

**KWAME NKRUMAH UNIVERSITY OF SCIENCE AND
TECHNOLOGY, KUMASI, GHANA**

COLLEGE OF ENGINEERING

DEPARTMENT OF MATERIALS ENGINEERING

**ASSESSMENT OF COMMUNITY FIRE MANAGEMENT
AROUND TAIN II FOREST RESERVE**



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April 2012

**KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
(KNUST), KUMASI, GHANA**

**Assessment of Community Fire Management around Tain II
Forest Reserve**

KNUST

**Master of Science Thesis
By
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(Integrated Development Studies)**

Thesis submitted to
The Department of Materials Engineering,
Kwame Nkrumah University of Science and Technology, Kumasi
In Partial Fulfilment of the Requirements for the Degree of Master of Science
In
(Environmental Resources Management)

**Materials Engineering
College of Engineering**

APRIL 2012

CERTIFICATION

I hereby declare that this submission is my own work towards the award of the MSc. Environmental Resources Management and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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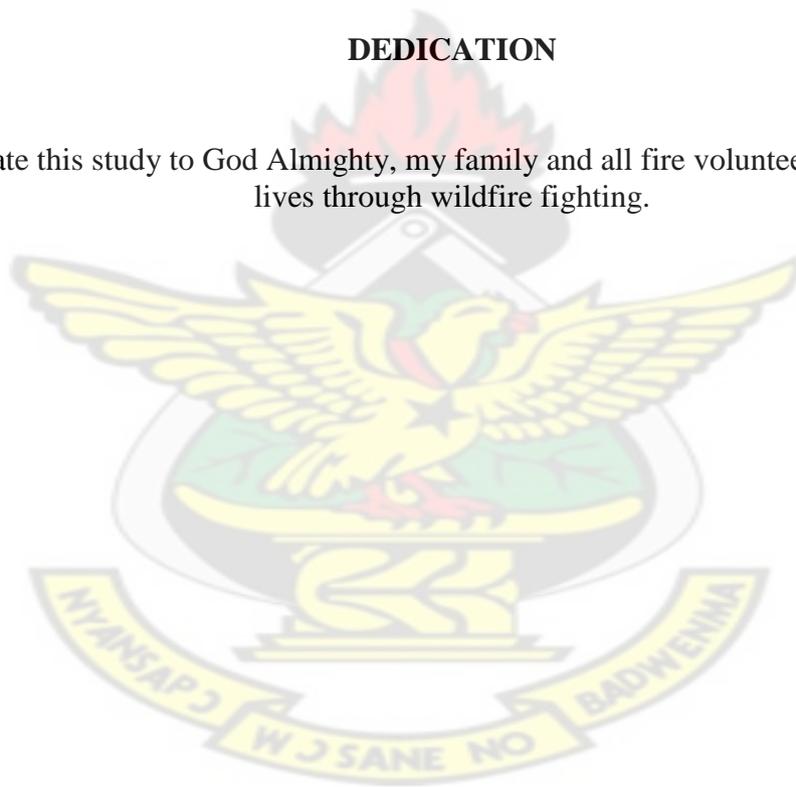
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DEDICATION

I dedicate this study to God Almighty, my family and all fire volunteer who lost their lives through wildfire fighting.



ABSTRACT

Until 1983 uncontrolled wildfires were relatively uncommon especially in the forest zones of Ghana. The question here is that can this change be attributed to the ineffectiveness of fire management at the community level? This study therefore compared the effectiveness of the indigenous fire management systems before 1983 and conventional fire management systems introduced after 1983 fires in fringe communities around the Tain II forest reserve. The study also investigated effectiveness of stakeholder participation and gender strategies in fire management around the Tain II forest reserve. Furthermore, the study identified challenges in fire management around the Tain II forest reserve. Participatory Rural Appraisal (PRA) techniques were used to collect data from the five communities. A total sample of 438 respondents comprising household heads and fire volunteer squads were interviewed. The data were analyzed using index of participation, descriptive statistics and Chi Square. The study results revealed that 85% of the respondents agreed that indigenous fire management systems were effective in curbing wildfires compared to 40% respondents agreed that conventional fire management systems are effective in curbing wildfire. However, 64% of the respondents agreed that indigenous fire management were more or less effective than the conventional fire management. The index of participation regarding stakeholders involvement in fire management planning, implementation and monitoring were 0.59; 0.60; and 0.56 respectively. Furthermore, 52% of the respondents are of the view that fire management before 1983 was a duty mainly for men while 73% of the respondents stated that currently (after 1983) both men and women are involved in fire management. The index of participation regarding women participation in fire management was 0.5; 0.5; and 0.5 respectively for planning, implementation and monitoring. Also the index of

participation for both men and women participation in fire management was 0.5. Respondents were of the opinion that they can no longer practice indigenous early burning as a measure to suppress and control fire. A total of 62% respondents agreed that culprits are not punished when arrested for setting wildfires. The research results bare that fire fighting equipments are not available and even where these fire fighting equipments are available they are not enough to be distributed among fire volunteer squads. Also there is lack of insurance scheme for fire volunteers in the study area. The study concludes that wildfire management will succeed or fail according to the degree of involvement of local communities and the support given to stakeholders including fire volunteer squads.



ACKNOWLEDMENT

‘Finally, brethren, whatsoever things are true, whatsoever things are honest, whatsoever things are just, whatsoever things are pure, whatsoever things are lovely, whatsoever things are of good report; if there be any virtue, if there be anything worth of praise, think of these things.’ (Philippians 4:8). To God almighty be the Glory, Honour and Adoration for his guidance, protection, peace and grace bestowed on me all these years.

I wish to express my sincere thanks and appreciation to my supervisors Prof. William Oduro (Dean, Faculty of Renewable Natural Resources-KNUST), Dr. V.R. Barnes (Faculty of Renewable Natural Resources-KNUST) and Dr. Paul Sarfo-Mensah (Director, BIRD-KNUST). I owe you a debt of gratitude for providing technical suggestions and constructive criticisms. I thank you for your guidance, encouragement, confidence, patience and willingness to supervise this thesis. To the Department of Material Engineering and lecturers in the Environmental Resources Management Programme, who have provided me with valuable insight and integrated knowledge in environmental resources management, I am grateful for your professional service to humankind.

I also wish to express my sincere thanks and appreciation to the University for Development Studies (UDS) for the support granted me. Furthermore, I wish to extend my profound gratitude to my parents for their financial and material support. I am also indebted to my elder brothers and sisters for their financial support and encouragement. To Lazarus A, Felix Mahama, Michael Ntim, Adams Marshall Alhassan, Samuel Kumi, Augustine Osei-Begyina, Fred Ofosu, Owusu Sebastian, and Apraku. Thank you for your morale and contributions in diverse ways. I extend my heartfelt gratitude to all the communities in and around the Tain II forest reserve. Finally, to all my friends especially, my room mates for their advise, encouragement and granting a conducive environment throughout the research work. May God richly bless you all.

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LIST OF ABBREVIATIONS

APERL	-	Agro-forestry Practices to Enhance Resource-Poor Livelihood
BURN	-	Bushfire and Rural Livelihood Project
CBFiM	-	Community-Based Fire Management
CBNRM	-	Community-Based Natural Resource Management
CIDA	-	Canadian International Development Agency
DFSD	-	District Forest Service Division
DSFZ	-	Semi-Deciduous Fire Zone
EPA	-	Environmental Protection Agency
FAO	-	Food and Agriculture Organization of United Nations
FC	-	Forestry Commission
FFRT	-	Faculty of Forest Resources Technology
FFWA	-	Fire Fight West Africa
FMU	-	Forest Management Unit
FORIG	-	Forestry Research Institute of Ghana
FORUM	-	Forest Protection and Resource Use Management
FSD	-	Forest Services Division
GNFS	-	Ghana National Fire Service
HFZ	-	High Forest Zone
IP	-	Index of Participation
ITTO	-	International Tropical Timber Organization
JICA	-	Japanese International Cooperation Agency
KNUST	-	Kwame Nkrumah University of Science and Technology
PNDC	-	Provisional National Defense Council
MLFM	-	Ministry of Lands, Forestry and Mines
MOA	-	Ministry of Food and Agriculture
NADMO	-	National Disaster Management Organization
NWMP	-	National Wildfire Management Policy
PRA	-	Participatory Rural Appraisal
RFC	-	Regional Forestry Commission
SPSS	-	Statistical Package for Social Scientists
UNCCD	-	United Nations Convention to Combat Desertification
UDS	-	University for Development Studies
WD	-	Wildlife Division
WFMP	-	Wildfire Management Project

CHAPTER ONE

1.0 INTRODUCTION

Fire is a paradox – it can kill plants and animals, and cause extensive ecological damage but it is also extremely beneficial, the source of forest regeneration and of nutrient recycling (Rowell and Moore, 2000). Over the past decade, many regions of the world have experienced a growing trend of excessive fire application in the forestry and agriculture interface, land-use systems and land-use change, and an increasing occurrence of extremely severe fires (FAO, 2006). It is estimated that 350 million hectares burn each year, much of which are forest and woodland (Burchi and Carle, 2009).

As the number of forest fires appears to increase, conventional suppression measures have increasingly come under question. Instead of alleviating forest fire problems, these measures have not solved the problem and in some countries, the scale and magnitude of forest fires has increased (IUCN, 2002). According to FAO (2007b) cited by Morgera and Cirelli (2009), fire prevention and suppression are often hampered, among several factors, by unclear lines of institutional responsibilities and by conflicting policies and legislations. Thus, the search for improved approaches has led to calls for revisiting traditional forest fire management systems that emphasise prescribed burning and prevention (Ganz and Moore, 2002; IUCN, 2002, Morgera and Cirelli, 2009).

Many policy makers and development workers are debating whether communities are capable of managing forest fire. However, the academic community has supported this by clearly stating that the community is the key to the survival of forests through integrating indigenous knowledge, conservation values and sustainable livelihoods

(Makarabhirom *et al.*, 2002). The theory behind Community-based Natural Resource Management (CBNRM) argues that the best way to manage natural resources is for local people to use their local knowledge and technologies (CIDR, 2007).

Community-Based Fire Management (CBFiM) has emerged as a new and increasingly adaptive mechanism for working with and managing fire in Africa and in the South East Asian (ASEAN) Region (Ganz and Moore, 2002; Shields *et al.*, 2006). The catalysts behind CBFiM approaches are indigenous land and/or use rights, including the right to use fire as a management tool (Ganz *et al.*, 2003, Moore, 2003; FAO, 2003). Communities have strong traditions that help enhance forest richness – biological and cultural diversity – through innovative means of forest fire management and integrated forest management (Makarabhirom *et al.*, 2002).

Although community empowerment has been recognized as a means to manage fires, the question is; are the communities in question adequately empowered or are they even aware that they are to be empowered to enhance their traditional practices? In Ghana, the 2006 National Wildfire Management Policy has recognized the crucial role communities can play in the sustainable management of natural resources but this is not backed by any legislative instrument to compel implementing agency to do so (Barnes, 2008).

In Ghana, CBFiM has been practiced both formally and informally since the last century. The informal practice was done before the 1982/83 dry season when Ghana experienced severe drought which resulted in widespread fires. The formal CBFiM came into being when the then PNDC government passed the legislation on control of

Bushfire in 1983 (PNDC law 46). But the PNDC law 46 did not make provision for implementation arrangement in terms of responsibilities for government agencies and the roles for communities and traditional authorities. In 1990, the PNDC law 229 replaced the PNDC law 46 to assign functions to district assemblies and made provision for village fire volunteer squads.

However, the law did not empower traditional authorities and communities to play a key role in its enforcement (Obiaw, 2004; MLFM, 2006). It appears that active community involvement in fire management has not been successful since wildfires continue to destroy life and property and the general environment in many communities (Barnes, 2008). The question then is; what causes the inability of communities in dealing with the wildfire menace? Could this be due to ineffectiveness of fire management systems or participation of key stakeholders or gender strategies being used by these communities? While community based fire control once helped protect sacred natural sites, today rural communities are increasingly vulnerable to political and economic pressures beyond their control (Steiner and Oviedo, 2004).

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Indigenous knowledge, the experts say offers an alternative perspective to western scientific knowledge and can compete with and sometimes outperform or enhance the models offered by western science (Castro and Ettenger, 1996). However, the absence of economic benefits and incentives in the use of indigenous knowledge has led to the loss of knowledge and sustainable practices (Steiner and Oviedo, 2004). Rural communities have vast knowledge, skills and experiences regarding wildfire management which could be tapped to check perennial fires which have unfortunately not been utilized (Apusigah, 2007).

Apart from the indigenous knowledge which has not been tapped and utilized in wildfire management, another critical area which requires attention is gender. A gendered approach to community based resource management account for gender differentiated activities, property rights and forest resource claims, and situates them within the context of a web of social relations (Agrawal *et al.*, 2006). It has been documented that women's and men's knowledge of forest resources differs considerably because they use different resources (Hannan, 2002). However, there is insufficient empirical evidence and analysis regarding the role that gender relations play in collective action (Pandolfelli *et al.*, 2007).

Community management programmes cannot be successful as expected if present trend of low women participation continues (Adhikari, 2001). Women are victims of the destructive power of advance technology, as they have been compelled to participate in the process. Women have had to resort to fire to burn the bush so that they can harvest fuel wood more easily with simple cutlasses (Apusigsh 2005). According to Adhikari (2001) women's participation is hindered by various gender biased roles within government, household and community. The issue is; are policy and decision makers as well as implementers integrating these concerns into policy formation and implementation? How effective are the integration of both men and women in the management of the environment? Managing the forest with the full involvement of community members is more effective for managing fire if it is an entrenched social responsibility in the first place (Chamarik and Santasombut, 1994; Wasee, 1996; Sukwong, 1998; Ganz *et al.*, 2001, cited by Makarabhirom *et al.*, 2002).

1.1 Problem Statement

In many parts of the world, local communities are often blamed for what are considered harmful forest fires. This view often encourages fire and forest management institutions to perceive local communities as part of the problem, and certainly not part of the solution (Ganz *et al.*, 2003; IFFN, 2003, Moore, 2003). They have largely ignored the human dimensions of fire and the positive social and ecological benefits of smaller prescribed and managed fires (Ganz and Moore, 2002).

Recent large-scale fires throughout the world have demonstrated the high social, economic and ecological costs of uncontrolled fires (Ganz and Moore, 2002; IUCN, 2002; Roy, 2005). In Yunnan - China one of the country's key national forest areas, fire had the most pronounced influence on the forest cover where more than 2,700 forest fire events occur, destroying 1.7 million hectares of forest (Lichang *et al.*, 2003). Also in some communities in Honduras, fire has become a barrier to the expansion of certain activities including farming (Alvarado *et al.*, 2003). It is estimated in India that the proportion of forest area prone to forest fire annually ranges from 33% in some states to over 90% in others (Roy, 2005). In Ghana it has been estimated that the total land prone to wildfire annually range from 30% in the high forest and transition zones to over 90% in the dry northern savanna zones while the annual loss of revenue from merchantable timber to wildfire is about US\$24 million. The cumulative effect of wildfire is an annual loss of 3% of Gross Domestic Product estimated at about US\$210 million (MLFM, 2006).

Wildfire is perhaps the most important single threat to the integrity of forest in Ghana. The loss of forest cover in the country has seriously affected local communities by its effects on local hydrology and the loss of a wide range of non-timber products (MLFM, 2006). The effects of these on rural livelihoods and on the ecosystem in Ghana are increasingly becoming extensive and damaging (Siaw, 2001). Fire management strategies in the past and the present focused on fire prevention and control at the central level without much emphasis at the community level (Barnes, 2008). But, it has been difficult to reduce or completely eliminate bushfires. This is evident in the efforts made to curb the menace through the establishment of legislation and enforcement, promotion of early burning, annual trace burning, construction of fire belts, fire patrols during dry season, green belt establishment, rehabilitation of sector department, development of partnership and embarking of educational campaigns (Wildfire Awareness Campaigns) (Apusigah, 2005; WFMP, 2008).

Even though these strategies worked for some time, they have failed to address the problems of wildfires in the country. With time, off-reserved areas or burn communities became the source where wildfires emanate and spread to the forest reserves or non burn communities (Sumbo *et al.*, 2006; WFMP, 2008). The question is; has something gone wrong with the implementation and scaling up of these programmes or there is lack of commitment from the community members? Did these programmes take into consideration the effectiveness of conventional and indigenous systems of fire management in the areas of prevention, pre-suppression, suppression and organization? Secondly did these programmes consider gender issues in fire management? Last but not least, did implementers of fire management programmes consider the contribution of key stakeholders or players in community fire management?

Currently, fire is one of the key challenges in and around Tain II forest reserve and also confronting the smooth take-off of the Agroforestry Practices to Enhance Resource-Poor Livelihood (APERL) project. The state of fire in Sunyani and its surrounding areas where the Tain II forest reserve is located is very alarming. In 2007/2008 fire season alone, a total of 120 fire incidences were recorded (Barnes, 2008). Although there have been some fire prevention and control intervention in these areas under the Regional Anti-bushfire committee and Wildfire Management project, annual fires still continue to occur. The existing interventions lack community ownership, effective education to change public attitude, effective laws and enforcement, adequate technical strategies and appropriate community capacity to deal with fires (Barnes, 2008).

1.2 Research Justification

Community fire management is an approach which if promoted can be more effective and more sustainable than the conventional fire management approaches over a long term. In order to improve fire management in Ghana, it is essential that practical steps are made to capture the opportunities that community fire management has to offer through the active involvement of all stakeholders especially the very communities who set and are affected by these fires. However, much study has not been done on the possible causes of failures of communities to effectively manage wildfires in Ghana.

A review of existing literature shows limited knowledge on effectiveness of community (local/indigenous) fire management systems and stakeholder participation and perception including gender in fire management in Ghana. Although, extensive research

work has been done on the causes and effects of wildfires, the role of fire in farming systems, socio-economic effects of wildfire, effects of uncontrolled and controlled burning among others, not much work have been done on the effectiveness of conventional fire management systems. This research seeks to investigate the effectiveness of the CBFiM with respect to management systems of participation, gender issues and identify indigenous practices which can be used to improve fire management in and around the Tain II forest reserve. Secondly, the study will also enhance the knowledge of the scientific community on the likely causes of ineffectiveness of the CBFiM in Ghana.

Presently, KNUST and CIDA are implementing a five year project known as Agroforestry Practices to Enhance Resource-Poor Livelihood (APERL) in the area. The APERL is being implemented in three communities in and around Tain II forest reserve in the Sunyani forest district. The aim of APERL in the area of fire management is to reduce fire incidence through active local community involvement in effective fire prevention and control for livelihoods enhancement in and around Tain II forest reserve. This research will help APERL programme to design appropriate community fire management systems which would serve the needs and aspirations of local communities around the reserve.

Recently a number of initiatives have been taken in Ghana to promote CBFiM which has led to a number of publications. These publications are; wildfire suppression training manual for community fire organizations; guidelines for the establishment of clubs in second cycle institutions; manual of procedures for wildfire management, guidelines for the establishment of green firebreaks in the high forest zone (HFZ) of

Ghana to mention but a few. But much has not been done in the area of the effectiveness of fire initiative programmes carried out in rural communities in Ghana. The study will investigate the effectiveness of these interventions with respect to indigenous and conventional fire management systems, the level of stakeholder participation in fire management and indigenous gender mechanism for fire management around the Tain II forest reserve which previous initiatives did not consider.

Community based fire management around Tain II forest reserve in the Brong Ahafo Region appears not to be effective (Barnes, 2008) as frequent fires are annually reported. The prevalence of these annual fires has come about as a result of the centralized nature of fire management in the area. This study seeks to bring to light how communities surrounding the Tain II Forest Reserve view past and current fire management interventions which have not achieved much success to either eliminate or minimize the recurrent fires. It will investigate concerns Barnes (2008) identified (lacked community ownership, effective education to change public attitude, effective laws and enforcement) in various discussions with community members in the APERL project who are reluctant to actively participate in the project activities because of the frequent fire in the area.

