	1
Perceptions and risk beliefs					
11. Infections can be transmitted from plant to my eyes to cause diseases	5	4	3	2	1
12. Eye injuries are always avoidable or preventable when working on the farms.	5	4	3	2	1
13. My chance of getting an eye injury at work on any given day is very low	5	4	3	2	1
14. Safety glasses help protect the eyes when working in agriculture	5	4	3	2	1
15. I often risk injury to my eyes in order to save time or to get more work done.	5	4	3	2	1
16. I think that eye protection would make me look funny.	5	4	3	2	1
17. I believe that eye injuries are sometimes caused by the gods if one disobeys them.	5	4	3	2	1
18. I change my protective eyewear only when I have money to purchase one	5	4	3	2	1
19. I think purchasing protective eyewear frequently is a waste of resources	5	4	3	2	1
20. I often see my co-workers doing something that is risky for their eyes.	5	4	3	2	1

STATEMENT	SA	A	N	D	SD
Injury and potential hazards					
21. I am well informed on preventing eye injuries in the farm	5	4	3	2	1
22. There are many jobs in agriculture where a worker does not need to wear safety glasses.	5	4	3	2	1
23. Taking a rest when tired can help reduce injury	5	4	3	2	1
24. I should consider my age before performing a task on the farm	5	4	3	2	1
25. I must wear ocular protection for every activity on the farm that has potential for causing injury	5	4	3	2	1
26. All farm tools can cause injury to my eye	5	4	3	2	1
27. Branches, vines, bushes and thorns can cause injury to my eye	5	4	3	2	1
28. Flying objects can cause injury to the eye	5	4	3	2	1
29. There is potential for eye injury in any activity I undertake in the farm	5	4	3	2	1
30. Injury to the eye can lead to blindness	5	4	3	2	1
Protection					
31. There are several types protective eyewear available to farmers apart from the "traditional" goggles	5	4	3	2	1
32. If my protective eyewear is old and I cannot afford a new one, I will continue using the old one	5	4	3	2	1
33. If I lost my safety glasses but need to do a job that is hazardous to my eyes it is important to get another pair before doing that job	5	4	3	2	1
34. I must wear eye protection whenever I am spraying with chemicals	5	4	3	2	1
35. It is important to wear safety glasses all the time while working on the farm.	5	4	3	2	1
36. Spectacle wearers need addtional ocular protection when working in the farm	5	4	3	2	1
37. Hats can reduce the amount of sun radiation getting into my eye	5	4	3	2	1
38. Sunglasses provide protection to the eye when working in the farm	5	4	3	2	1
39. I can wear sunglasses to reduce the amount of sun radiation entering my eye	5	4	3	2	1
40. I consider the quality of the protective eyewear before purchasing	5	4	3	2	1

STATEMENT	SA	A	N	D	SD
First Aid					
41. If I get something in my eye, like a piece of sand, I should immediately wash it with clean water	5	4	3	2	1
42. If I splash my eyes with chemicals, the first thing I should do is wash my eyes out with clean water	5	4	3	2	1
43. If I get a cut or puncture in my eye, I can wash it with water	5	4	3	2	1
44. If I get a cut or puncture to my eye, I have to bandage it and see a physician immediately	5	4	3	2	1
45. I am not allowed to rub my eyes if particles fall in it	5	4	3	2	1
46. I can apply herbs if I sustain an eye injury	5	4	3	2	1
47. If I get a blow to the eye, I can apply cold compresses	5	4	3	2	1
48. If I get a blow to the eye hard enough to cause discoloration, I am supposed to see a physician.	5	4	3	2	1
49. I can purchase eye medication from the chemical shop when I have an eye disease or injury	5	4	3	2	1
50. It is important for me to get a first aid box in the farm	5	4	3	2	1

51. How will you assess the training you recieved? [ ] Very Beneficial [ ] Beneficial [ ] Not Beneficial

52. How many times in a year would you want to attend such a training? __________________________

Appendix VII: Ethical Approval (BREC/GHS)

GHANA HEALTH SERVICE ETHICAL REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted.

My Ref. :GHS-ERC: 3
Your Ref. No.