1.3 Research Objectives and Hypothesis

The overall objective of this study was to evaluate community fire management systems used around Tain II Forest Reserve. The specific objectives of the research included:

- I. To assess the effectiveness of community fire management systems used around Tain II Forest Reserve.

- II. To assess the effectiveness of participation of key participants and indigenous gender strategies in fire management used around Tain II Forest Reserve.
- III. To identify challenges of the fire management systems used around Tain II Forest Reserve.

From the arguments that until 1983 uncontrolled wildfires were relatively uncommon especially in forest zones and the threats fire have on local resources and livelihoods, the hypothesis that this research seeks to examine is:

- Indigenous fire management systems before 1983 were more effective than the conventional fire management systems introduced after the 1983 fires.

1.4 Scope of the Study

This study covers the Tain II Forest Reserve in the Transitional Forest Zone of Ghana. It focuses on the fire management systems used before 1983 (Indigenous fire management systems) and the introduction of government intervention after the 1983 (Conventional fire management systems) in Ghana. It also seeks to evaluate stakeholder and gender participation in fire management around Tain II Forest Reserve.

To explore this focus, the critical questions this research sought to find answers to were:

- a. What are the indigenous methods of fire prevention, pre-suppression and suppression used in community fire management around the forest reserve?
- b. Which exotic (conventional knowledge) fire management systems are used around Tain II Forest Reserve?
- c. What are the key differences in the fire management systems in these communities?

- d. What are the challenges in the use of conventional (exotic) and indigenous fire management systems?
- e. Who are the key stakeholders who participate in fire management around Tain II; to what extent do stakeholders participate in fire management around Tain II?
- f. What are the incentives for the stakeholder?
- g. What are the available and used indigenous gender strategies for community fire management around the Tain II Forest Reserve?
- h. How effective are the contributions and incentives of the key stakeholders in the promotion of fire management around Tain II Forest Reserve?

1.5 Organization of the Study

This thesis is divided into six chapters. The Chapter One focuses on the introduction of the study: problem statement; research rationale/justification; scope of the study; research hypothesis and objectives; and the organization of the study. Chapter Two deals with literature review. The literature review focuses on relevant literature on the subject under study - definitions and concepts of fire and community fire management; fires in Ghana; wildfire management systems; community based fire management; indigenous fire management and indigenous knowledge in natural resources management; and stakeholders and gender issues in fire management. Chapter Three focuses on the profile of Tain II Forest Reserve and the study methodology used for data collection while Chapter Four focuses on the results obtained from the field. Chapter Five deals with the discussion of the results obtained from the field. Chapter Six focuses on the research findings, conclusion and recommendations of the research.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This literature review covers issues of fire management as it relates to the objectives of the research. The literature review therefore touches on the following: definitions and concepts of fire and community fire management, fires in Ghana; wildfire management; community based fire management; fire management systems, fire prevention, suppression and pre-suppression; indigenous fire management and gender perspectives-indigenous fire management, gender issues in fire management, indigenous knowledge in natural resources management.

2.1.0 Definitions and Concepts

This section covers the concepts and definition of key issues in line with the subject under investigation notably fire and community fire management.

2.1.1 Concept of Fire

Fires vary enormously and can lead to everything from spare influences on the ground layer to severe impact on entire ecosystem (Mysterud *et al.*, 1997). However, for fire to exist three elements must be present namely; Oxygen; Heat; and Fuel (Barnes *et al.*, 2004). Barnes *et al.* (2004) defined fire as a manifestation of burning involving fuels, air and heat that produces light and heat and often smoke, flame and ashes.

Fires according to Barnes *et al.* (2004) may result from a number of conditions notably;

- Direct ignition from another source already burning
- Heat applied over a long period of time

- Chemical action within the substance itself
- Focused rays from the sun

Fire is one of the oldest tools known to human (Rowell and Moore, 2000). Fire is a disturbance that has played, and will continue to play, a major role in ecosystems throughout the world (Ganz et al 2003, Sanders 2003, Rowell and Moore 2000; Mysterud et al., 1997). In almost all ecosystems, humans have altered the natural fire regimes by changing the frequency and intensity of fires (Ganz *et al* 2003, Sanders 2003). However, Fire, the experts say, is nature's way of recycling the essential nutrients, especially nitrogen (Rowell and Moore, 2000). Ecological fires are ignited by natural ignition sources (lightning strikes) and anthropogenic ignition sources (humans) (Mysterud and Mysterud, 1997).

Fires are often classified according to the location of the fire namely: forest fires, heather fires and grass fires (Mysterud and Mysterud, 1997). Also, fires can be called "catastrophic fires" based on the intensity and severity or "prescribed fires" which are hazard reducing fires that are ignited as part of risk management. Fires may also be ignited consciously through arson (evil will) or be ignited through carelessness linked to several human activities ("accidents", "not intentional") (Mysterud and Mysterud, 1997).

According to Mysterud and Mysterud (1997), it is generally purposeful during surveys to divide fires into some main categories based on background and causal conditions. They thus suggested the following categories; natural fires, anthropogenic fires and wildfires. But fire types includes domestic fires; industrial fires; wildfires or bushfires/forest fires; and prescribed fires (Barnes *et al.*, 2004). However, the focus of

the research is on wildfires/bushfires or forest fires. FAO (2009a) defines wildfires as any unplanned and uncontrolled fire that, regardless of ignition source, may require suppression response or other action according to agency policy. This research will use Barnes et al. (2004) definition of wildfires as any uncontrolled fire in the natural vegetation and cultivated lands.

2.1.1.1 Importance of Fire

The importance of fire is different from continent to continent. Areas where extensive researches have been conducted are Africa (Booyesen and Tainton 1984, Cowling 1992, van Wilgen et al., 1992), Australia (Gill et al., 1981, Pyne 1991), USA and Canada (Wade et al., 1980, Mooney et al. 1981, Wright and Bailey 1982, Minnich 1988, Walstad et al., 1990) and Siberia (Goldammer and Furyaev 1996). Fires are also of great importance in many regions of Europe, for example in the Mediterranean area (Mooney and Conrad 1977, Goldammer and Jenkins 1990).

Traditionally, the use of fire for pest control is widespread in communities in both the forest and the savanna zone (Amissah, 2008). Other uses of fire include control of dangerous animals, insects and pests (grasshoppers, ticks, locusts, anthrax) and livestock parasites which live and thrive on the vegetation (Nsiah-Gyabaah, 1996). Also, as chemicals for pest control has become expensive following the removal of subsidies, fire thus offers the cheaper source of protection against pests and diseases (Ahn, 1970; Amanor, 1996; Quartey and Peasah, 2000).

2.1.2 Fire Management

Fire management essentially incorporates efforts to maintain fire within a desired fire regime (Schweithelm, 1999 cited in Karki, 2002). Fire management system enables assessment of needs and identification. There are many models and approaches which

have evolved worldwide about fire management systems. In various ways with varying degrees of success, these fire management systems attempt to balance the requirement for an effective approach tuned to national and local needs and resources (Karki, 2002).

FAO (2006; 2009) defines fire management as the discipline of using fire to achieve land management and traditional use objectives, together with the safeguarding of life, property and resources through the prevention, detection, control, restriction and suppression of fire in forest and other vegetation in rural areas. This study adapts FAO (2009) definition of forest fire management which comprises all activities required for the protection of combustible forest and other vegetation from fire and the use of fire to meet land management goals.

Managing forest fires is a complex task due to a wide range of issues bordering on prevention, pre-suppression and suppression/control (FORIG 2003). Fire management is most effectively broken down into four discrete components (Karki 2002):

- Prevention involves all measures that impede the outbreak of fire or reduce its severity and spread.
- Preparedness (pre-suppression) includes the actions and activities needed to ensure that organizations are fully prepared for any fire suppression measures.
- Response (firefighting, also called suppression) refers to the control and extinguishing of unwanted fires. These actions attain the highest profile in most media coverage of fires, which can (and has) influenced public and political opinions towards a firefighting-dominated response to fires.

- Recovery refers to attempts to prevent recurrence of fires and further degradation of the forest in the short term, and to re-establish the original structure, biodiversity and productivity of agricultural and forest lands over the long term.

In Ghana, fire management systems used include fire prevention, fire pre-suppression and fire suppression (Barnes *et al.*, 2005, Barnes *et al.*, 2004, Ninnoni *et al.*, 2003).

2.1.2.1 Fire Prevention

Fire prevention is the first step towards protecting forest areas from devastating effects of fire (Ninnoni *et al.*, 2003). Fire prevention is the most cost-effective and efficient mitigation programme an agency or community can implement (FAO, 2006; Ninnoni *et al.*, 2003). The overall objective of fire prevention in Ghana and in many parts of the world is to reduce the annual amount of forest areas burned (Ninnoni *et al.*, 2003).

FAO (2006) defined fire prevention as all measures in fire management, fuel management, forest management and forest utilization concerning the land users and the general public, including law enforcement, that may result in the prevention of outbreak of fires or the reduction of fire severity and spread.

In Ghana, the following fire prevention programmes or activities are carried out in fire management; law enforcement, talk shows/ talking point, mobile van education, drama, community durbars, leaflet and pamphlets, permits and inspection among others (Ninnoni *et al.*, 2003). In the opinion of Chandler *et al.* (1983) successful fire prevention activities should include three components; education, law enforcement

and engineering. But the main fire prevention strategies according to Barnes *et al.*, (2004) includes education, awareness creation and law enforcement.

On the contrary, Sanders (2003) argue that the strategies that are most effective in dealing with human-caused ignitions are education and enforcement referring to fire prevention. Sanders is quick to add that it is difficult to assess the overall effectiveness of fire prevention programs because it is impossible to determine how many fires there could have been without these programs. However, the most effective implementation of prevention strategies occurs immediately before, during or after an unwanted fire is ignited. The challenge is to be proactive, and implement effective education, patrols, and enforcement in high risk, high hazard, and high value areas during periods of high fire danger (Sanders, 2003).

Fire prevention programmes that are accepted and promoted within the community not only reduce costs and resource damage, but also promote understanding of the role and impact of fire in the ecosystem (FAO, 2006). All too often, fire prevention campaigns are aimed at sections of the community that do not cause a significant proportion of fire, while those that use and cause the vast majority of fire, are bypassed in prevention activities (Shields *et al.*, 2006). It is in view of this that Shields *et al.*, conclude that fire prevention programmes and activities should be targeted toward those people and groups that are causing and igniting fire.

Fire prevention, the practitioners say is much safer than fire suppression and needs to be strongly emphasized for successful fire management programmes (Ninnoni *et al.*, 2003). It applies to human-caused ignitions and requires a combination of community

education, effective prevention programmes and enforcement of laws or regulations (FAO, 2006; 2009). According to the FAO (2007b; 2009) empirical observation conclude that fire prevention is often hampered by unclear lines of institutional responsibilities and by conflicting policies and regulations. It is in line with this that Shields *et al.* (2006) writes that without clear understanding of the linkages between fire cause and fire prevention actions, and more particularly, who causes them and why, it will remain a difficult task to effectively target sound fire management practices, particularly fire prevention.

2.1.2.2 Fire Pre-Suppression

Fire pre-suppression activities are the activities undertaken prior to fire season. These pre-fire season activities involve cooperative action with collaborators, contractors and organizations in support of fire management (FAO, 2006). Jansen (1995) is of the opinion that the quality of fire break as well as pre-suppression activities at the site of burning and the number of people carrying out the burn are important factors to consider in burning.

The objective of fire pre-suppression management is to plan and prepare for fire suppression activities prior to their occurrence (Ninnoni *et al.*, 2003). In Ghana, as well as other fire prone countries, the following pre-suppression preparations are carried out (Barnes *et al.*, 2005; Ninnoni *et al.*, 2003);

- Green firebreaks

Green fire breaks have been identified as one of the most effective pre-suppression measures to ensure the containment of wildfires. The creation involves putting in place physical structures capable of stopping and/or slowing down ‘running fires’ due to reduction in fuel available for burning in the firebreak (Barnes *et al.*, 2005).

According to Ninnoni *et al.* (2003), the advantage of green firebreaks is that they are cheap to establish and maintain since the approach normally is to use local communities to plant the firebreaks. Also, the firebreaks are self-maintaining, except for the possible need for a light early burn of accumulated leaf litters. The principle behind green firebreak is to cover an area with a complete tree canopy to prevent the growth of weeds and other vegetation. Thus it serves as a buffer capable of checking advancing wildfires by reducing the fuel available for burning (Barnes *et al.*, 2005).

- Cleared firebreaks

According to Ninnoni *et al.* (2003), cleared firebreaks are standard bare-ground firebreaks and fire traces which represent the simplest form of fire control. Cleared firebreaks are used to burn off all flammable fuel within a strip of land to mineral soil in order to serve as a buffer. The strips are made wide enough to prevent creeping fires from encroaching forest reserves. Cleared firebreaks are effective in degraded forest especially in the savanna and grassland vegetation zones where crown fires are uncommon (Ninnoni *et al.*, 2003).

- Early burning

Early burning as a pre-suppression measure is used as fuel management tool where an area is burnt under controlled conditions in order to reduce the fuel available for late burning when conditions are favourable for wildfires Ninnoni *et al.* (2003). The advantage of early burning according to Ninnoni *et al.* (2003), is that the fire intensity is low so the impact on juvenile trees and soil microbes are minimal.

Pre-suppression also involves risk assessment, detection and communication. Fire detection and communication are necessary activities which according to Barnes *et*

al. (2004) when managed effectively and efficiently could save fire suppression cost. Furthermore, wildfire can easily be controlled with little resources when detected and communicated early enough.

2.1.2.3 Fire Suppression

Fire suppression is based on the ability of a well trained and equipped fire crew to safely and rapidly respond (Initial Attack) to a wild land fire, contain or control the fire within a 24 hour period (or certain size limit), and be ready to respond again by the next day (Sanders, 2003). But Barnes *et al.* (2004) see the operation of fire suppression to include planning, through the initial attack and expended attack to mop up and finally patrols.

Barnes *et al.*, (2004) defined fire suppression *as* all the work and activities connected with fire extinguishing operation, beginning with discovery and continuing until fire is completely extinguished. FAO (2006) also defined fire suppression as all activities concerned with controlling and extinguishing a fire following its detection (synonyms: fire control, firefighting). The objective of fire suppression according to Barnes *et al.* (2004) and Ninnoni *et al.* (2003) is to contain and control fire at minimum cost consistent with land and resource management objectives. Based on the objective and definitions of fire suppression, Barnes *et al.* (2004) and Ninnoni *et al.* (2003) identified three basic fire suppression methods, which are used to confine, contain or control fires in wildland areas;

- Direct attack method

The direct attack of fire suppression is offensive and is used to suppress slow moving or small fires. It involves suppressing flames by cooling the fuel with water, chemicals or dirt (Barnes *et al.*, 2004 and Ninnoni *et al.*, 2003).

- Parallel attack method

Parallel attack is used in situations where fires are spreading fairly rapidly. According Barnes *et al.* (2004) in parallel attack, a line is constructed as near to the fire edge as possible while still allowing for crew comfort and ensuring that the line is completed before the arrival of the burning fire.

- Indirect attack method

This method is used strategically to take advantage of favourable terrain and natural barriers or firebreaks well in advance of a fast moving fire perimeter (Barnes *et al.*, 2004). Indirect attack is used when the fire is too intense for safe use of any other method or when the values being protected are insufficient to justify a large fire fighting expenditure (Barnes *et al.*, 2004, and Ninnoni *et al.*, 2003).

The FAO (2007) reveal that fire suppression is often hampered among several factors by unclear lines of institutional responsibilities and by conflicting policies and regulation.

FAO (2006) however argue that effective monitoring and assessment of the prevention programme can reduce the occurrence of specifically identified types of fires and the costs of suppression. Yet, governments responses to fires have tended to focus on fire suppression and costly technological solution to fight fires (Ganz and Moore, 2002). Local citizens, Everett (2002) indicates are not normally involved in fire suppression planning or pre-fire decision making processes. But as the number of fires appeared to increase, conventional fire suppression has increasingly come under question (Ganz and Moore, 2002).

2.1.3 Concept of Community Fire Management

Communities and community based approaches to fire management have received elaborate examination in such fields as anthropology, community based forest management and other social science disciplines in contemporary times (Ganz *et al.*, 2003). But the technical and organizational capacity of communities in relation to managing fire historically and culturally is poorly understood and rarely studied (Ganz *et al.*, 2003; Changchui, 2002). Jackson and Moore (1998); Ganz and Moore (2002); and Moore (2003) revealed that relevant and high quality information (published and unpublished) on community involvement in fire management was difficult to find.

There is no single definition of community based fire management but rather principles which have evolved around the globe (Ganz, 2009). Community based fire management has been used in different ways to describe in a wide variety communities involvement in fire management that makes it difficult to make any systematic comparison or generalization (Moore, 2003).

According to Ganz and Moore (2002), lessons gained from community involvement in forest management are directly relevant to community fire management. The term “community” in the context of community fire management is taken broadly to include a household, a group of households, a settlement or a group of settlements (Ganz and Moore, 2002). However, in general, a single household is not considered a community. “Community” is used in two completely different ways – one sense carries with it the idea of a group of people who live within a particular locality. The second sense is that of “community interest” (Moore, 2003).

It is worth noting however that, the term “community based” in the context of community based fire management is much more than community labour in fighting fires (Ganz, 2009; Ganz and Moore, 2002). The emphasis of “community-based” is sometimes focused on community involvement alone. At other times, Community based fire management has been recognized and supported by external agencies. However, community “involvement” covers a wide spectrum of situations, from potentially forced participation in an activity (coercion) to free and willing participation in actions developed by the actors themselves (empowerment) (Ganz and Moore, 2002; Ganz *et al.*, 2003).

Community fire management is concerned with ensuring local people’s access to and involvement in the management of forest resources. The catalysts behind community fire management approaches are indigenous land owners and/or those with use rights, including the right to use fire as a management tool (Ganz *et al.*, 2003; Ganz and Moore, 2002; Moore, 2003). In the perspective of Moore (2003); Ganz and Moore (2002), community fire management has three nodes:

1. Local scale fire management where traditional or indigenous knowledge plays the major role in informing and undertaking fire management, which is also planned, conducted and controlled by local people.
2. Community involvement in fire management that involves a range of local actors, including agencies and NGOs that work on fire management.
3. Volunteers from the community, perhaps with agency involvement, conduct fire management on behalf of the community across private and public lands.

In many parts of the world, local communities and their inhabitants are often blamed for causing harmful fires. This view often encourages fire and also makes forest management institutions perceive local communities as part of the problem and certainly not part of the solution (Ganz *et al.*, 2003). However, studies conducted by Lichang *et al.* (2003); Dampha, (2003); Alvarado *et al.* (2003); Nanda and Sutar, (2003); London, (2003); and Kurtulmuslu and Yazici (2003), in separate places of the world revealed that the underlying reason for the local communities and their inhabitant's failure to control fires is not lack of awareness or carelessness but rather lack of incentives to protect forest resources. The question posed by Ganz *et al.* (2003) is: Why protect forests when they are owned by the state and utilized by outsiders?

This view of Ganz *et al.* (2003) is worth sharing because, before the advent of state ownership of forest reserves and concessions given, local inhabitants managed these forests for their livelihood. Denying the local communities of their livelihood implied giving them the license to destroy forest reserves in protest. Unless these perceptions about local people are changed it is doubtful if there would be any success in the management of fire.

Rakyutidharm (2002) noted that if communities have no sense of resource ownership, it results in the careless use of fire. This happens when communities are barred from participating in forest management. Makarabhirom *et al.* (2002), agreed to the assertion of Rakyutidharm (2002) by stating that when government assumes ownership of resources, communities find it increasingly difficult to impose rules and regulations on those who set forest fires. Ganz and Moore (2002) further provided

evidence that land/resource tenure security and incentives are important ingredient for successful community based fire management. Ganz and Moore (2002) nonetheless added that focus should be on people and organizational structures rather on equipment or legal contract.

Community based fire management is considered as a component of participatory community development strategies and forest fire management. Also, community based forest management has recognized the integral contribution that community based fire management has to offer participatory forest management (Ganz *et al.*, 2003). Proponents of community fire management have maintained that there are potential and important linkages among community based fire management, land use planning, natural resource management and overall community development processes (Ganz and Moore, 2002; Ganz *et al.*, 2003).

The foregone discussions have placed the concept of community based fire management into well drilled perspective and varied contexts. However, the study will adopt the definition proposed in a recent work by Ganz *et al.* (2003), which puts community based fire management as: A type of land and forest management in which a locally resident community (with or without the collaboration of other stakeholders) has substantial involvement in deciding the objectives and practices involved in preventing, controlling or utilizing fires.

2.2.0 Wildfires in Ghana

Fire is widely accepted throughout Ghana as being a valuable tool in the management of natural eco-systems, agriculture including livestock production and in other land use systems (Nsiah-Gyabaah, 1996). As a result, it has been in the country since time

immemorial. Orgle (1994) indicated that, Ghana's records of fire date back to the 1910s. It is also on record that Ghana experienced serious bushfires during the catastrophic Sahelian drought between 1973 and 1974 (Nsiah-Gyabaah, 1996).

Notwithstanding, before 1983, uncontrolled fires were relatively uncommon especially in forest zones. The severe droughts of 1982/1983 and the accompanying wildfires was the turning point (Korem, 1985). Since then wildfire has become an annual ritual in most part of Ghana due to changes in weather pattern, composition of vegetation and increasing population (Barnes, 2008).

An assessment by FAO during 1982 and 1983 revealed that 50% of Ghana's vegetative cover and 35% of her standing crops were burnt by bushfires (Ampadu-Agyei, 1988). Although complete data on the extent of damage made by the 1982-1983 fires are non-existent, Ampadu-Agyei (1988) indicated that 1005 bushfire incidents were reported country wide. However, according to Nsiah-Gyabaah (1996) available records show that during the 1982-83 harmattan season, about 35 per cent of crops were destroyed by bushfires. In 1984-85, about 145 bushfires were reported in the northern savanna zone and 110 bushfires in the transitional zone. By 1993, the forest reserves affected by fire in the high forest zone was 0.917 million hectares (FFMG, 1998; FORIG, 2003).

In the last two decades, wildfire has become one of the most dramatic natural and anthropogenic forces which have shaped the biotic community (Nsiah-Gyabaah, 1996; Apusigah, 2005). This is so especially in the fragile savanna regions where biodiversity has decreased and the existing vegetation has been destroyed, or

disturbed by fire resulting from human activities such as agriculture, including livestock and hunting (Nsiah-Gyabaah, 1996; Apusigah, 2005; Bagamsah, 2005).

Fire according to Hawthorne (1994) controls the structure and composition of vegetation over most parts of Ghana. The damage caused by fire in Ghana during the drought of 1982-1983 has significantly altered the structure and composition of 30% of the semi-deciduous forest (Hawthorne, 1994). Brookman-Amissah *et al.* (1980) and Swaine *et al.* (1992) stressed that without regular fires, large areas of savanna would have been forested and at least support greater density of trees than now. But fire is by far the greatest threat to the long term productivity, genetic wealth and general health of the semi-deciduous forest, which contains about half of the forest remaining in Ghana (Hawthorne, 1994).

The causes of wildfire in Ghana are linked mainly to anthropogenic factors (Korem, 1985; Bagamsah, 2005). Indeed, fires caused by natural factors are uncommon in Ghana (Bagamsah, 2005). Korem (1985) noted that bushfires in Ghana are started rarely accidentally but rather intentionally. He further pointed out that many people especially in northern Ghana practice indiscriminate burning with the intention of gaining something. But such people often have not the slightest idea how severely they act against themselves and against the whole society.

Specifically, the causes of bushfires in Ghana include honey hunting, burning for pastures, shifting cultivation/slash and burn agriculture, cooking on the farm, religious and ceremonial burning, hunting, gathering fire wood and smoking (Korem, 1985 and

Ampadu-Agyei, 1988). However, Barnes *et al.*(2004) generally classified the causes of wildfires in Ghana as negligence; arson; accident; and tradition, cultural and belief.

The causes of wildfire in Ghana as posited by the authors in this context points to the conclusion that, burning is an integral part of agricultural practices and indeed embedded in the cultural activities of the Ghanaian. Korem (1985) and Ampadu-Agyei (1988) have maintained that fire is part of traditional farming systems in northern Ghana as they burn crop residues instead of using them. The culture of burning has become a generational phenomenon. Nsiah-Gyabaah (1996) and Amissah (2008) further cemented this assertion and indicated that burning is embedded in the cultural values and traditional farming systems of the people.

In a similar fashion, Amanor (2005) writes that within the national coalitions that determine wildfire management, fire is considered a product of cultural backwardness and moral torpor. This position, Amanor traced to Korem's publication on Bushfire and Agricultural Development (1985), a book that has been highly influential in defining contemporary bushfire policy in Ghana. Another concern raised is the inadequacy of institutional controls to mitigate bushfires and the need to counter the backward cultural beliefs by soliciting traditional authorities to impose customary sanctions on those who persist in burning (Amanor, 2005). However, Ampadu-Agyei and Atsiatorme (1998) and Alhassan and Saaka (1999) advocated strengthening the roles of traditional authorities in implementing anti-fire laws.

2.2.1 Wildfire Management in Ghana

The perceived destructive influence of wildfire was identified in Ghana from as early as 1910 (Wardell, 2004). However, early efforts to prevent, control and suppress wildfires

in Ghana involving both colonial agricultural and forestry officers began in the 1920s (Wardell, 2004). Attempts at controlling wildfires at the early stages unfortunately did not place emphasis on management. In 1934, the first official attempt to manage wildfires was seen in the Savanna Woodland Policy (MLFM, 2006; Apusigah, 2007). The 1930s and 1940s witnessed a number of attempts by the colonial government and its Native Authorities (Tater, 2004; MLFM, 2006; Apusigah, 2007). Taking a cue from this initiative, the Dagomba (1934, 1949), Lawra (1938) and Kassena-Nankana (1938) Native Authorities instituted measures to check burning (Apusigah, 2007).

In the later parts of the 1940s, new fire management strategies were formulated (Apusigah, 2007; MLFM, 2006). These included construction of fire belts, early burning, annual trace burning, patrols during dry season, wildfire awareness campaigns and green fire-belt establishment. Although these new fire management strategies worked effectively in protecting areas and forest reserves, they did not however, address fires outside the forest reserves (MLFM, 2006). A bushfire experiment was established near the Red Volta River in 1949 and by 1963 results had confirmed that early burning techniques represented the only practical solution, given the diversity of interest groups in Northern Ghana (Wardell, 2004).

In lieu of these early lessons learned, the Forestry Department of Ghana became instrumental in constructing the conceptual dichotomy between the realms of the “modern and scientific” approach to fire control and the “traditional and haphazard” use of fire as a land management tool in Northern Ghana. This has veiled complex historical, ecological and socio-cultural realities and the persistence of the wildfire challenge in spite of repeated attempts by the state to legislate against the setting of

wildfire throughout the period 1957-2000 (Wardell, 2004). This particular assertion by Wardell is at the very core of this study.

Before 1983 when fires were rare, the local people were using the indigenous methods of fire prevention and control. In 1983 when wildfires apparently became uncontrollable in Ghana, conventional fire management systems were introduced and legislation (PNDCL 46 – Control of bushfire law) was enacted to control fires (Tater, 2004; Wasai, 2004; Obiaw, 2004; MLFM, 2006). The legislation did not make provision for implementation arrangement in terms of responsibilities for governmental agencies and roles for communities and traditional authorities (Obiaw, 2004 and NWMP, 2006). This was subsequently amended in 1990 (PNDCL 229 – control and prevention of bushfire law) (Obiaw, 2004 and MLFM, 2006; Apusigah, 2007).

The PNDCL 229 on bushfires, as it currently stands however does not provide a comprehensive framework for addressing the wildfire menace in Ghana. Its limitation includes; lack of clear identification of the custodian of the law; no legislative instrument to guide and streamline the implementation of the law; penalties not being deterrent enough to deter would be offenders; and it did not empower traditional authorities and communities to play a key role in its enforcement (Obiaw, 2004 and MLFM, 2006).

In apparent attempt to forestall these short comings, the Forestry and Wildlife Policy of 1994 came into force for the maintenance of environmental quality and perpetual flow of optimum benefits to all segments of society. However, the policy did not consider wildfire as a major issue in forest management and did not place wildfire

management issues high on the national agenda (Obiaw, 2004 and MLFM, 2006). Also, the National Fire Service Act of 1997 (Act 537) is flawed with respect to wildfire management as it is highly skewed towards industrial and domestic fire management; it does not go far enough with respect to empowering local communities and groups; and the act is silent on how logistics would be provided to assist the operation of fire volunteer squads even though the act advocated for its establishment in communities (Obiaw, 2004 and MLFM, 2006).

Until 2006, Ghana did not have any formal and clear cut policy on fire management. The absence of clear cut policies led to inconsistencies in the implementation and enforcement of the bushfire/wildfire laws. The challenge for Ghana was to move away from the piece-meal approach to wildfire to more comprehensive and sustainable community based approach (Obiaw, 2004; MLFM, 2006). Although the 2006 wildfire management policy identified and allows relevant institutions and stakeholders to develop individual action plans for the attainment of the policy objectives, it is silent on the time frame for the establishment of these institutional action plans. Also though the 2006 National Wildfire Management Policy have recognized the crucial role communities can play in the sustainable management of natural resources, this is not backed by any legislative instrument to compel implementing agencies to do so (Barnes, 2008).

In recent times, specific initiatives have been fashioned out including; the formation of an inter-ministerial technical committee on bushfire prevention; the formation of Rural Fire Division of Ghana National Fire Service; Forest Protection and Resource

Use Management (FORUM); JICA forest management project; and wildfire management project which started in 2002 and is ended in 2008 (Obiaw, 2004).

Also International Tropical Timber Organization (ITTO) funded a forest fire management project in Ghana aimed at collecting baseline data for use by policy makers and forest managers (Amissah, 2003). In 2004, the wildfire suppression training manual for community fire organizations was introduced by the forestry commission. The main aim of the manual is to promote and provide technical and practical training in wildfire suppression for rural communities to enable them to effectively carry out wildfire fighting while maintaining technical standards, which form part of the resource management operations (Barnes *et al.*, 2004).

The activities of the Forestry Commission (FC), with regards to bushfire management over the past three decades can be grouped into the pre-participatory and participatory periods. The Forestry Commission in collaboration with the Ghana National Fire Service, trains communities in basic fire suppression procedures as well as pre-suppression and restoration activities. An integrated forest management approach has also been adopted by the commission with the forest fringe communities (Dogbe, 2004).

Non-Governmental and educational institutional efforts have also contributed towards developing sustainable community fire management programmes. For instance, CARE International with sponsorship from Royal Danish Embassy and in close collaboration with University for Development Studies and other stakeholders designed the Bushfire and Rural Livelihood Project (BURN). The project which

ended in 2006 covered Brong Ahafo – Wenchi and Tain Districts, Northern Region – East and West Mamprusi Districts and Upper East – Talensi Nabdam District and Bolga Municipality (Sumbo *et al.*, 2006). Whereas these strategies worked for some time, they failed to address the problems of wildfires in the country. With time, off-reserved areas or BURN communities became the sources from which wildfires emanate and spread to the forest reserves or non burn communities (Sumbo *et al.*, 2006; WFMP, 2008). Also, ongoing efforts fail to mobilize and tap into individual and collective experiences and knowledge of all stakeholders in order to develop a sustainable program for combating bushfires (Apusigah, 2007).

Laudable as the ongoing efforts at combating wildfire have been, they still have not been without challenges. While acknowledging that these efforts have been useful, Apusigah (2007) argues that to a large extent, the defects in policy framing and resulting strategies served to impede progress toward sustainable wildfire management. This situation Apusigah (2007) attributed to framing limitations regarding;

1. Punitive language use - The strong language that has framed policy can be critiqued against the backdrop of a colonial past, patriarchal society and technicist agenda of development and change. It might be necessary to seek out areas of collaborations that foster restorative justice rather than the usual legislation and enforcement. New and alternative avenues that are informed by indigenous, especially women's, ways of knowing might be more effective than existing punitive measures.
2. Competing allegiance - The fact remains that the competing systems of governance in Ghana neither favour government nor citizens. The inability

to forge effective alliances between traditional systems and formal systems results in divided allegiances that often work against formal and/or structured attempts at law enforcement. The inadequacies of and inefficiencies in the management strategy makes it convenient for people to exploit the situation to selfish ends. In recent times, there has been a high recognition of the need to involve all stakeholders in the fight against bushfires (Rhodes, 1996; Gear, 1996).

3. Blaming communities - Another significant problematic area is that past efforts reflect a very limited viewing of community, which disallows them from taking full advantage of the wealth of experiences and knowledge available at that level. The framing of policy and practice reflects a viewing of communities as ignorant people, implicated victims and stubborn perpetrators of bushfires.
4. The gender blindness - A related problem is the stark lack of gender perspectives in the framing of policy and programming of interventions. Past anti-wildfire strategies did not reflect an appreciation of gender issues in management efforts. They lacked an appreciation of women's contributions to wildfire management as a category that works closely with nature. Interventions hardly consider the different ways that wildfires affect females and males and as such hardly incorporate such understandings in intervention initiatives.

The preceding write ups have elaborated on the various fire management practices (be it in the realm of institutional, national or community based) in the country for decades now vis-a-vis their challenges. These challenges, especially the contribution of Wardell (2004) that the persistence of the wildfire challenge in spite of repeated attempts by the

state to legislate against the setting of wildfire throughout the period 1957-2000, has veiled complex historical, ecological and socio-cultural realities. Thus, the effectiveness of community based fire management in the nation can be questioned. It is against this background that this study focuses on assessing the effectiveness of the community fire management around the Tain II forest reserve.

2.2.2 Indigenous Fire Management in Ghana

In Ghana, burning is embedded in the cultural values and traditional farming systems of the people (Nsiah-Gyabaah, 1996). Traditional burning is peculiar to the northern parts of Ghana among different tribes notably Dagombas, Moshie, Mamprusi, Kusasis, Gonjas, Gurimas, Talensis, Komkombas, Walas and Dagartis (Korem, 1985). The custom of burning is performed in the evening of the ninth day of the month of fire. It is believed that something good will happen to those who partake in ceremonial burning in the coming year (Korem, 1985).

Ampadu-Agyei (1988) attributes the yearly occurrence of bushfires to what he describes as the perpetration of the culture of burning in the wake of disintegrating socio-cultural norms which regulated burning. The culture of burning by Ampadu-Agyei is perhaps what Akyea (1988) described as crazy culture. Kirby (1988) explored the less visible but perhaps more fundamental reason for bush fires, which are attitudinal – the ways in which the issue is understood by the rural communities who set the fires. Kirby also contextualized bush burning as a cultural problem.

Millar (2005) identified that in the Badu and Banda Traditional Areas in the Wenchi District, there exist two separate festivals associated with fire notably

“DAFLAKALEGO” meaning fire festival that follows the traditional rite of the people of Badu and JORBENE festival respectively. The “Jorbene festival” does not only suggest the celebration of the bushfires but also an occasion within each year in which traditional rulers and family heads pay homage to the gods of the land in return for peace, reduction in calamities such as fire outbreaks, tribal war, illness among others.

Similarly, Agubie Community (2004) adds that; unless a sacrifice is made to a maiden god called Drobo to appease them for protection from any calamity that might occur in the Wenchi Traditional Area, it is prohibited for anyone to set fire on his/her field. During this sacrifice, a fire belt is created around the portion of the forest, which is torched and burnt to mark the advent of bushfires on farms. It could be argued that these cultural practices make up the practical sphere of indigenous wild fire management in Ghana.

Beyond the practical realm however, in rural communities in Ghana, there also exist vast knowledge, skills and experiences regarding wildfire management. According to Millar (2004); Wulugu Community (2004); Bowku Community (2004); Agubie Community (2004); Kalbeon Community (2004) there are in-depth knowledge on the bushfire menace and the various technologies devised by communities to control and manage the fires. Many of the rural communities, as part of their way of living, have developed environmentally sensitive strategies for living with and managing nature. They have developed knowledge and skills and even spiritualities that enable them to conserve their sources of livelihoods and their way of life. Taboos, sacred places, festivals and cultural practices have conservation ethics built in them (Apusigah, 2007).

Traditional time-tested ways of knowing have proven quite successful for many communities for many decades. According to Apusigah (2007) until the rights and responsibilities for the management of wildfires were taken from them and replaced by control and preventive measures, the traditional strategies served the purposes of the people. Perhaps the inability of the traditional strategies to meet current challenges has also contributed to the current situation.

However, for reasons that current initiatives have also failed, it becomes imperative for the search for alternatives that are informed by all histories. Past history and evolving strategies that tap into local knowledge and experiences will be useful (Apusigah, 2007). Local people according to FORIG (2003) have some indigenous knowledge of forest fires, which is reliable but remains to be tapped and processed into scientific knowledge to enhance its effectiveness. Researching into indigenous fire management practices in Ghana, Amissah (2008) remarked that present indigenous practices for fire usage and management in Ghana are comparable to scientific practices. Amissah, however, was quick to add that these practices are fraught with certain weaknesses such as repeated burning, inappropriate time of burning and a not too well developed set of alternatives to the use of fire.

Amissah (2008) identified broadcast burning and burning of heaps as indigenous burning techniques. Indicators used before burning take place include; 2-3 rains after the end of dry season in March, low temperature and relative humidity, leaf flush of *Morus mesozygia* (Wonton) and the throwing of soil into the air to check direction and speed of wind to ensure safe burning (Amissah, 2003). The idea of checking for these signs locally are consistent with scientific ways of burning except that these

indigenous procedures are not specific and heavily depends on the experience of elderly farmers involved in burning (Amissah, 2008).

Furthermore, Amissah (2008) indicated that over the past two decades, indigenous people in Ghana have managed fires through prevention and suppression activities. Fire pre-suppression was carried out through the construction of fire breaks and early burning which were not common in the forest zone in the past. In suppressing fires, community members are assembled through beating of gong-gong or drums authorized by the chief. Also local people construct fire breaks to stop fires directly or indirectly by beating fires with palm fronds and water. In spite of this, FORIG (2003), states that indigenous knowledge of fire prevention has received little attention and remains to be tapped into by government institutions responsible for defending public interest in the forest reserves.

However, Makarabhirom *et al.* (2002), indicates that traditional and cultural practices have been replaced and eroded by economic development making indigenous knowledge ineffective in fire management. This, Makarabhirom *et al.* (2002) attributed to the loss of indigenous knowledge and community responsibility for fire management. Like Makarabhirom *et al.* (2002), some studies have stressed that local knowledge is disappearing; women do not pass this information on to their daughters and men no longer pass it down to their sons (Howard, 2003).

But as blurred though as the picture may appear, there still remains useful indigenous knowledge that adds to the understanding of specific dynamics of fire within a complex local landscape (Mayer, 2002). Furthermore, indigenous knowledge

enhances comprehension of how community members are able and motivated to manage fire for their own and their neighbours' safety and well being, for ecological integrity and response to broader concerns (Mayer, 2002).

Traditional knowledge itself is insufficient to ensure effective fire management as institutional structures and the capacity to apply the knowledge are needed (Ganz and Moore, 2002). Ganz and Moore (2002) call for integration of traditional approaches into fire management. However, the government has a role in preventing uncontrolled forest fires, especially when offenders are not members of the community. Policies that deter land conversion and migration may be critical in stopping some forest fires (Karki 2002).

Historically, traditional authority has always been in the forefront of management of wildfires. Various institutions, structures and systems, still exist and put in-place as traditional management systems to regulate wildfire management and the general uses of fire. If left alone, this traditional responsibility system could have been relied on for sustainable fire management. Tinkering with this authority has led to the diminishing of their effectiveness and efficiency (Mbow et al., 2004; Wardell, 2004).