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
Tel: +233-302-681109
Fax + 233-302-685424
Email: nitadzy@yahoo.com

25th November, 2013

Dr. Samuel Bert Boadi-Kusi
University of Cape Coast
School of Physical Sciences
Department of Optometry

ETHICAL APPROVAL - ID NO: GHS-ERC: 02/09/13

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol titled:

"Ocular health and safety assessment of cocoa farmers in Ghana"

This approval requires that you inform the Ethical Review Committee (ERC) when the study begins and provide Mid-term reports of the study to the Ethical Review Committee (ERC) for continuous review. The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Please note that any modification without ERC approval is rendered invalid.

You are also required to report all serious adverse events related to this study to the ERC within seven days verbally and fourteen days in writing.

You are requested to submit a final report on the study to assure the ERC that the project was implemented as per approved protocol. You are also to inform the ERC and your sponsor before any publication of the research findings.

Please always quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED...

PROF. FRED BINKA
(GHS-ERC CHAIRPERSON)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra

Appendix VIII: Certificate of translation of protocol into local language

Appendix IX: Approval letters from districts/municipals of study sites

In case of reply the number
and the date of this letter
should be quoted

GHANA HEALTH SERVICE
Juaboso Dist Health Adm.
P. O. Box 5
Sefwi Juaboso
22[th] July, 2013.

Your Health - Our Concern

My ref: JD/GHS/DHA-G.25

Your Ref no..................................

RE:REQUEST FOR PERMISSION CONDUCT A RESEARCH STUDY.

I refer to your letter dated 15[th] July, 2013 on the above stated subject, I am glad to inform you that your permission has been granted by the District Health Directorate.

We wish you well in your undertaking

CHARLES OPOKU- GYASI

EXECUTIVE OFFICER

for FOR: DISTRICT DIRECTOR.

DIRECTOR
GHANA HEALTH SERVICE
DIST. HEALTH DIRECTORATE
JUABOSO

DR. SAMUEL BERT BOADI-KUSI
UNIVERSITY OF CAPE COAST
SCHOOL OF PHYSICAL SCIENCE
CAPE COAST.

In case of reply, the Number and date of this Letter should be quoted

REPUBLIC OF GHANA

JUABOSO DISTRICT ASSEMBLY

POST OFFICE BOX 1
SEFWI – JUABOSO

WESTERN REGION

Our Ref: JDA/ES.26/Vol.II

Your Ref: ……………………

Date: 22/7/ 2013

RE- REQUEST FOR PERMISSION TO CONDUCT A RESEARCH STUDY

I refer to your letter dated 15th July 2013 on the above subject matter and wish to inform you that the Assembly has no objection to the request to conduct the research study.

The Assembly wishes you all the best in your endeavour.

JOHN NANA OWU
DISTRICT CO-ORDINATING DIRECTOR
for: DISTRICT CHIEF EXECUTIVE

DR. SAMUEL BERT BOADI
UNIVERSITY OF CAPE COAST
SCHOOL OF PHYSICAL SCIENCES
CAPE COAST

ATWIMA MPONUA DISTRICT HEALTH DIRECTORATE

In case of the reply the number
And the date of this letter
Should be quoted

TEL. 0322090104
My Ref. No: AMDHD//HRU/R-153
Your Ref. No:
Email: ddhsatmponua@yahoo.com

GHANA HEALTH SERVICE
DISTRICT HEALTH
DIRECTORATE
P. O. BOX 60
ATWIMA MPONUA - NYINAHIN

23RD JULY, 2013

RE: REQUEST FOR PERMISSION TO CONDUCT A RESEARCH STUDY

In reference to your letter dated 15th July, 2013, I am glad to inform you that permission has been granted for you to conduct the study in Atwima Mponua District.

Thank you.

DIST DIRECTOR OF H/SERVICES
DISTRICT HEALTH DIRECTORATE
ATWIMA MPONUA
NYINAHIN - ASH.

MR. GEORGE KWADWO KYEI-FRAM
DISTRICT DIR. OF HEALTH SERVICE
ATWIMA MPONUA

To:
Dr. Samuel Bert Boadi-Kusi

ATWIMA MPONUA DISTRICT ASSEMBLY

NYINAHIN

In case of reply the number and The date of this letter should be quoted

REPUBLIC OF GHANA

P.O. BOX 105
NYINAHIN – ASH.

WEST AFRICA

TEL: 051-38800

Our Ref. AMDA.H.3/VOL.III/32

Your Ref: ....

Date: 20th July, 2013

Dr. Samuel Bert Boadi-Kusi
University of Cape Coast
School of Physical Science
Department of Optometry
Cape Coast

RE-REQUEST FOR PERMISSION TO CONDUCT RESEARCH STUDY

Your letter dated 5th July, 2013 on the above on the above subject refers.