Reflecting on the foregone discussions, it can be said that traditional fire management in Ghana does have two important avenues for addressing the menace of bush fires across the country namely: the practical imperative; made up of the numerous cultural rituals as well as the knowledge bracket; including the knowledge, skills and experience of local communities that remain largely untapped. Not too refreshing though is the impression that these indigenous practices and knowledge have not been

fully tapped, leaving the effectiveness of local fire management in the balance. Perhaps the contribution of Mbow *et al.* (2004) that even though there are “a basket of policy choices” by way of best practices relating to wildfire management, whatever practice is being tested will require the active participation of traditional authorities in a lead role position, evoking their structures, systems and practices to regulate wildfire.

2.2.3 Indigenous Knowledge in Natural Resource Management

The interpretation of nature amongst most ethnic groups in Ghana, as elsewhere in West Africa, has influenced most aspects of social, material and spiritual life (Rattray, 1923; Frazer, 1926; McLeod, 1981). Also in Ghana, traditional natural resource management, as in other parts of Africa, is shaped around local rules and regulations (Ntiamoa-Baidu, 1995; Abayie Boateng, 1998). These rules and regulations are most often enshrined in religious or cultural beliefs and superstitions and enforced by prohibitions. These have no legal backing, but the beliefs have been strong enough in the past to make people obey the regulations (Ntiamoa-Baidu, 1995).

The environmental wisdom and ethics expressed through these religious beliefs have been very useful tools in resource management. For instance, the belief that the earth has a power of its own which is helpful if propitiated and harmful if neglected, is a strong moral sanction against the wanton destruction of the environment (Appiah-Opoku and Hyma, 1999).

Forests are considered the most important natural resource culturally, economically and ecologically (Abbiw, 1990; McCaskie, 1995; Afikorah-Danquah, 1998). The forest environment is noted to have made a significant impact on the social life of

many tribes in Ghana (Sarfo -Mensah and Oduro, 2007). Forests are perceived generally amongst most tribes in Ghana to be the abode of spirits such as dwarfs (Abbiw, 1990 cited in Sarfo - Mensah and Oduro, 2007). Folklore has it that the forest is the domain of the mythical Sasabonsam (McLeod, 1981; Abbiw, 1990).

Other local perceptions are based on the socio-economic and environmental value of the forests as sources of fertile land for cultivation, timber, food, household utilities, game, and medicinal plants and for the maintenance of environmental and ecological stability (Ntiamoa-Baidu, 1991 cited in Sarfo-Mensah and Oduro, 2007). Traditional conservation approaches to the forest have, therefore, been based on these local perceptions. Amongst the prominent traditional approaches are sacred groves and sanctuaries (Sarfo-Mensah and Oduro, 2007).

Also, farming strategies have been considered to be amongst the major modes of managing the environment in the country (Amanor, 1994). Traditional farming systems which enhance conservation and good land husbandry have come under tremendous pressure for change (Abayie Boateng, 1998). Traditional farming systems were developed on the principle of a belief in and regard for mother earth as a deity (Anane, 1997; Abayie Boateng, 1998). In order to allow her to continue to play a motherly role and to enhance biodiversity, traditional farming systems amongst the Akans were fashioned through laws and regulations to allow sustainable use of the land (Abayie Boateng, 1998; Appiah-Opoku and Hyma, 1999). Traditional farming systems have many advantages that include the minimisation of soil erosion, the preservation of agro-biodiversity, the maintenance of ecological stability and the enhancement of food security and a balanced diet (Benneh, 1997).

In fact, they can be considered to be organic farming systems because they rely on natural soil fertility for regeneration or the limited use of artificial fertilisers (Benneh, 1997; Gyasi, 1997). However, in several parts of Ghana, traditional farming systems have undergone drastic changes and many practices are disappearing (Benneh, 1997; Abayie Boateng, 1998). Although traditional farming practices are undergoing changes, it has been argued that these are in reaction partly to forces of change that were imposed externally on the systems (Amanor, 1997).

Both biophysical and socio-economic factors have been cited as responsible for these changes. However, in recent times, it is increasingly being acknowledged that the rapid change is due to the breakdown of traditional beliefs and associated taboos. As demonstrated, beliefs, rituals and taboos underlie the majority of traditional natural resource management practices. The reason for the central role of these beliefs is that, in Ghana as in other parts of West Africa, the spirituality of local people serves as the basis for all human endeavours and is reflected in their worldview (Millar, 1995). Several of the traditional management practices, although are undergoing changes, have retained some of their intrinsic practices despite production pressures. This has partly been attributed to the fact that many local people still perceive them to be associated with gods and ancestors who are still revered (Dorm Adzorbu *et al.*, 1991; Fargey, 1991; Falconer, 1992; Ntiamoa-Baidu, 1995; Gyasi, 1996; Abayie Boateng, 1998).

2.2.4 Community Fire Management

Community based fire management case studies conducted by Lichang *et al.* (2003); Dampha (2003); Alvarado *et al.* (2003); Nanda and Sutar (2003); London (2003); and Kurtulmuslu and Yazici (2003), in China, the Gambia, Honduras, India, the Lao

People's Democratic Republic and Turkey respectively, indicate a shift in direction in fire management; a movement away from centralized and state driven forest fire management towards decentralized and mainly community based management regimes. In China, Lichang *et al.* (2003), discovered that in Wenyime village, the community discussed and formulated regulations of its own which are effective. Lichang *et al.* concluded that the most effective forest fire prevention regulations are not necessarily those of the government or outsiders.

In contrast with the views of Lichang *et al.* (2003), London (2003) who researched in the Lao People's Democratic Republic identified that project based solely on community based fire management are not likely to be initiated in the near future. The study concluded that incorporating community fire management into forest fire management requires sincere commitment from all stakeholders' particularly Lao government, the donor community and the local people involved.

It is interesting to note that the issue of community based forest management bring divergent results from specific locations. For instance, while evidence from Honduras according to Alvarado *et al.* (2003) suggests that although forest fires continued to pose a threat to these communities, there was a high level of forest awareness, the situation in India in the perspective of Nanda and Sutar (2003) is different. They observed that with regard to initiatives for forest fire management, there is an apathetic attitude among community members who believe that, because fires occur each year, there is nothing that they can or should do about it. This, according to Nanda and Sutar had led to 72 hours fire in 2001 without community members taking action to mitigate it.

Nanda and Sutar (2003) noted further that the outbreak and frequency of forest fires are dependent on the interest and level of forest dependence of the rural community living close to the forest area. Forest protection measures are adopted only when communities experience scarcity of forest resources and realize the magnitude of the impending disaster. Dampha (2003) in the Gambia revealed that chiefs and villages fear losing the cooperation and support of their subjects by prosecuting them for fire offences. However, Dampha concluded that consistent law enforcement can help to deter those inclined to careless practices in relation to fire use. It further stated that people who willingly comply with regulation will continue to do so only if they see that culprits are being prosecuted.

In spite of these debates regarding motivation or otherwise of communities to embrace fire management as part of their livelihood issue, research results point to the fact that many gains have been made. Community-based fire management is believed to have helped reduce wildfires in Namibia's Caprivi region by more than 50 percent (Jurvelius, 2004). The approach, adapted to local cultures and conditions, is now being extended to other developing countries in Africa, Asia, the Near East and Latin America (FAO, 2003) as well as to countries with economies in transition (Jurvelius, 2004).

Adding to this, Ganz *et al.* (2003) posited that community based fire management offer promise as an effective and more sustainable approach than conventional fire management over the long term. Community fire management in the eyes of Ganz and Moore (2002) operate effectively when local populations are already adequately empowered to manage and use natural resources. In a more cautious tone however,

Suyanto *et al.* (2002) added that for community based fire management to be effective, it required detailed knowledge of environmental impacts, communities' livelihood systems and their relationship with the wider socio-economic and institutional environment. This had informed the decision to do an assessment of community fire management in Tain II to identify these concerns raised by the authors and factors affecting community fire management.

Community-enforced fines and other penalties often work better than government legislation in discouraging people from breaking rules. Simple rules aimed at fire prevention in forests managed by communities have existed for many decades (Karki, 2002). Villagers of Tenganan, Bali, Indonesia, follow customary law or 'awig-awig desa', which includes a provision for punishment for fire damages: "if one of the villagers burns bush or garbage that causes other trees to be burnt he will be fined in accordance with the damage done and he should also perform a religious purification ceremony" (Tantra, 1990 cited in Karki, 2002).

2.2.5 Stakeholders Participation and Gender Perspectives

2.2.5.1 Gender issues in Fire Management

An intrinsic aspect in community based fire management is gender, the roles of women, men and children. These roles can be quite specific, detailed and different (IFFN, 2003; Moore, 2003). According to FAO (2005), there are different tasks and responsibilities of women and men that have enable them to accumulate different types of local knowledge and skills.

However, the community has been seen as a homogeneous unit in terms of status, influence, wealth, gender and access to resources (Muckherjee *et al.*, 2006; Wollenberg

et al., 2001). Even where these difference have been recognized and participatory processes have been employed, issues of power and the capacity of the groups to negotiate solution have not always been adequately considered. As a result, many women's concerns regarding forest use and access have been neglected in the consultations undertaken in the participatory design and implementation of projects (Anyonge *et al.*, 2009).

Equal participation in community based decision making remains a complex and difficult goal to achieve, especially in the context of high unequal gender and class relations. Community level participation often leaves women's views and concerns unacknowledged. Even when women attend meetings or events, they may not feel free to voice their opinions, or their opinions and needs may not be taken seriously (Agarwal, 2003; Prokopy, 2004). Furthermore, community participation often favour local elites, usually men, but sometimes elite women's concern directly conflict with and override poor women's access to resources (Singh, 2006; Sultana, 2006).

Despite attempts to mainstream gender at all levels of participation, few women participate. Gender is rarely a central issue in policy initiatives. Men tend to dominate in decision making whiles women's limited participation in decision making restricts their capacity to engage in decisions that can impact their specific needs and vulnerabilities (Denton, 2002; Masika, 2002). In most societies, women typically have fewer ownership rights than men (Rocheleau, 1996). Women frequently have de facto or land use rights as compared to men's de jure or ownership rights (Sachs *et al.*, 2009). Poor rural women lacking secure land tenure often depend on common property resources for fuel wood, foddors and food, and therefore seek for the well being of their

household. The depletion of common property resources poses a severe threat to the livelihoods and food security of poor women and men (Sachs *et al.*, 2009).

When collecting data to serve as a basis for a study underpinning the above discussions, Virtanen (2000) cited in Moore (2003), found that, the main reason men give for burning was because of “traditions”, inherited from father to son. But women, state that most wildfires had escaped from controlled agricultural burning, a task that was exclusively carried out by women. Studies in Namibia (NFFP, 2000) and Mozambique (Virtanen *et al.*, 2002) showed that although the clearing of new land in shifting cultivation was usually carried out by men, 80 percent of the number of fires were lit by women, who commonly carried out agricultural burning following the harvesting of crops and spot-burning to remove stumps from clearings.

It is apparent that in order to prepare a viable strategy for sustainable fire management in which local people are involved, gender aggregated baseline data is needed (Moore, 2003). Apusigah (2007) writing on promoting sustainable wildfire management in Northern Ghana: learning from history, assert that there is stark lack of gender perspective in the framing of policy and programming of wildfire interventions. Also, past anti wildfire initiative and strategies did not reflect an appreciation of gender issues in management efforts. According to Apusigah, this has led to the lack of appreciation of women’s contributions to wildfire management. Apusigah (2007) further stressed that strategists on wildfire management continue to rely on existing patriarchal structures and develop strategies that reinforce the systemic inequalities. However, from the works of Amissah (2008) men construct fire breaks whilst women

fetch water to be used in the outbreak of fires by men counterparts in rural communities.

Women are blamed as destroyers of the environment and also depicted as compromising ongoing efforts at the control and prevention of wildfires (Apusigah, 2007). Apusigah (2005) early on had argued that wildfire programmes that target and blame women for their negative roles are not likely to succeed and that to reverse the menace of wildfire in Ghana, policies and programmes should recognize and work from women's experiences. Thus, to Apusigah, it requires learning from women's experiences in sustainable development which is rooted in feminine principles.

The ongoing discussion on gender related issues in fire management shows that both men and women have accumulated some knowledge and experience on the subject based on their relationship with fire and also their dependence on forest resources for their livelihood. However, the literature provides evidence that the playing field is unequal for men and women to contribute to mitigating the menace of fire which affect the very core of their livelihoods. It is in the light of this that this research seeks to examine the views of community members and experts as to how the imbalance in participation could be bridged taking into consideration socio-economic and traditional environments within which these men and women find themselves.

2.2.5.2 Stakeholder Participation in Fire Management

Although information on involving communities in fire management is still scarce, widely scattered and only slowly evolving, the involvement of all stakeholders can play substantial role in forest fire management (Changchui, 2002). A prerequisite for the success of fire management is the active involvement of all stakeholders and

raising their awareness (Kieft and Nur, 2002). Ganz and Moore (2002) agreed to this but went ahead to state that integration of traditional approaches into forest fire management systems will need a concerted effort by all stakeholders to build constructive partnerships that recognize the importance of attitudes toward fire, roles in decision making and securing incentives for balance fire management.

Goldammer *et al.* (2002) further stressed that fire management would only be successful if stakeholders agree on a distribution of responsibilities, decision making, power and resources. But Fire Fight West Africa (FFWA) (2003) concluded that if harmful forest fire is to be contained then fire related behaviour of a range of stakeholders must be addressed and that attention has to be focused on policy reform and the removal of perverse economic incentives that encourage stakeholders to use fire irresponsibly.

High levels of public participation are often cited as central components of an effective planning process for ecosystem management and environmental planning in general (Brody, 2003). Scholars argue that because ecosystem management is by definition a trans-boundary, multiparty issue, the participation of key stakeholders is widely viewed as the single most important element of a successful outcome (Grumbine, 1994; Westley, 1995; Yafee et al., 1996; Duane, 1997; Duram and Brown, 1999; McCool and Guthrie, 2001). Again, including stakeholders in decision making process help build a sense of ownership and ensures that all interest is reflected (Brechin et al., 1991; Innes, 1996).

However, Castro and Nielsen (2001) were of the opinion that co-management agreement between local people, stakeholders and government agencies offers substantial promise as a way of dealing with natural resources based conflicts. These collaborative natural resources management arrangement Castro and Nielsen (2001) also agreed can foster a sense of community empowerment in decision making and benefit sharing. Brody (2003) added that stakeholder participation goes beyond ownership to contribution of resources, knowledge, time personnel, funding, and technical experts which enhances effective management by allowing for expansive data collection, better monitoring of programmes and regular planned updates.

Although stakeholders hold different interests, the fundamental assumption according to Mc Cay and Jentoff (1998) cited in Castro and Nielsen (2001) is that sharing authority and decision making enhance the process of resource management, making it more responsive to a range of needs. But Brody (2003) is of the view that the underlying assumption of stakeholder participation is that these groups have valuable knowledge and resources to contribute to management of natural resources.

During the 1980s and 1990s, several technical co-operation projects implemented on fire dealt directly with national institutions responsible for the prevention and control of forest fires. Local people who use fire and affected were not involved in project activities. There was little or no recognition of local people as important actors and stakeholders (Goldammer et al., 2002). In Ghana, Fire Fight West African (FFWA-2003) identified lack of inter-agency working relationship and little stakeholder participation in fire management.

While theorists and practitioners consistently call for increased participation in ecosystem management and environmental planning in general, only few studies have empirically tested the assumption that community representation and stakeholder participation during the planning process will lead to stronger, more durable management (Brody, 2003). The driving trend toward increased participation of local people and stakeholder in management according to Changchui (2002) is based on greater decentralization and devolution which rose from the realization that central governments often lack the capacity to manage effectively and also advocating increased partnership with local people, recognizing that their own forest management techniques are inadequate.

This study examines whether stakeholders are actually involved in fire management regarding planning/decision making, implementation of activities, logistic and finances, monitoring of community fire management. It would also seek community members' opinion of who these stakeholders are and whether they are effective?

2.2.5.3 Agencies involved in Wildfire Management in Ghana

In Ghana there are a number of institutions and/or agencies involved in fire management (fire prevention and control). These agencies among others are mandated under law(s) to perform such roles whilst others are playing collaborative roles. The agencies involved in fire management include; the Ghana National Fire Service (GNFS); Forestry Commission (FC) – Wildlife Division (WD); Environmental Protection Agency (EPA); National Disaster Management Organization (NADMO) ; Forestry Research Institute of Ghana; and the District Assemblies.

The Ghana National Fire Service (GNFS) under the PNDC law 229 is mandated to train fire volunteers. The law gave fire volunteers the responsibility to implement byelaws on fire drawn by District Assembly (Amanor, 2002). However, the law (PNDC Law 229) did not give any legal protection, no health care, insurance and incentives to fire volunteers. According to Obiri (1998) the GNFS has trained about 750,000 volunteers in Ghana. The Service organizes each year (November to March) Anti-Bushfires Campaigns through public education on the radio, the use mobile vans and visits to communities.

The Forest Service Division (FSD) and Wildlife Division (WD) under the Forestry Commission are responsible for fire management. The FSD is responsible for the implementation of the National Forest Policy. Recently the FSD have implemented the fire management project in the transitional zone and focused on developing and implementing effective means of preventing and controlling wildfires in fire prone forest areas with local communities' involvement (Orgle, 2000). On the other hand WD is exempted by the law (PNDC Law 229) to use fire for the management of reserves and parks. It carries out early burning in savanna and transitional zone prior to the dry season (Orgle, 2003).

The National Disaster Management Organization (NADMO) was enacted by Act 517, 1996 to be responsible for the management of areas affected by disasters and similar emergencies, for the rehabilitation of persons affected by disasters and to provide for related matters. The Act also mandate NADMO to set up sub-committees which are technical in nature to come out with plans for the management of specific types of disasters which Wildfires or Lightening sub-committee is part. However, NADMO is

mandated not only to manage disaster among which wildfire is one but also to identify the various hazards types, map them and plan to prevent those which are man-made and to mitigate their effects (Portuphy, 2000). NADMO also conducts public education on wildfires through the use of radio, seminars, workshop and durbars (Amissah, 2003).

The Environmental Protection Agency (EPA) which was formally known as Environmental Protection Council (EPC) was established by a decree 1974 due to the devastating effects of wildfire nationwide (NAPCDD, n.d.). The EPC played a major role in developing fire prevention and control programmes in Ghana. It further collaborated with Forestry Commission and Ghana National Fire Service and Meteorological Services Division to carry out fire prevent educational campaigns through workshops and conferences (Pers. Comm cited in Amissah, 2003). However, since the inception of EPA by Act 470 of 1994 its focus has changed from a direct role in fire prevention programmes to enforcing and regulating environment laws (EPA, 1996).

District Assemblies are obliged by PNDC Law 229 to establish a Bushfire Control Sub-Committee of the Executive Committee of the District Assembly. The Bushfire control sub-committee is empowered to draw byelaws to ensure adequate control of wildfires in the District.

CHAPTER THREE

OVERVIEW OF STUDY SITE AND METHODOLOGY

3.0 Study Site

Tain II forest reserve forms part of the Dry Semi-Deciduous Fire Zone (DSFZ) forest (Hall and Swaine, 19981). This corresponds with the Antiaris-Chlorophora Association of Tropical Moist Semi-deciduous Forest Type (Taylor, 1960). The bulk of the reserve is a transitional high forest with areas of derived savanna grassland intruding into the forest along parts of the external boundary (FMU 23, 1993).

The Tain II (Tain tributaries block II forest reserve) is located in the Dormaa Ahenkro District in the Brong Ahafo region and lies between latitude 7° 22' and 7° 41' N, and longitudes 2° 17' and 2° 27' W. The total area of the forest reserve is 50,906.45 ha. This comprises 49,261.80 ha of productive forest, 1,062.35 ha of admitted farms, 64.77 ha of roads and waterways and about 518.00 ha of grassland.

Ownership is vested in the stools of Berekum, Odumasi and Nsoatre. Little is known of the history of the area prior to reservation. Tain II was reserved to be managed under a protection working circle to prevent the southward encroachment of the savannah. The reserve suffered from rubber-tapping activities during the Second World War (FMU 23, 1993), and was last logged in 1991. The reserve could be said to have degraded since about 25 – 50% of the trees are damaged (World Rainforest Movement, 1999).

The Tain II forest reserve which was established in 1934 covered 509.20 Sq Km. By the year 1986, the area of forest cover was 499.10 Sq Km while that of 1991 forest cover

was 451.37 Sq Km. In the year 2000, the forest cover was 108.87 Sq Km while the forest cover for 2007 was 87.53 Sq Km.

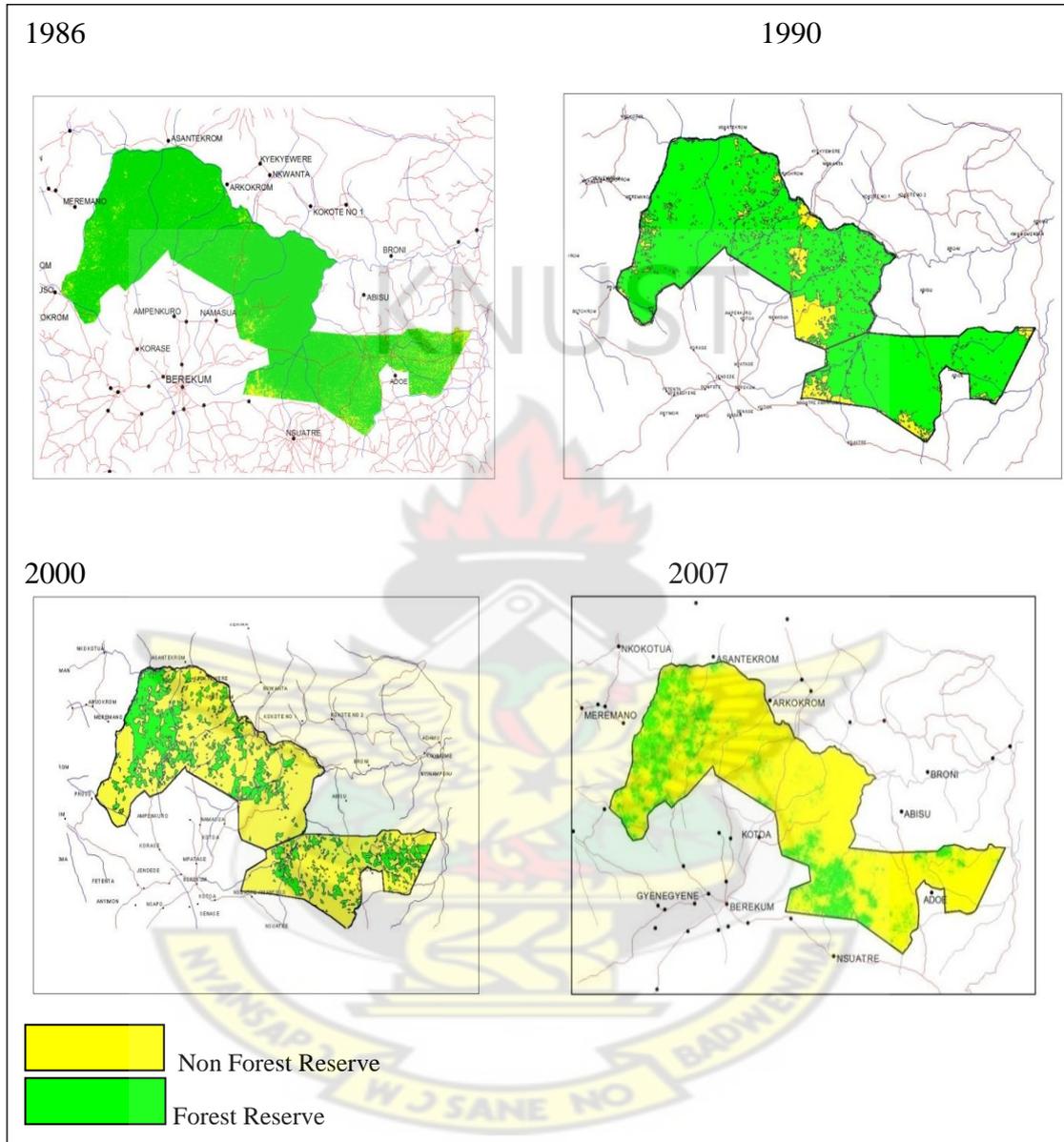


Plate 1: Changes in Tain II Forest Reserve cover from 1986 to 2007

The following are percentage changes of forest cover from 1986 to 2007: 1986 -1990 (4 years) is 1.98%; 1991 – 2000 (ten years) is 78.62%; and 2000 – 2007 (8 years) is 19.59%. The possible causes of the high percentage changes in the forest cover may be due to the annual wildfires occurrences in and around the Tain II forest reserve,

increasing population growth with its associated increase in land use activities, uncontrolled logging, irresponsible farming practices and erratic rainfall patterns (Barnes, 2008).

3.0.1 Climate

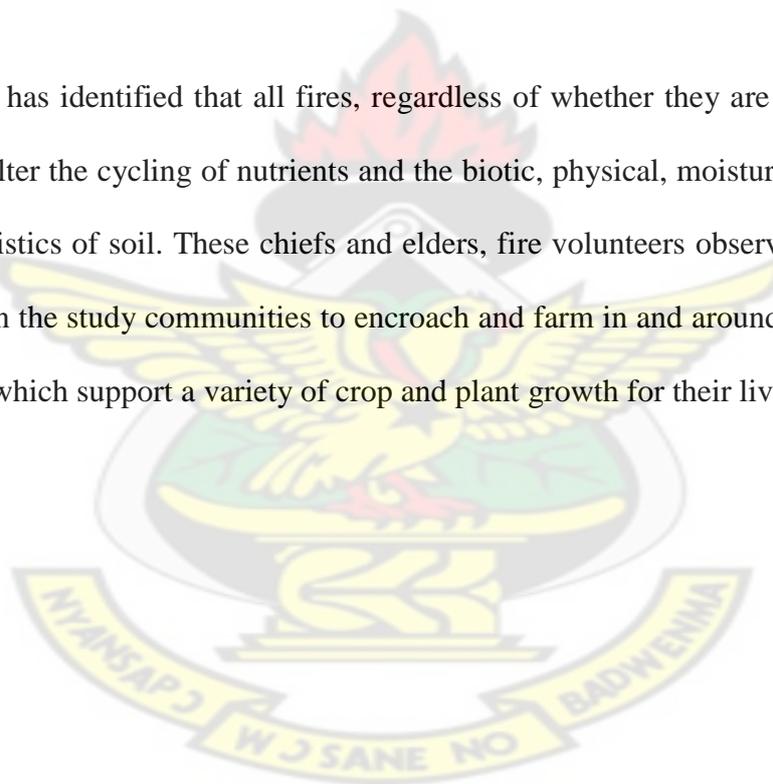
The rainfall pattern of Tain II is of the bimodal type. The mean annual rainfall for the reserve is not available but, the area lies between the 1,410mm (55ins) and 1,538mm (60ins) isohyets (FMU 23, 1993). However, the mean annual rainfall in Sunyani Forest District under which the reserve is being managed is 1,179mm with the minimum and maximum mean annual temperature being 21.4°C and 31.2°C respectively (Regional Meteorological Office, 2000 cited by Barnes, 2008). The rainfall peaks are in June for the major season and October for the subsidiary; August is relatively dry and November to March constitutes the dry season. The prevailing wind for most of the year is light with moisture laden south-westerly trade winds. Humidity is uniformly high for most of the year with the exception of January to March (FMU 23, 1993).

Prevailing winds leave the biggest impression on vegetation as it aids the spreading of wildfires. Vegetation offering a large surface area relative to its volume, such as grasses, leaves and ground litter will ignite at lower temperature than large smooth-barked tree trunk. This has led communities to blame each other for the ignition and spreading of wildfires to their communities.

3.0.2 Soil

The soils of the Tain II reserve are mainly derived from middle Pre-Cambian and lower Birrimain Schists and Phyllites, mixed with Pyroclastic rocks. Soils found on summits usually have a red topsoil with ironstone conditions below which may be cemented together to form hard pan and are therefore only capable of supporting vegetation of grass characteristic of the Guinea Savanna Woodland. Also, soil of the middle slopes are well drained, yellow and moderately fertile on account of the reasonably good base status (FMU 23, 1993).

Research has identified that all fires, regardless of whether they are natural or human-caused, alter the cycling of nutrients and the biotic, physical, moisture, and temperature characteristics of soil. These chiefs and elders, fire volunteers observed might have led farmers in the study communities to encroach and farm in and around the Tain II Forest Reserve which support a variety of crop and plant growth for their livelihood.



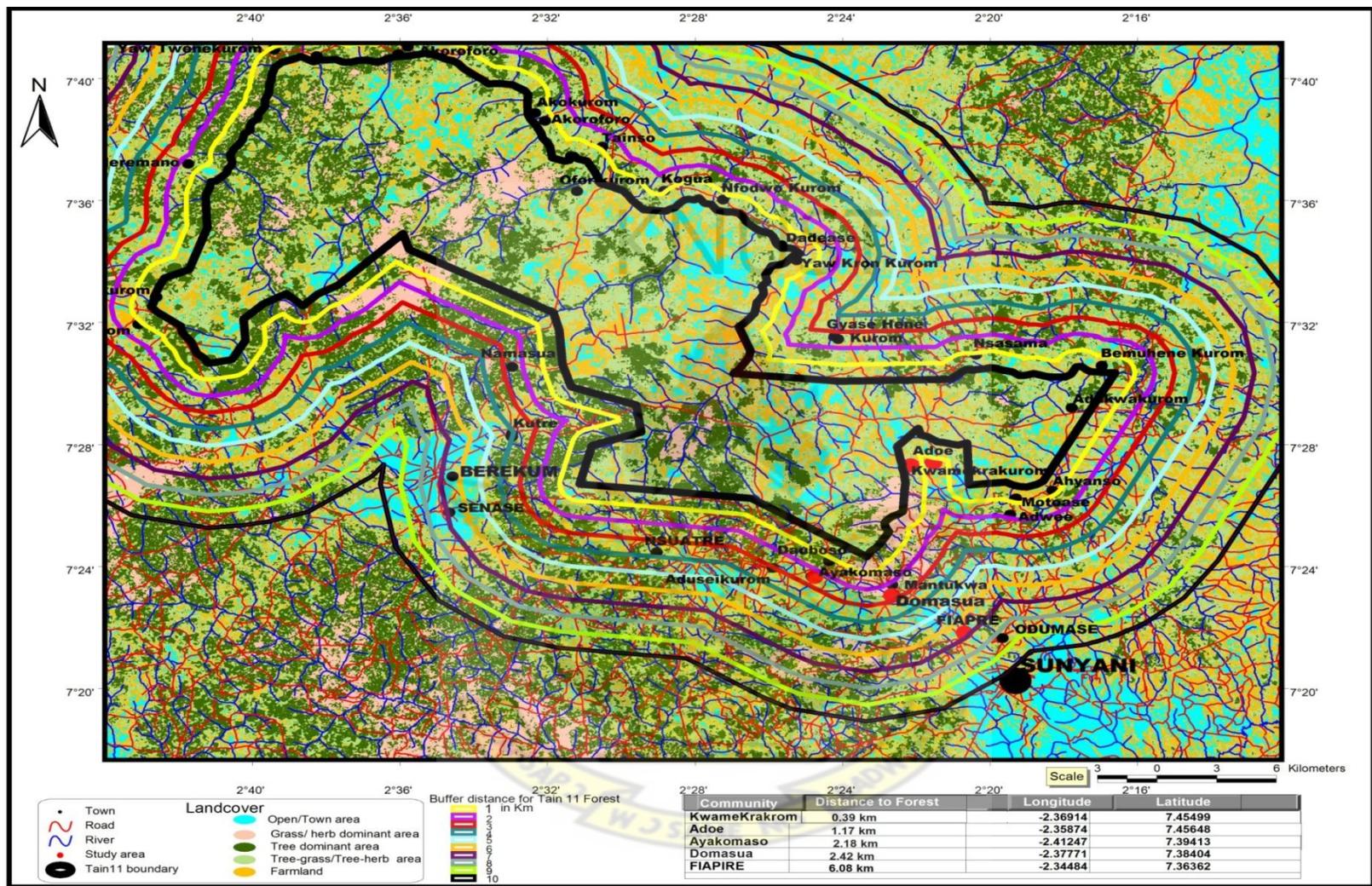


Plate 2: A map of Tain II Forest Reserve

3.1 METHODOLOGY

The procedure adopted for the study comprised: preliminary literature search; familiarization visit to the study area; reconnaissance survey, design of questionnaires; pre-test of questionnaires and main field survey (data collection).

3.1.1 Preliminary Literature Search

Preliminary literature search was done on the following: wildfires in the World, Africa and Ghana, gender and stakeholder participation in fire management, the effectiveness of the indigenous fire management systems and effectiveness of the conventional fire management systems after the 1983 El Nino in Ghana. It was also used to search literature on Community-Based Fire Management (CBFiM) practices around the globe and in Ghana, wildfire management programmes implemented in the past and indigenous knowledge in natural resources management in Ghana.

3.1.2 Familiarization Visits

This visit to the study communities offered the opportunity to have first hand information about the exact locations of the communities and also to make contacts with opinion leaders in these communities. During the familiarization visits, the opportunity was seized to visit the Chiefs and elders of the five communities and other stakeholders involved in fire management around the Tain II forest reserve through the processes of community entering. The familiarization visits was used to introduce the essence of the research around the Tain II forest reserve and to build trust with the stakeholders.

3.1.3 Reconnaissance Survey

Reconnaissance survey was done to gather the following information: map of Tain II forest reserve, Population and number of households in the five study communities,

institutions involved in fire management, stakeholders involved in fire management at the local community level and the roles of District Assemblies in fire management. During the reconnaissance survey, visits were made to the institutions identified (those involved in fire management in the study areas) to solicit information regarding their respective roles in fire management around the Tain II forest reserve. These institutions included: Ghana National Fire Service (GNFS), National Disaster Management Organization (NADMO), Forestry Service Division (FSD) - Sunyani, Ministry of Food and Agriculture (MOFA), Faculty of Forest Resources Technology (FFRT), JICA and Forestry Commission (Regional), and Sunyani Municipal and Sunyani West District Assemblies.

3.1.4 Sampling Design and Sample Size

Two sampling techniques were used for the study. Purposive sampling technique was used to select respondents in the research communities for the investigation. They included elders, women and men, youth and practitioners in the subject area for focus group discussion. Toe (1998) cited in Berg (2007) used purposive sampling to identify only technology-related firms as a target group to include in his study of management.

Simple random sampling technique was used to select households for questionnaire administration based on the formula:

$$n = \frac{N}{1+N(a)^2};$$

n is the sample size, N is the total household size and a is the alpha (0.08).

The following are the total household sizes obtained from the Ghana Statistical Service Department (2000 Population and Household Census) from which samples were taken for households' questionnaire administration: Fiapre – 2,245; Dumesua - 319; Adoe –

55; Motoase – 22; and Ayakomaso – 71. Based on the formula and households data obtained from Ghana Statistical Service Department the following sample sizes were calculated: Fiapre – 146; Dumesua - 105; Adoe – 40; Motoase – 19; and Ayakomaso – 49. Furthermore the following fire volunteer squads were interviewed due to their availability and willingness: Fiapre – 9; Dumesua - 29; Adoe – 14; Motoase – 10; and Ayakomaso – 17. In all a total of 438 respondents were interviewed from both households and fire volunteers (Fiapre - 155; Dumesua - 134; Adoe – 54; Motoase - 28 and Ayakomaso – 66). Typically, this procedure was intended to produce a representative sample (Berg, 2007; Creswell, 2003).

3.1.5 Design of Research Questionnaires

Three (3) sets of research questionnaires were designed. These were based on the research hypothesis and objective, and the critical questions raised in the scope of the study. The three set of questionnaires included: household questionnaire for household heads and fire volunteer squads, questionnaire for six institutions (GNFS, NADMO, FSD, MOFA, and FFRT) and focus group discussion guide.

3.1.6 Pre-Test of Research Questionnaires

This was used to solicit views from the field to come out with well-designed questionnaires for the households and the six institutions, and focus group discussion guide for the purpose of gathering relevant data for the study. It was further used to restructure the various questionnaires to be administered. Twenty (20) household questionnaires each were administered in the study communities whilst ten institutional questionnaires were administered among GNFS, NADMO, FSD (Regional and District Forestry), FFRT and MOFA.

3.1.7 Main Field Survey (Data Collection)

The following Participatory Rural Appraisal (PRA) tools were used to collect field data:

3.1.7.1 Focus Group Discussion

Focus group discussions were held for identified groups within the communities to express their views in greater detail. It created a favourable condition for in-depth sharing of knowledge and insights for better decision making. Focus group discussions were held in Fiapre, Dumesua, Adoe, Motoase and Ayakomaso. The group discussions were held with women, men, the youth, chiefs and elders, and fire volunteers to identify indigenous gender strategies, indigenous fire management methods, and the rules and regulations governing fire management in the study communities. Focus group interviews provided the means for collecting qualitative data in some settings and situations where a one-shot collection was necessary (Berg, 2007).

3.1.7.2 Questionnaire Administration

The questionnaires were administered to household heads and in their absence the available spouse was used, preferably a woman if the household head is a man. Questionnaires were also administered to fire volunteer squads and six institutions involved in fire management. The questions for the interviews were open-ended to allow participants express their views more freely than in a structured questionnaire. Three hundred and fifty-nine (359) household questionnaires were administered while seventy-nine (79) were administered to fire volunteer squads in Fiapre, Dumesua, Adoe, Motoase and Ayakomaso communities. Also, twenty-four (24) questionnaires were administered to the six institutions. All questionnaires covered issues regarding knowledge in indigenous methods, rules and regulations in community fire

management, level of involvement, incidence of wildfires around the forest reserve and challenges in the implementation of their indigenous methods in wildfire management.



Plate 3: Interview Session in two separate Communities

3.2 Data Sources

Primary and secondary data sources were used in this research. The use of this information enabled both sources to complement each other and helped in filling gaps. The primary source was based on Participatory Rural Appraisal (PRA) tools to collect field data. The adoption of PRA data gathering techniques facilitated the collection of reliable data and also complemented one other in the information gathering process. It is worth mentioning that data from existing literature on the subject were reviewed. These included relevant information on community based fire management, Indigenous fire management, bushfires in Ghana and its adverse effects on forest reserves. Profiles of study areas were obtained from existing literature.

3.3 Data Analysis

Both qualitative and quantitative data analysis techniques were employed to analyze field data. The quantitative analysis was done at two levels: community level comprising responses from the household heads and volunteer squads; and the six institutions (GNFS, NADMO, MOFA, FFRT, SDF, and RFC) interviewed. The analyses were done based on comparative and descriptive analysis using frequencies

and percentages. Chi Square were used to test for significant differences in responses given by respondents during the study. Statistical softwares that were used included the Statistical Package for Social Scientists (SPSS) version 16.0 by Pearson Prentice Hall, April 2008, Statistical/Data Analysis (STATA) version 9.0 and Microsoft Excel.

To measure stakeholder participation in community fire management, index of participation were calculated based on involvement in fire planning/decision making, implementation and monitoring. A 5-point scale comprising: always, often, occasionally, rarely and never were used to measure the degree of participation.

Always	Often	Occasionally	Rarely	Never
1.0	0.8	0.6	0.4	0.2

Kamnap (2003)

Index of participation by Adhikari (1996), cited by Kamnap (2003) was used to calculate the participation indices:

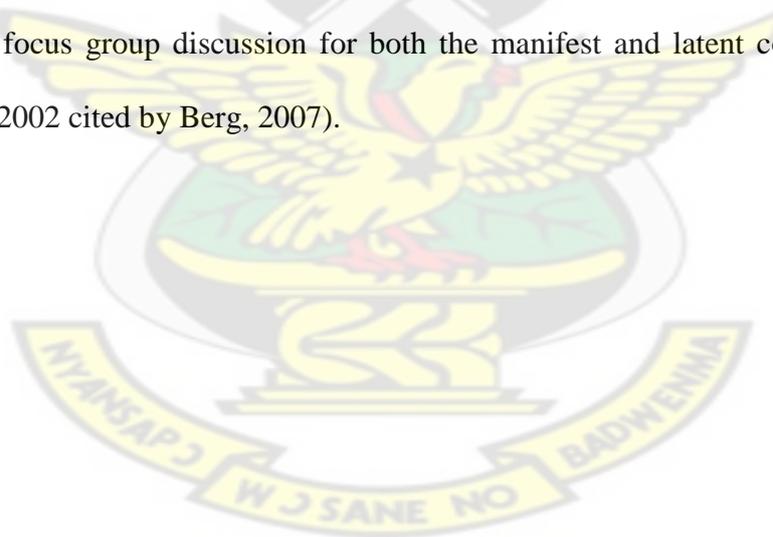
1. Computation of frequency of participants (n) in particular activities
2. Division of frequency by the total number of respondents (N).