Please, I have been directed to convey to you approval to conduct your research in the Atwima Mponua District of the Ashanti Region. The district will be ready to provide the team with accommodation.

For: DISTRICT CHIEF EXECUTIVE
(DAMBA MOHAMMED)
ASSISTANT DIRECTOR IIB

KWAHU WEST MUNICIPAL ASSEMBLY

P.O. Box 253, Nkawkaw - Kwahu. Ghana
Tel: 03431 - 22337 Fax: 03431 - 22542

REPUBLIC OF GHANA

Your Ref:..

Our Ref: KWMA/ER/ GHS/Vol.2

26TH JULY, 2013

RE: REQUEST FOR PERMISSION TO CONDUCT A RESEARCH STUDY

I refer to your letter dated 15th July, 2013, requesting the Assembly to grant you permission to enable you secure ethical clearance from the Ethics Review Committee of the Ghana Health Service to aid you undertake your research.

You have been granted permission in this regard to undertake your research in the Municipality.

for: **MUNICIPAL CO-ORD. DIRECTOR**
(CAROLINE AWUYE)
ADII[B]

DR. SAMUEL BERT BOADI - KUSI
UNIVERSITY OF CAPE COAST
SCHOOL OF PHYSICAL SCIENCES
DEPT. OF OPTOMETRY

Our core values
People Centred
Professionalism
Team Work
Innovation
Discipline
Integrity

GHANA HEALTH SERVICE
Your Health - Our Concern

Ghana Health Services
Municipal Health Administration
Post Office Box 419
Nkawkaw
Kwahu West

MyRef.No KWMHA/EAS/ /2013

Your Ref. No. ....

Date: 29th July 2013

DR. SAMUEL BERT BOADI-KUSI
UNIVERSITY OF CAPE COAST
CAPE COAST
TEL: 0208752876

Dear Sir;

RE: REQUEST FOR PERMISSION TO CONDUCT A RESEARCH STUDY

I wish to inform you that, you have been granted permission to conduct your research in the municipality as requested.

Thank you

....

Ms. Theresa Dakurah

DDNS/PH

Kwahu West

Nkawkaw

In case of the reply the number and the date of this letter should be quoted.

GHANA HEALTH SERVICE
MUNICIPAL HEALTH DIRECTORATE
P. O. BOX 30
ASSIN FOSO
CENTRAL REGION
GHANA.

My Ref. No ghs/an
Your ref. no. ....

tel: 042 40553
JULY 23RD, 2013

Dear Sir,

RE: REQUEST FOR PERMISSION TO CONDUCT A RESEARCH STUDY

Reference your letter dated 15th July, 2013 on the above-mentioned subject.

I am pleased to inform you that the Municipal Health Directorate has granted your request and looks forward to having a mutually beneficial study with you.

Thank you.

Yours faithfully,

Mun. Director of Health Service
Municipal Health Directorate
Assin Foso

(Mad. Georgina Asimadi)

Municipal Director of H/Services

Assin North Municipality

DR SAMUEL BERT BOADI-KUSI
UCC
CAPE COAST

ASSIN NORTH MUNICIPAL ASSEMBLY

In case of reply the number and date
of this letter should be quoted

Office of the Municipal Assembly
Post Office Box 99
Assin Fosu, C/R
Ghana – W/A

REPUBLIC OF GHANA

Our Ref: ANMA/S.30/145
Your Ref.:........................

26th July, 2013

RE-REQUEST FOR PERMISSION TO CONDUCT A RESEARCH STUDY

With reference to your letter dated 15th July, 2013 on the above subject matter, we wish to inform you that approval has been given you to conduct the study on the topic "Ocular Health and Safety assessment of Cocoa Farmers" in Ghana of which Assin North Municipality has been selected as one of the study sites.

It is our hope that the outcome of the study will not only fulfill your academic qualification but, will also benefit the Municipality.