The formula adopted is: $IP = n / N$; Where, IP - index of participation in an activity; n - frequency of respondents participating in an activity; N - total number of respondents. The Index of Participation values is interpreted on a scale of 0 – 1; where zero means stakeholders have no chance of participating and 1 means always participating. Increase in values from 0-1 implies increase in participation level of the stakeholder group with respect to the specific forest resources management stage.

Furthermore, Likert scale of ranking was used to assess the effectiveness of both indigenous and conventional fire management systems in the studied communities.

The assessment was based on inter and intra effectiveness of the various fire management systems in the communities. It is on a typical five-level: Strongly disagree; Disagree; neither agree nor disagree; Agree; and strongly agree. Each item was analyzed separately and in some cases item responses were summed to create a score for the group of items (Tastle *et al*, 2005).

Data collected from the field using focus group discussions on local people's perception in fire management was analyzed using content analysis based on themes and topics. Also, manifest and latent content analysis were carried out. The analyses were done by transcribing the entire focus group discussion interview. It was a verbatim transcription of each question asked by the researcher and each individual answer given was analyzed to identify the trend and patterns that existed either within a single or among series of focus group discussion for both the manifest and latent content (Morse and Richard, 2002 cited by Berg, 2007).



CHAPTER FOUR

RESULTS

4.0 Personal Characteristics of Respondents

4.1.1 Sex Distribution

Table 1 shows the sex distribution of the respondents interviewed in the five communities. A total of 438 respondents were interviewed and out of this 287 (66%) were males and 151 (34%) were females. The highest males interviewed were in Motoase 21 (72%) and the lowest were in Fiapre 88 (57%). However, the highest females interviewed were in Fiapre 67 (43%) and the lowest females were from Motoase 8 (28%).

Table 1: Sex Distribution of Respondents

Community	Sex		Total
	Male	Female	
Adoe	38	16	54
Motoase	21	8	29
Fiapre	88	67	155
Dumesua	95	39	134
Ayakomaso	45	21	66
Total	287	151	438

4.1.2 Age Characteristics

Table 2 illustrates the age characteristics of the respondents in the five communities. Of the total 438 respondents interviewed 144 (33%) respondents were in the age group of 50-59 while the least 23 (5%) were in the age group of 20-29. The result indicates that three communities out of five have majority of their respondents [(Fiapre 51 (33%); Dumesua 45 (34%); and Ayakomaso 24 (36%)] in the age group 50-59. In Adoe, majority of the respondents 16 (30%) were in the age group 30-39

while in Motoase, majority of the respondents 12 (41%) were in the age group 40-49.

Also all the five communities have their lowest respondents in the age group 20-29.

Table 2: Age Distribution of Respondents

Community	Age					Total
	20-29	30-39	40-49	50-59	60+	
Adoe	0	16	10	14	14	54
Motoase	0	3	12	10	4	29
Fiapre	10	26	34	51	34	155
Dumesua	9	22	25	45	33	134
Ayakomaso	4	7	15	24	16	66
Total	23	74	96	144	101	438

4.1.3 Educational Characteristics

Figure 1 describes the educational characteristics of respondents of the five communities around Tain II Forest Reserve. Of the 438 respondents interviewed from the five communities, 212 (49%) respondents have no formal education while 5 (1%) respondents have Tertiary/Post secondary education. The figure depicts that all the five communities have majority of the respondents [Adoe 26 (48%); Motoase 25 (86%); Fiapre 60 (39%); Dumesua 66 (49%); and Ayakomaso 35 (53%)] without formal education. Of the five communities, two communities [Fiapre 45 (29%) and Dumesua 34 (25%)] have majority of the respondents with SSS/Vocational/Technical education. Also only Fiapre has 5 (3%) respondents with tertiary/post secondary education while Adoe, Motoase, Dumesua and Ayakomaso on the other hand have none of the respondents with tertiary/post secondary education.

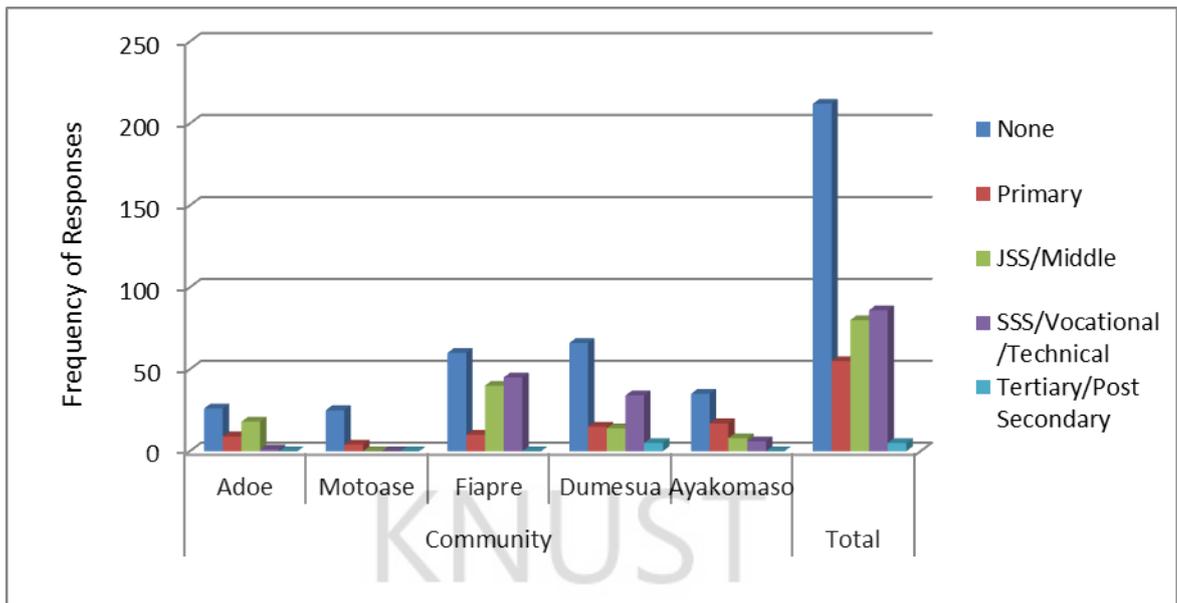


Figure 1: Educational Characteristics of Respondents in the Five Communities

4.2.0 Effectiveness of Community Fire Management

This section deals with the effectiveness of indigenous fire management and conventional fire management systems.

4.2.1 Effectiveness of Indigenous Fire Management

Table 3 indicates the distribution of responses on the effectiveness of indigenous fire management in general in the five communities before 1983. A total of 374 (85%) out of the 438 respondents interviewed agreed to the assertion that, indigenous fire management in general helped in curbing the menace of wildfires before the severe wildfires of 1983 compared to 15 (3%) who disagreed. The community which had the highest number of respondents agreeing to the statement was Motoase 29 (100%); while the lowest was Dumesua 105 (78%). Also the community that disagreed to the assertion was Dumesua 10 (7%); while Motoase and Ayakomaso did not record any response. The chi-square analysis for indigenous fire management shows that there are significant differences in the responses given by respondents among the five communities (Table 3).

Table 3: View on the Effectiveness of Indigenous Fire Management

Community	Indigenous fire management before 1983 were effective in curbing wildfires			Total
	Disagree	Neither agree nor disagree	Agree	
Adoe	2	4	48	54
Motoase	0	0	29	29
Fiapre	3	14	138	155
Dumesua	10	19	105	134
Ayakomaso	0	12	54	66
Total	15	49	374	438

$[\chi^2 = 21.103, p = 0.007]$

Table 4 illustrates the distribution of responses on the effectiveness of the individual indigenous fire management systems in the five communities. The study indicated that majority of the respondents agreed that all the fire management strategies; prevention [381 (87%)], pre-suppression [381 (87%)] and suppression [381 (87)] contributed to the effectiveness of the indigenous fire management before 1983. The chi-square analysis for indigenous fire prevention [$\chi^2=25.001, p = 0.002$], pre-suppression [$\chi^2=30.694, p = 0.000$], suppression [$\chi^2=22.562, p = 0.004$], shows that there are significant differences in the responses given by respondents among the five communities.

Table 4: Views on the Effectiveness of Indigenous Fire Management in curbing perennial Wildfires

Respondents Responses on the:	Community	D	NA/D	A	Total
Indigenous fire prevention before 1983 were effective in curbing wildfires	Adoe	0	1	53	54
	Motoase	0	0	29	29
	Fiapre	6	18	131	155
	Dumesua	0	19	115	134
	Ayakomaso	0	13	53	66
	Total	6	51	381	438
$(\chi^2 = 25.001, P = 0.002)$					
Indigenous fire pre-suppression before 1983 were effective in curbing wildfires	Community	D	NA/D	A	Total
	Adoe	0	0	54	54
	Motoase	0	0	29	29
	Fiapre	3	14	138	155
	Dumesua	10	19	105	134
	Ayakomaso	0	11	55	66
Total	13	44	381	438	
$(\chi^2 = 30.694, P = 0.000)$					
Indigenous fire suppression before 1983 were effective in curbing wildfires	Community	D	NA/D	A	Total
	Adoe	0	1	53	54
	Motoase	0	0	29	29
	Fiapre	3	18	134	155
	Dumesua	0	20	114	134
	Ayakomaso	0	15	51	66
Total	3	54	381	438	
$(\chi^2 = 22.562, P = 0.004)$					

Disagree; D – Disagree; NA/D – Neither Agree nor Disagree; A – Agree

The highest community who confirmed this stance that indigenous fire prevention curbed wildfires was Motoase 29 (100%) while the lowest responses was from Ayakomaso 53 (80%). Furthermore, the highest community who disagreed to the statement was Fiapre 6 (4%) while Adoe, Motoase, Dumesua and Ayakomaso recorded no disagreement to the statement.

Also Adoe 54 (100%) and Motoase 29 (100%) had the highest respondents agreeing that indigenous pre-suppression curbed wildfires and the lowest respondents to agree were from Dumesua 105 (78%). However, Dumesua community had the highest respondents 10 (7%) who disagreed to the contention that indigenous pre-suppression

helped curb wildfires while Adoe, Motoase and Ayakomaso recorded no disagreement to the statement. Furthermore, Motoase 29 (100%) had the highest respondents agreeing that indigenous suppression curbed wildfires while the lowest respondents to agree were from Ayakomaso 51 (77%). The highest respondents who disagreed that indigenous suppression curbed wildfire were from Fiapre 3 (2%) while Adoe, Motoase, Dumesua and Ayakomaso recorded no disagreement (Table 4).

The claim by the five communities that indigenous fire management in general has helped curb wildfires is further established by the responses from the six institutions interviewed (Table 5). A total of 11 (46%) respondents of the 24 interviewed agreed while 5 (21%) respondents neither agreed nor disagreed that indigenous fire management have helped curb the menace of fire (Table 5). The chi-square analysis shows that there are significant differences in the responses given by respondents among the five institutions (Table 5).

Table 5: Views of Institutions on the Effectiveness of Indigenous Fire Management

Institutions	D	NA/D	A	Total
GNFS	1	2	2	5
District Forestry	0	1	2	3
Agriculture	2	1	1	4
NADMO	3	1	0	4
JICA (RFC)	1	0	4	5
APERL (FFRT)	1	0	2	3
Total	8	5	11	24
($\chi^2 = 23.03, P = 0.0287$)				

Disagree; D – Disagree; NA/D – Neither Agree nor Disagree; A – Agree;

Table 6 shows the distribution of responses on the use of rules and regulations around Tain II Forest Reserve. From the study it was identified that indigenous fire management succeeded in curbing wildfires mainly by indigenous fire prevention

through the use of local rules and regulations. A total of 284 (65%) respondents indicated that local rules and regulations were used to prevent fires while 154 (35%) indicated that local authorities did not use local sanctions to curb fires in the communities. The highest respondents 23 (79%) who stated that indigenous fire management curbed wildfires mainly by the use of indigenous rules and regulations were from Motoase and the lowest respondents 70 (52%) were from Dumesua. Whiles the highest respondents 64 (48%) who stated No were from Dumesua and the lowest respondents 6 (21%) were from Motoase.

Table 6: Responses on the use of Indigenous Rules and Regulations

Community	Were indigenous rules and regulations use in curbing wildfires		Total
	Yes	No	
Adoe	39	15	54
Motoase	23	6	29
Fiapre	101	54	155
Dumesua	70	64	134
Ayakomaso	51	15	66
Total	284	154	438

4.2.2 Effectiveness of Conventional Fire Management

Table 7 shows the distribution of responses on the effectiveness of conventional fire management systems used around Tain II. Of the total 438 respondents interviewed, 177 (40%) respondents agreed that conventional fire management have helped curb perennial fires while 157 (36%) respondents neither agreed nor disagreed. The highest respondents 37 (56%) who agreed that conventional fire management systems in general curbed wildfires were from Ayakomaso and the lowest respondents 44 (28%) were from Fiapre. On the other hand, the highest responses 50 (32%) who disagreed to the contention were from Fiapre and the lowest 2 (7%) were from Motoase. The

chi-square analysis revealed that there are significant differences in the responses given by respondents among the five communities (Table 7).

Table 7: Views on the Effectiveness of Conventional Fire Management in Curbing Fire Menace

Community	Conventional fire management after 1983 were effective in curbing perennial wildfires			Total
	Disagree	Neither agree nor disagree	Agree	
Adoe	23	6	25	54
Motoase	2	13	14	29
Fiapre	50	61	44	155
Dumesua	24	53	57	134
Ayakomaso	5	24	37	66
Total	104	157	177	438

$[\chi^2 = 48.876, p = 0.000]$

Table 8 indicates the distribution of responses on the effectiveness of the individual conventional fire management systems in the five communities. The responses on conventional fire prevention gave the confirmation that conventional fire management has helped curb perennial bushfires in the study communities. A total of 175 (40%) respondents agreed that conventional fire prevention have helped curb perennial fire but 150 (34%) respondents neither agreed nor disagreed with the assertion. However, majority of the respondents neither agreed nor disagreed that the conventional fire management strategies; pre-suppression [171 (39%)] and suppression [174 (40%)] contributed to the effectiveness of the conventional fire management after 1983. The chi-square analysis for conventional fire prevention, pre-suppression and suppression revealed that there are significant differences in the responses given by respondents among the five communities (Table 8).

Table 8: Views on the Effectiveness of Conventional Fire Management in Curbing Perennial Wildfires

Respondents Responses on:	Community	D	NA/D	A	Total
Conventional fire prevention after 1983 were effective in curbing wildfires	Adoe	23	8	23	54
	Motoase	1	14	14	29
	Fiapre	60	47	48	155
	Dumesua	24	50	60	134
	Ayakomaso	5	31	30	66
	Total	113	150	175	438
($\chi^2 = 50.075, P = 0.000$)					
Conventional fire pre-suppression after 1983 were effective in curbing wildfires	Community	D	NA/D	A	Total
	Adoe	26	8	20	54
	Motoase	1	15	13	29
	Fiapre	47	59	49	155
	Dumesua	26	54	54	134
	Ayakomaso	5	35	26	66
Total	105	171	162	438	
($\chi^2 = 44.344, P = 0.000$)					
Conventional fire suppression after 1983 were effective in curbing wildfires	Community	D	NA/D	A	Total
	Adoe	25	4	25	54
	Motoase	1	16	12	29
	Fiapre	52	56	47	155
	Dumesua	14	68	52	134
	Ayakomaso	3	30	33	66
Total	95	174	169	438	
($\chi^2 = 73.275, P = 0.000$)					

D – Disagree; NA/D – Neither Agree nor Disagree; A – Agree

The highest respondents 14 (48%) who agreed that conventional fire prevention had helped curb wildfires were from Motoase while the lowest respondents 48 (31%) were from Fiapre. But the highest respondents 23 (43%) who disagreed to the assertion that conventional fire prevention had curb wildfires were from Adoe while the lowest respondents 1 (4%) were from Motoase. On the other hand, responses on conventional fire pre-suppression indicated that Motoase [15 (52%)] had the highest responses neither agreeing nor disagreeing to the effectiveness of conventional pre-suppression in curbing perennial wildfires. Whiles in Adoe [26 (48%)] had the highest responses disagreeing that conventional pre-suppression helped curb perennial wildfires. Also, responses on conventional fire suppression revealed Motoase [16 (55%)] recorded the

highest responses neither agreeing nor disagreeing to the effectiveness of conventional suppression while Adoe 25 (46%) recorded the highest responses disagreeing that conventional suppression helped curb perennial wildfires (table 8).

But the six institutions interviewed indicated that, 15 (63%) respondents agreed that conventional fire management in general after 1983 have helped curb wildfires while 4 (17%) disagreed to the assertion (Table 9). The chi-square analysis shows that there are no significant differences in the responses given by respondents among the five institutions (Table 9).

Table 9: Views of Institutions on the Effectiveness of Conventional Fire Management

	Organization	D	NA/D	A	Total
Conventional fire management after 1983 were effective in curbing wildfires	GNFS	2	0	3	5
	District Forestry	0	3	0	3
	Agriculture	0	0	4	4
	NADMO	0	2	2	4
	JICA (RFC)	1	0	4	5
	APERL (FFRT)	1	0	2	3
	Total	4	5	15	24
$\chi^2=28.38, P= 0.101$					

D – Disagree; NA/D – Neither Agree nor Disagree; A – Agree

4.2.3 Comparison of Indigenous and Conventional Fire Management

Table 10 illustrates the responses of respondents on the effectiveness of indigenous fire management before 1983 over the conventional fire management after. Of the total 438 respondents from the five communities, 282 (64%) respondents agreed that indigenous fire management was effective in curbing wildfires than the conventional fire management systems introduced after 1983 fires while 78 (18%) respondents disagreed and another 78 (18%) neither agreed nor disagreed to the assertion. The chi-square

analysis revealed that there are significant differences in the responses given by respondents among the five communities (Table 10).

Table 10: Comparison of the effectiveness of Indigenous Fire and Conventional Fire Managements

Community	Indigenous Fire management is effective than conventional			Total
	Disagree	Neither agree nor disagree	Agree	
Adoe	3	12	39	54
Motoase	0	3	26	29
Fiapre	31	23	101	155
Dumesua	38	21	75	134
Ayakomaso	6	19	41	66
Total	78	78	282	438

$[\chi^2=33.335, p = 0.000]$

Of the five communities, Motoase [26 (90%)] recorded majority of their respondents agreeing that indigenous fire management is more effective than conventional fire management while Dumesua [75 (55%)] had the least. However, Dumesua [38 (28%)] had the highest respondents disagreeing that indigenous fire management is effective in curbing fires than conventional fire management.

4.3.0 Changes in Fire Frequency

4.3.1 Fire Frequency Before 1983

Table 11 indicates the distribution of responses on the frequency of wildfires five-ten years before 1983. Of the 438 respondents, 361 (82%) respondents were of the view that wildfires rarely (not yearly) occurred before 1983 fires. All the five communities had majority of their respondents indicating that wildfires rarely occurred around the Tain II forest reserve before 1983.

Table 11: Frequency of Wildfires Before 1983

Community	What was the frequency of wildfires before 1983fires?			Total
	Yearly	Not yearly	Never	
Adoe	5	48	1	54
Motoase	0	29	0	29
Fiapre	10	122	23	155
Dumesua	5	114	15	134
Ayakomaso	7	48	11	66
Total	27	361	50	438

4.3.2 Fire Frequency After 1983

Table 12 illustrates responses on the frequency of wildfires after the 1983 fires around Tain II Forest Reserve. Of the 438 respondents interviewed, 397 (91%) are of the opinion that after the 1983 wildfires, each year communities experience wildfires while 5 (1%) respondents stated that wildfires never occur yearly. All the five communities had majority of their respondents expressing that wildfires are a yearly phenomena around the Tain II forest reserve.

Table 12: Frequency of Wildfires After 1983

Community	What was the frequency of wildfires after 1983fires?			Total
	Yearly	Not yearly	Never	
Adoe	47	7	0	54
Motoase	26	3	0	29
Fiapre	141	11	3	155
Dumesua	121	11	2	134
Ayakomaso	62	4	0	66
Total	397	36	5	438

Records from the GNFS indicated that generally wildfire incidences have reduced between 2001 and 2009. However the fires occurred every year irrespective of the magnitude. In the year 2000, the GNFS recorded fifty-six (56) wildfires while in 2001 a total of ninety-one (91) wildfires were recorded. The number of wildfires dropped from 91 in 2001 to fifty-five (55) in 2003 while in 2004, 2005, 2006, and 2007, the GNFS recorded 54, 57, 28 and 53 wildfires respectively. In the 2008 fire season, the GNFS

recorded seventy-seven (77) wildfire but in 2009 a total of eleven (11) wildfires were recorded (Figure 2).

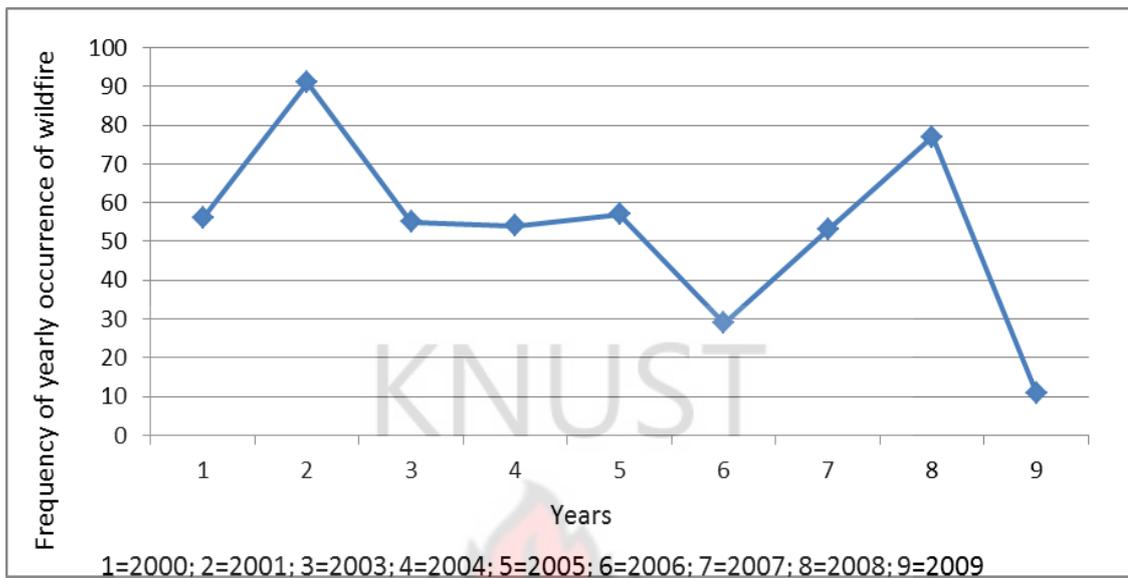


Figure 2: Yearly Occurrence of Wildfires around the Tain II Forest Reserve

Figure 3 depicts the distribution of responses on the changes in fire frequency after 1983 in the study communities. A total of 327 (75%) respondent are of the view that the incidences of fires are decreasing in the study communities; 85 (19%) respondents are of the view that the incidence of perennial fires are increasing. Also 26 (6%) respondents are of the view that there are no changes in the incidence of perennial wildfires in the study area.

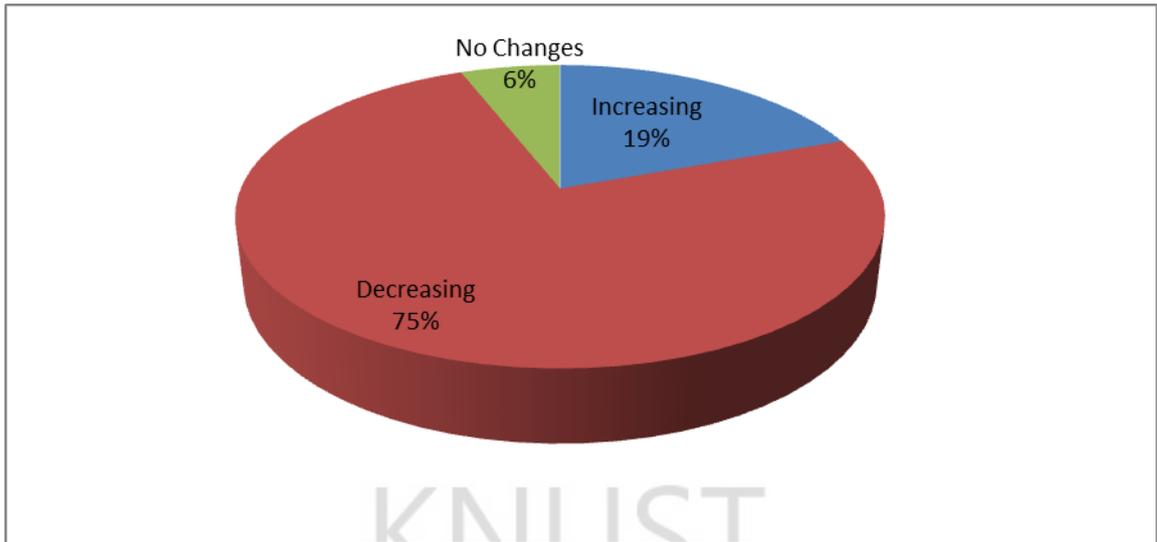


Figure 3: Responses on the Changes in Fire frequency in the study communities

Six institutions affirm this decreasing trend in fire frequency in the study communities. The results in Figure 4 indicated that 14 (58.3%) respondents; 10 (41.7%) said the incidence of wildfires are increasing.

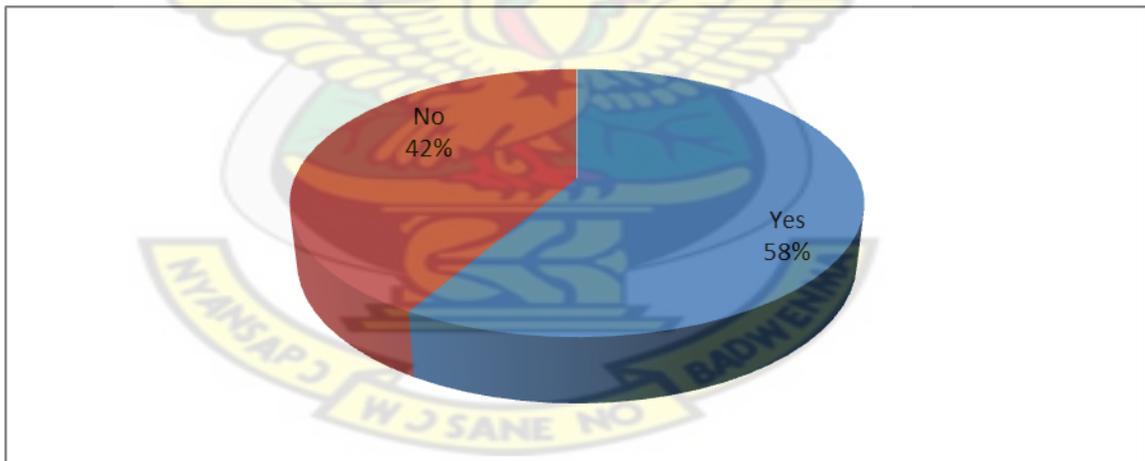


Figure 4: Responses on the Changes in Fire frequency by the six institutions

4.3.3 Changes in Losses

Losses from wildfires according to respondents are increasing. The results show that 213 (49%) respondents stated that the losses from wildfires are increasing while 171 (39%) indicated that the losses are decreasing. A total of 54 (12%) respondents are of

the view that there are no changes in the losses due to wildfires in the communities (Figure 5).

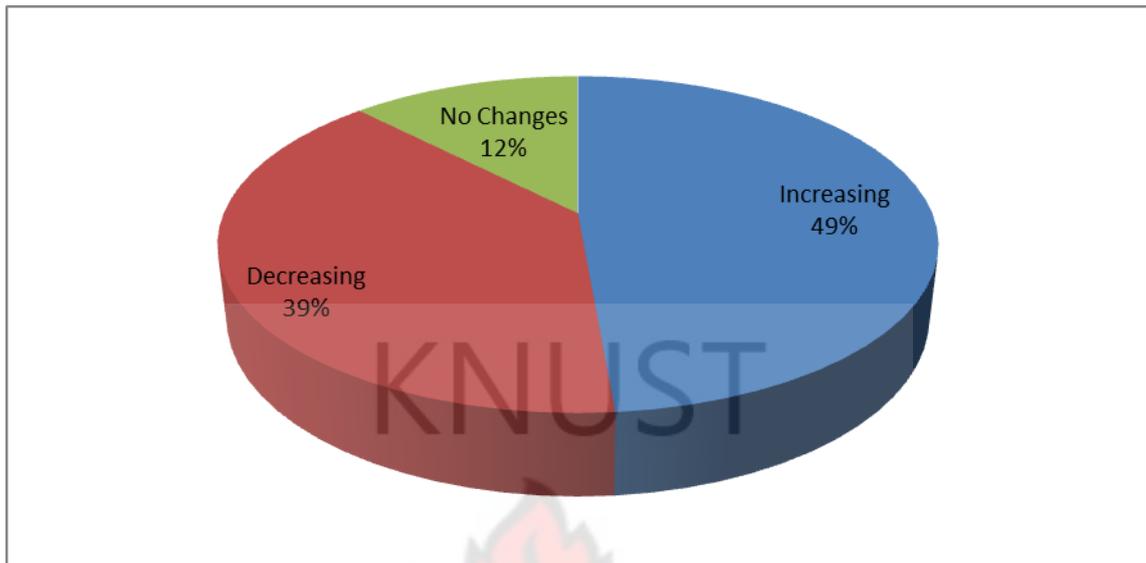


Figure 5: Distribution of Responses on the losses due to Wildfires

4.4. Stakeholder Participation in Fire Management

The following stakeholders were identified; Fire volunteers, Chief/Elders, Opinion leaders, Unit committee members / Assembly person, Forestry Officer, Youth Groups and Environmental Clubs, and Ghana National Fire Service during the research. However, responses from the study revealed that the identified stakeholders in the five communities are not actively involved in fire management. Figure 6 depicts the distribution of the active involvement of stakeholders in fire management. A total of 272 (62%) respondents agreed stakeholders are not actively involved in fire management while 146 (33%) respondents disagreed. But 20 (5%) respondents do not know whether stakeholders are involved in fire management or not.

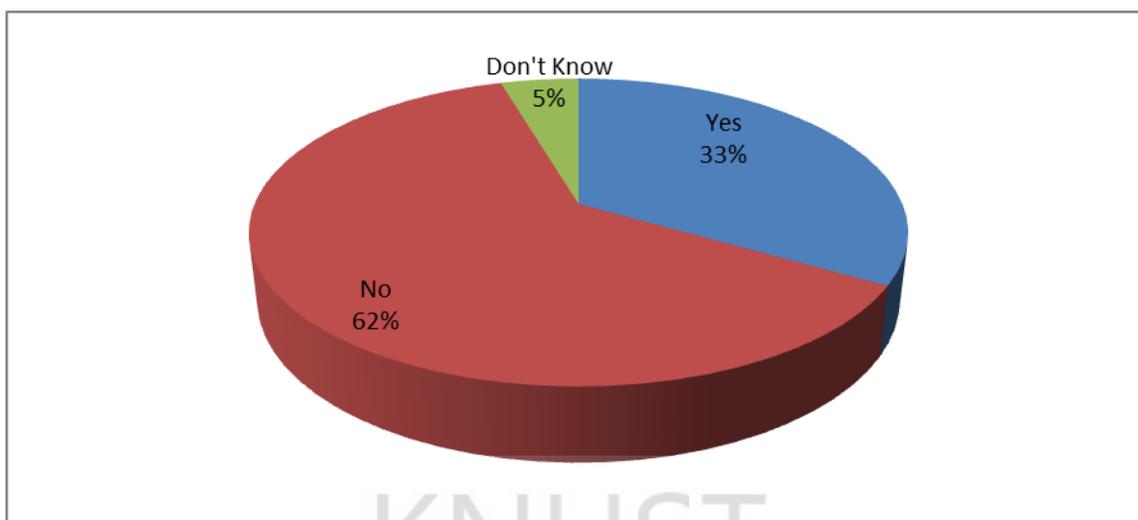


Figure 6: Responses of Respondents on Stakeholder active involvement in Fire Management

Table 13 shows the distribution of six institutions responses on stakeholder involvement in fire management. Of the 24 respondents from the six institutions, 21 (87.5%) respondents disagreed with the five communities that stakeholders are not actively involved in fire management in the study communities while 3 (12.5%) respondents agreed with the five communities that stakeholders are not actively involved in fire management.

Table 13: Views on Stakeholder active involvement in Fire Management

Organization	Are stakeholders actively involved in fire management		Total
	Yes	No	
National Fire Service	4	1	5
District Forestry	3	0	3
Agriculture	4	0	4
NADMO	3	1	4
JICA(RFC)	4	1	5
APERL (FFRT)	3	0	3
Total	21	3	24

4.4.1 Stakeholder Participation in Planning, Implementation and Monitoring of Fire Management Activities

Table 14 indicates respondents' views on stakeholder participation regarding fire planning / decision making, implementation, and monitoring. Of the 438 respondents interviewed, 230 (53%) respondents expressed that stakeholders occasionally participated in fire planning / decision making at the community level while 28 (6%) stated that stakeholders never participated in fire planning. All the five communities had highest responses [Adoe 30 (56%); Motoase 26 (90%); Fiapre 66 (43%); Dumesua 70 (52%); and Ayakomaso 38 (58%)] stating that stakeholders occasionally did participate in fire planning / decision making.

Also, 227 (52%) respondents out of the 438 interviewed stated that stakeholders occasionally did participate in fire implementation activities in the communities while 28 (6%) expressed that stakeholders never participated in fire implementation. Of the five communities, three communities (Motoase, Dumesua and Ayakomaso) did not record response (0) on stakeholders never participating in fire implementation at the community level. However, the five communities had majority of their respondents [Adoe 28 (52%); Motoase 23 (79%); Fiapre 53 (34%); Dumesua 82 (61%); and Ayakomaso 41 (62%)] indicating that stakeholders occasionally participated in fire implementation activities.

Furthermore, 266 (61%) of the 438 respondents interviewed indicated that stakeholders occasionally participated in fire monitoring in the communities while 16 (4%) specified that stakeholders always participated in fire monitoring in the communities. Of the five communities, three communities (Adoe, Motoase and Ayakomaso) did not have responses (0) on stakeholders always participating in fire monitoring. On the other hand

Motoase, Dumesua and Ayakomaso also recorded no responses (0) on stakeholders never participating in fire monitoring in the communities.

Table 14: Stakeholder participation in fire Management

Respondents responses on:	Communities	A	O	Oc	R	N	Total
How regular do stakeholders participate in fire planning at the community level?	Adoe	3	8	30	10	3	54
	Motoase	0	0	26	3	0	29
	Fiapre	11	14	66	39	25	155
	Dumesua	16	21	70	27	0	134
	Ayakomaso	3	21	38	4	0	66
	Total	33	64	230	83	28	438
How regular do stakeholders participate in fire implementation at the community level?	Communities	A	O	Oc	R	N	Total
	Adoe	0	19	28	6	1	54
	Motoase	0	5	23	1	0	29
	Fiapre	16	23	53	36	27	155
	Dumesua	13	17	82	22	0	134
	Ayakomaso	1	21	41	3	0	66
	Total	30	85	227	68	28	438
How regular do stakeholders participate in fire monitoring at the community level?	Communities	A	O	Oc	R	N	Total
	Adoe	0	9	31	11	3	54
	Motoase	0	0	26	3	0	29
	Fiapre	4	13	66	44	28	155
	Dumesua	12	3	97	22	0	134
	Ayakomaso	0	17	46	3	0	66
	Total	16	42	266	83	31	438

A - Always; O - Often; Oc - Occasionally; R - Rarely; N – Never

4.4.2 Stakeholder Participation in Logistical, Financial and Technical Support

Table 15 presents the responses on stakeholder involvement in: logistical; financial; and technical decisions. The assertion made by respondents that stakeholders are not actively involved in fire management in the communities is further confirmed by their responses that stakeholders are not involved in decision regarding logistics; finance and technical support for fire management in the communities. A total of 226 (51.6%) respondents stated that stakeholders do not take part in decision regarding logistics while 96 (22.0%) respondents stated that stakeholders are involved. But 116 (26.4%) respondents do not know whether stakeholders' are involved in decision regarding fire management logistics.

Also 251 (57.3%) respondents said stakeholders are involved in fire management finance while 60 (13.7%) respondents disagreed. The results indicated that 127 (29.0%) respondents could not tell whether stakeholders are involved in decisions with respect to fire management finances in the study area. Furthermore, 209 (47.7%) respondents indicated that stakeholders are not involved in technical support decisions making regarding fire management in the study communities while 165 (37.7%) respondents indicated that stakeholders are involved. But 64 (14.6%) respondents could not tell whether stakeholders are involved in technical support in fire management in the study communities.

Table 15: Stakeholder involvement in Logistical, Financial and Technical Support

Respondent Responses on:	Communities	Yes	No	Don't know	Total
Stakeholder involvement in logistic support	Adoe	8	39	7	54
	Motoase	1	24	4	29
	Fiapre	37	79	39	155
	Dumesua	45	49	40	134
	Ayakomaso	5	35	26	66
	Total	96	226	116	438
Stakeholder involvement in financial support	Communities	Yes	No	Don't know	Total
	Adoe	9	36	9	54
	Motoase	1	24	4	29
	Fiapre	25	91	39	155
	Dumesua	22	63	49	134
	Ayakomaso	3	37	26	66
Total	60	251	127	438	
Stakeholder involvement in technical support decisions	Communities	Yes	No	Don't know	Total
	Adoe	2	29	9	54
	Motoase	1	14	4	29
	Fiapre	60	54	33	155
	Dumesua	63	56	15	134
	Ayakomaso	39	24	3	66
Total	165	209	64	438	

Figure 7 show respondents views on whether stakeholders are given incentives in order to participate in fire management. The study revealed that stakeholders do not receive

any incentives for participating in fire management activities in the five communities. Of the 438 respondents 370 (85%) respondents stated that stakeholders are not given any incentives for their participation in fire management compared to 59 (13%) respondents who stated that stakeholders are given incentives. Six institutions confirm that stakeholders are not given incentives in participating in fire management decision regarding logistic, finances and technical support. Of the 24 respondents from the six institutions, a total of 18 (75%) respondents indicated stakeholders are not given incentives while 6 (25%) respondents indicated stakeholders are given incentives.