ASSISTANT DIRECTOR
(CHARLES LARTEY)
FOR: MUNICIPAL CHIEF EXECUTIVE

DR. SAMUEL BERT BOADI-KUSI
DEPARTMENT OF OPTOMETRY
UNIVERSITY OF CAPE COAST
SCHOOL OF PHYSICAL SCIENCES

DEPARTMENT OF GHANAIAN LANGUAGES AND LINGUISTICS
UNIVERSITY OF CAPE COAST
FACULTY OF ARTS

Tel: 03321- 30939
Fax: c/o 03321- 30941
E-Mail: deptghling@yahoo.com

University Post Office
Cape Coast, Ghana

Our Ref: GL/82/10

Your Ref:

15th July, 2013

Biomedical Research Ethics Administration
Research office, Westville CampusGovan
Mbeki Building
Private Bag X 54001
Durban 4000
KwaZulu-Natal, South Africa

Dear Sir/Madam,

INFORMATION LETTER (TWI TRANSLATION):
SAMUEL BERT BOADI-KUSI

I write to certify that the enclosure information has been well translated by the expert from this Department and also approved to the standard language usage in this module.

Thank you.

Yours faithfully,

Angela Amoah
(Administrative Assistant)

DEPT. OF GHANAIAN LANGUAGES
UNIVERSITY OF CAPE COAST
CAPE COAST

UNIVERSITY OF KWAZULU-NATAL™
INYUVESI YAKWAZULU-NATALI

05 December 2013

Dr SB Boadi-Kusi
PMB
University of Cape Coast
Cape Coast
Ghana
sbertk@yahoo.com

Dear Dr Boadi-Kusi

PROTOCOL: Ocular health assessment of cocoa farmers in Ghana. REF: BE201/13

EXPEDITED APPLICATION

A sub-committee of the Biomedical Research Ethics Committee has considered and noted your application received on 10 May 2013.

The study was provisionally approved pending appropriate responses to queries raised. Your responses dated 26 November 2013 to queries raised on 15 August 2013 have been noted by a sub-committee of the Biomedical Research Ethics Committee. The conditions have now been met and the study is given full ethics approval and may begin as from 05 December 2013.

This approval is valid for one year from **05 December 2013.** To ensure uninterrupted approval of this study beyond the approval expiry date, an application for recertification must be submitted to BREC on the appropriate BREC form 2-3 months before the expiry date.

Any amendments to this study, unless urgently required to ensure safety of participants, must be approved by BREC prior to implementation.

Your acceptance of this approval denotes your compliance with South African National Research Ethics Guidelines (2004), South African National Good Clinical Practice Guidelines (2006) (if applicable) and with UKZN BREC ethics requirements as contained in the UKZN BREC Terms of Reference and Standard Operating Procedures, all available at http://research.ukzn.ac.za/Research-Ethics/Biomedical-Research-Ethics.aspx.

BREC is registered with the South African National Health Research Ethics Council (REC-290408-009). BREC has US Office for Human Research Protections (OHRP) Federal-wide Assurance (FWA 678).

The sub-committee's decision will be **RATIFIED** by a full Committee at its next meeting taking place on **11 February 2014.**

We wish you well with this study. We would appreciate receiving copies of all publications arising out of this study.

Yours sincerely

Professor D.R Wassenaar
Chair: Biomedical Research Ethics Committee

Professor D Wassenaar (Chair)
Biomedical Research Ethics Committee
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban, 4000, South Africa
Telephone: +27 (0)31 260 2384 **Facsimile:** +27 (0)31 260 4609 **Email:** brec@ukzn.ac.za
Website: http://research.ukzn.ac.za/Research-Ethics/Biomedical-Research-Ethics.aspx

UNIVERSITY OF
KWAZULU-NATAL

INYUVESI
YAKWAZULU-NATALI

RESEARCH OFFICE
BIOMEDICAL RESEARCH ETHICS ADMINISTRATION
Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604769 - Fax: 27 31 260-4609
Email: BREC@ukzn.ac.za
Website: http://research.ukzn.ac.za/Research-Ethics/Biomedical-Research-Ethics.aspx

03 December 2014

Dr SB Boadi-Kusi
PMB
University of Cape Coast
Cape Coast
Ghana
sbertk@yahoo.com

Dear Dr Boadi-Kusi

PROTOCOL: Ocular health assessment of cocoa farmers in Ghana. REF: BE201/13

Your application for Amendments dated 20 November 2014 changing the title for the above study from ***Ocular health assessment of cocoa farmers in Ghana*** to ***Ocular health of cocoa farmers in Ghana: an assessment and intervention study*** has been noted and approved by a sub-committee of the Biomedical Research Ethics Committee.

This approval will be ratified at the next BREC meeting to be held on **10 February 2015.**

Yours sincerely

p.p. Mrs A Marimuthu
Senior Administrator: Biomedical Research Ethics