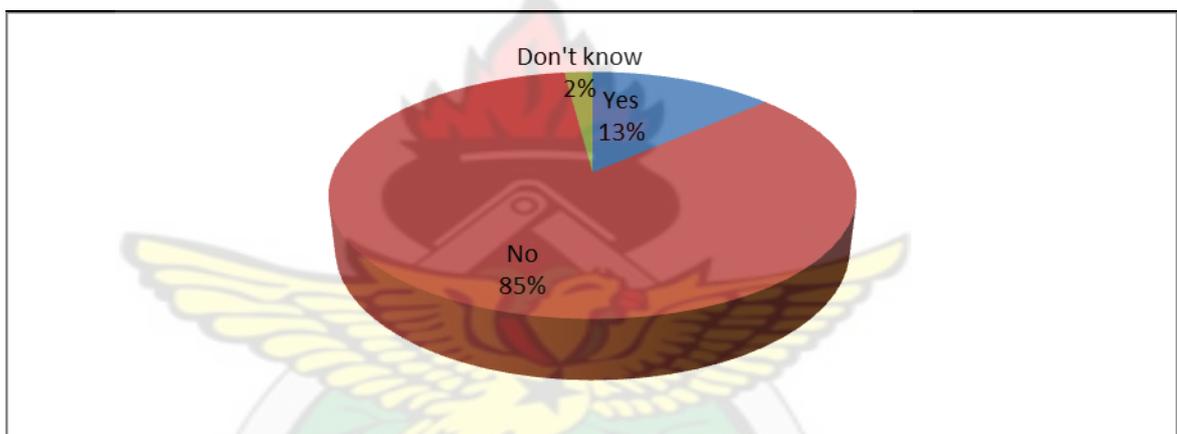


Figure 7: Responses on whether Stakeholders are given incentives in Participating in Fire Management

The lack of incentives for stakeholders to participate in fire management was given as a reason why stakeholders might have not been participating in fire management decision regarding logistic, financial and technical support in the study communities. A total of 338 (77%) respondents agreed to this assertion while 100 (23%) respondents disagreed (Table 16).

Table 16: Responses about stakeholders not giving their best due to the lack of incentives

Community	Stakeholders do not give their best because they are not given incentives		Total
	Yes	No	
Adoe	54	0	54
Motoase	27	2	29
Fiapre	100	55	155
Dumesua	107	27	134
Ayakomaso	50	16	66
Total	338	100	438

Index of participation calculated from the study revealed that stakeholders participated in fire management regarding fire management planning, implementation and monitoring occasionally in the study communities. The index of participation for stakeholders regarding planning, implementation and monitoring were 0.59, 0.60 and 0.56 respectively. This was confirmed by the six institutions index of participation regarding planning, implementation and monitoring. The calculated indices of participation for stakeholders from the six institutions are 0.62, 0.67 and 0.60 respectively for fire management planning, implementation and monitoring.

4.5.0 Gender Strategies in Fire Management

4.5.1 Gender Issues in Fire Management Before 1983

The study results showed that before 1983, fire management activities were mainly carried out by men in the five communities around Tain II forest reserve. The results in Figure 8 show that 229 (52%) respondents were of the view that fire management was a duty mainly for men while 99 (23%) respondents were of the opinion that fire management was an activity for men only.

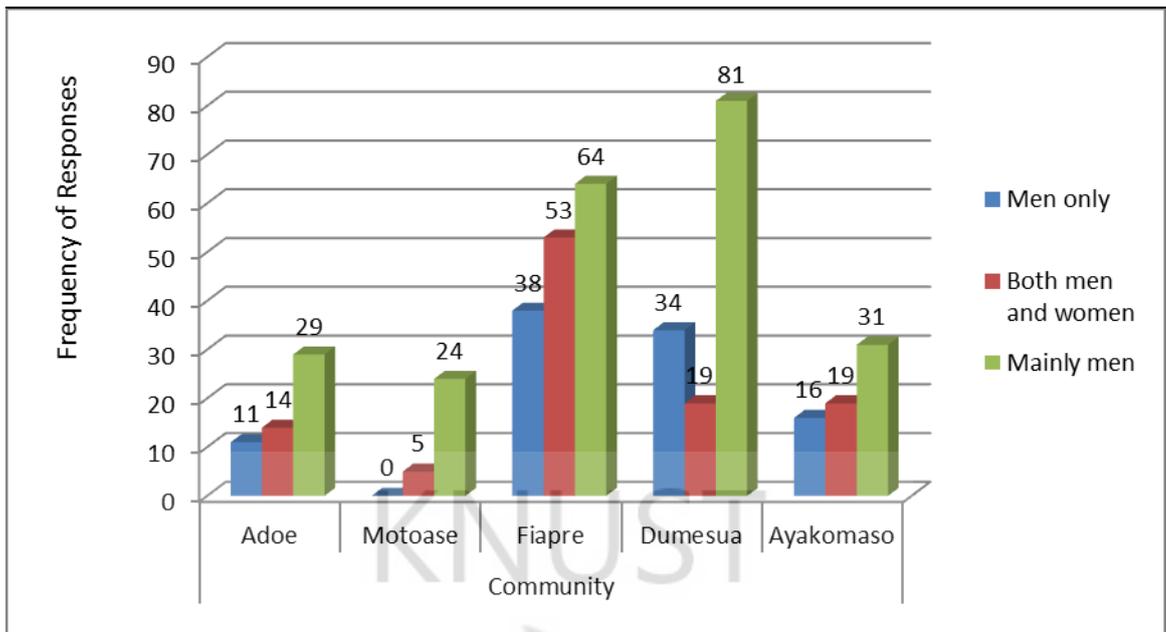


Figure 8: Responses on the Participation of Men and Women in Fire Management Before 1983

4.5.2 Gender Issues in Fire Management After 1983

Figure 9 shows respondents responses on the involvement of men and women in fire management after 1983. Responses after 1983 indicated that both men and women are involved in fire management in the five communities around Tain II forest reserve. Majority of respondents 318 (73%) stated that both men and women are involved in fire management while 120 (27%) respondents indicated that fire management is mainly for men.

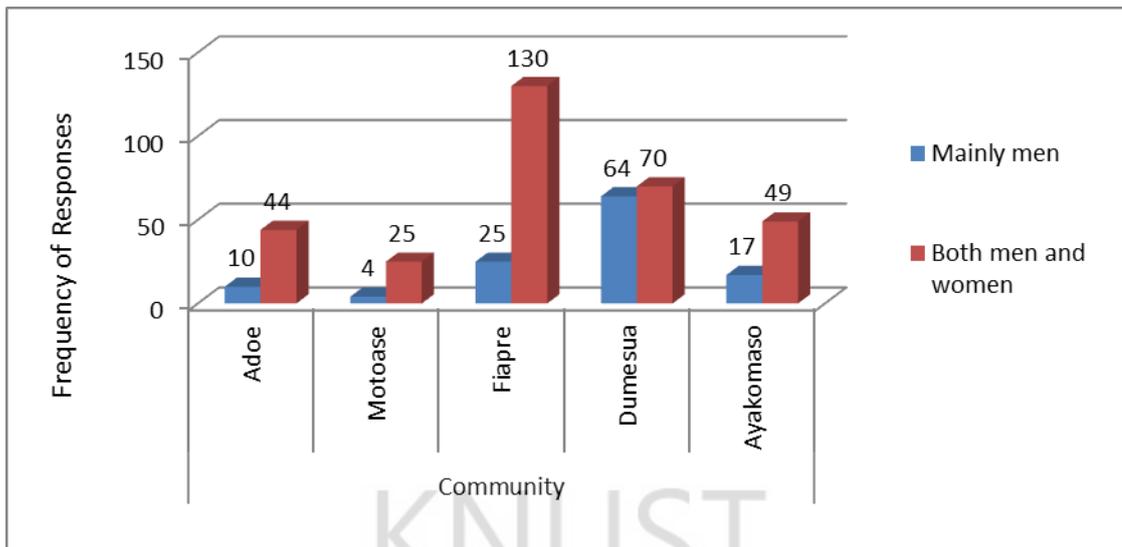


Figure 9: Responses on the Participation of Men and Women in Fire Management After 1983



Plate 4: A Male and Female Fire Volunteer

4.5.3 Gender Issues in Fire Management Planning, Implementation and Monitoring

Table 17 indicates responses concerning women participation in fire management regarding planning, implementation and monitoring at the community level. Majority of the respondents [194 (44%); 175 (40%), and 206 (47%)] out of 438 interviewed stated that women really participated in fire management planning/decision making, implementation and monitoring respectively in the five communities. The results

revealed that 35 (8%) respondents stated that women often participated in fire management planning / decision making while 38 (9%) and 28 (6%) respondents indicated that women always participated in fire implementation and monitoring.

However, all the five communities had majority of their respondents [Adoe 29 (54%), Motoase 16 (55%), Fiapre 71 (46%), Dumesua 53 (39%), and Ayakomaso 25 (38%)] indicating that women rarely participated in fire management planning / decision making. Also all the five communities had majority of their respondents stating that women rarely participated in fire implementation [Adoe 21 (39%), Motoase 16 (55%), Fiapre 48 (31%), Dumesua 61 (46%), and Ayakomaso 29 (44%)] and monitoring [Adoe 24 (44%), Motoase 16 (55%), Fiapre 64 (41%), Dumesua 71 (53%), and Ayakomaso 31 (47%)].

But of the 438 respondents interviewed, 174 (40%) respondents stated that both men and women were occasionally involved in fire management activities in the communities while 21 (5%) indicated that both men and women were always involved in fire management activities. Of the five communities, two communities [Adoe 20 (37%) and Fiapre 60 (39%)] had majority of their respondents stating that both men and women were rarely involved in fire management activities while the other three communities [Motoase 13 (45%), Dumesua 60 (45%) and Ayakomaso 32 (48%)] had majority of their respondents indicating that both men and women were occasionally involved in fire management.

Table 17: Responses on Women Participation in Fire Management

Respondents responses on:	Communities	A	O	Oc	R	N	Total
How regular do women participate in fire management planning / decision making	Adoe	6	6	12	29	1	54
	Motoase	0	0	13	16	0	29
	Fiapre	10	12	39	71	23	155
	Dumesua	16	6	44	53	15	134
	Ayakomaso	4	11	15	25	11	66
	Total	36	35	123	194	50	438
How regular do women participate in fire management implementation	Communities	A	O	Oc	R	N	Total
	Adoe	4	4	11	21	14	54
	Motoase	0	6	7	16	0	29
	Fiapre	26	13	42	48	26	155
	Dumesua	4	21	36	61	12	134
	Total	38	59	107	175	59	438
How regular do women participate in fire management monitoring	Communities	A	O	Oc	R	N	Total
	Adoe	4	2	18	24	6	54
	Motoase	0	1	12	16	0	29
	Fiapre	4	26	49	64	12	155
	Dumesua	16	1	46	71	0	134
	Total	28	30	141	206	33	438
How regular do both women and men participate in fire management	Communities	A	O	Oc	R	N	Total
	Adoe	6	5	18	20	5	54
	Motoase	0	0	13	10	6	29
	Fiapre	5	13	51	60	26	155
	Dumesua	6	21	60	40	7	134
	Total	21	44	174	150	49	438

A - Always; O - Often; Oc - Occasionally; R - Rarely; N – Never

The index of participation calculated from responses of respondents in the five communities regarding women participation in fire management (planning, implementation and monitoring) was 0.5, 0.5 and 0.5 respectively. However, the index of participation calculated for the six institutions for women involvement in fire management (planning, implementation and monitoring) was 0.6, 0.6 and 0.6 respectively. But the index of participation calculated for both men and women participating in fire management in the five communities was 0.5.

The calculated index of participation goes to confirm women's involvement in fire management in the five communities.

4.6.0 Challenges of Community Fire Management Systems

The following challenges were identified by respondents regarding the current use of indigenous and conventional fire management systems as well as stakeholder participation in fire management around Tain II Forest Reserve

4.6.1 Challenges of Indigenous Fire Management Systems

The study revealed that majority of respondents are of the view that there is ineffectiveness of traditional rules and regulation (bye laws/sanction) and lack of respect for traditional authority (after 1983) which was once used as measures to curb fire incidence. A total of 338 (77%) respondents agreed to this assertion compared to the 100 (23%) respondents who still believe that traditional norms are still being used to curb current fire menace (Figure 10).

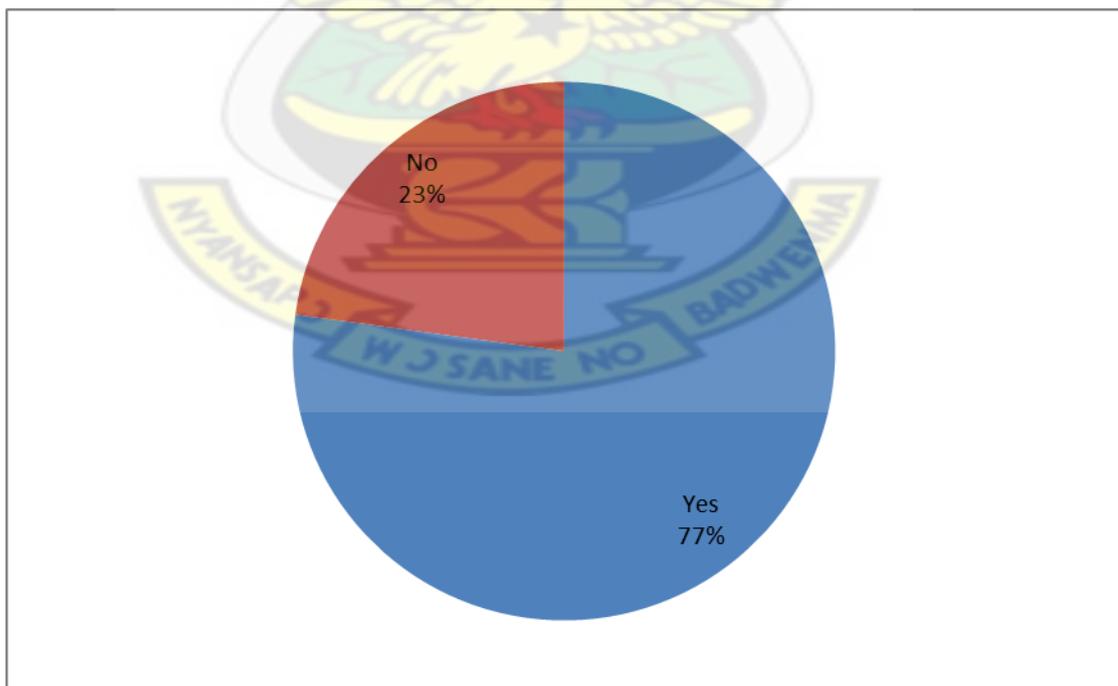


Figure 10: Responses on the ineffectiveness of Traditional Rules and Regulation

Respondents were of the opinion that they can no longer practice indigenous early burning as a measure to suppress and control fire. This was confirmed by 278 (63%) respondents compared to 160 (37%) respondents who disagree to the assertion. Furthermore, respondents are of the view that indigenous fire suppression and pre-suppression can no longer help reduce annual wildfires around Tain II Forest Reserve as the once thick vegetation and forest which enhanced suppression and pre-suppression have been removed leaving most of the area covered with grass. A total of 228 (52%) respondents agreed to this while 210 (48%) respondent disagreed (Table 18).

Table 18: Responses on indigenous pre-suppression and suppression in controlling wildfire

Can indigenous early burning (pre-suppression) be used to suppress and control wildfires?	Communities	Yes	No	Total
	Adoe	16	38	54
	Motoase	11	18	29
	Fiapre	58	97	155
	Dumesua	53	81	134
	Ayakomaso	22	44	66
	Total	160	278	438
Can indigenous suppression be used to control wildfires?	Communities	Yes	No	Total
	Adoe	25	29	54
	Motoase	12	17	29
	Fiapre	77	78	155
	Dumesua	66	68	134
	Ayakomaso	30	36	66
	Total	210	228	438

4.6.2 Challenges of Conventional Fire Management Systems

The following challenges were identified by respondents concerning the conventional fire management systems used around Tain II Forest Reserve.

4.6.2.1 Effective Penalties for Offenders

Table 19 indicates respondents' responses on whether culprits are punished for setting fires as well as whether the punishments given to culprits are deterrent enough to stop annual wildfires. The study results show that opinions were divided on whether

punishments of culprits in the five communities are deterrent enough. A total of 271 (62%) respondents agreed that culprits are not punished when arrested for setting wildfires while 167 (38%) respondents are of the view that culprits are punished. However, a total of 312 (71%) respondents stated that punishments given to culprits are not deterrent enough to stop the continuous occurrence of fires in the study communities compared to 126 (29%) respondents who were of the opinion that punishments are deterrent enough to deter offenders. Another challenge uncovered by the research in group discussion and confirmed by some staff of Ghana National Fire Service is the interference by political parties and state officials. As a result, culprits are arrested for fire offences, but are not punished.

Table 19: Responses on whether Culprits are punished in setting wildfires

Are culprits punished for setting fires?	Communities	Yes	No	Total
	Adoe	17	37	54
	Motoase	12	17	29
	Fiapre	60	95	155
	Dumesua	55	79	134
	Ayakomaso	23	43	66
	Total	167	271	438
Are punishment given to culprits deterrent enough?	Communities	Yes	No	Total
	Adoe	20	34	54
	Motoase	7	22	29
	Fiapre	44	111	155
	Dumesua	32	102	134
	Ayakomaso	23	43	66
	Total	126	312	438

4.6.2.2 Inadequate Awareness of National Laws and Policies

Regarding awareness of national laws and policy concerning wildfire management, 239 (55%) respondents are not aware of any national laws and policy while 199 (45%) are aware of these laws and policy. This was confirmed by 14 (58%) respondents from six institutions interviewed that at community level majority may not be aware of these laws and policies while 10 (42%) disagreed. Furthermore, 331 (76%) stated that

wildfire laws are not effectively applied in dealing with perennial wildfires compared to 107 (24%) respondents who said the laws are effectively applied (Table 20).

Table 20: Responses on the Awareness of National Laws and Polices

Are community members aware of national laws and policies?	Communities	Yes	No	Total
	Adoe	13	41	54
	Motoase	17	12	29
	Fiapre	84	71	155
	Dumesua	62	72	134
	Ayakomaso	23	43	66
	Total	199	239	438
Are community members aware of national laws and policies?	Organizations	Yes	No	Total
	National Fire Service	2	3	5
	District Forestry	1	2	3
	Agriculture	2	2	4
	NADMO	2	2	4
	JICA (RFC)	2	3	5
	APERL (FFRT)	1	2	3
	Total	10	14	24
In your opinion are these laws effectively applied?	Communities	Yes	No	Total
	Adoe	21	33	54
	Motoase	5	24	29
	Fiapre	34	121	155
	Dumesua	25	109	134
	Ayakomaso	22	44	66
	Total	107	331	438

4.6.2.3 Inadequate Resources for Fire Volunteers

Table 21 shows the distribution of responses on whether fire volunteers are equipped or not. The study results revealed that fire fighting equipment are not available and even where these fire fighting equipment are available they are not enough to be distributed among fire volunteer squads (Plates 4.3 and 4.4). A total of 266 (61%) respondents agreed to the assertion that fire volunteer are not equipped; 61 (14%) respondents disagreed; and 111 (25%) respondents did not know whether fire volunteers are equipped or not. Of the 24 respondents from the six institutions, 15 (62.5%) agreed that fire volunteers are not equipped while 9 (37.5%) disagreed.

Table 21: Responses on whether Fire Volunteer Squads are well Equipped to Perform their Duties

Are fire volunteer squads well equipped to work	Communities	Yes	No	Don't know	Total
	Adoe	0	46	8	54
	Motoase	0	23	6	29
	Fiapre	34	83	38	155
	Dumesua	14	65	55	134
	Ayakomaso	13	49	4	66
	Total	61	266	111	438

Are fire volunteer squads well equipped to work	Organization	Yes	No	Total
	National Fire Service	2	3	5
	District Forestry	0	3	3
	Agriculture	2	2	4
	NADMO	2	2	4
	JICA (RFC)	2	3	5
	APERL (FFRT)	1	2	3
	Total	9	15	24



Plate 5: Fire Fighting Equipment for Fire Volunteer squads

It was also gathered from a group discussions that fire management was carried out by various government agencies which in opinion of the study communities do not help the current situation of annual fires because it brings with it conflicting implementation strategies and programmes.

4.6.3 Challenges of Stakeholders

The study identified that the Ghana National Fire Service is not able to monitor the activities of the fire volunteers and neither do the fire volunteers able to give feedback to the Service due to lack of incentives for fire volunteers.

Table 22 illustrates the distribution of responses on fire volunteer squads being insured against wildfires as well as given incentives for wildfire fighting. There is lack of insurance schemes for fire fighters in the study area. A total of 238 (54%) respondents agreed to the fact fire fighters are not insured while 200 (46%) respondent are of the view that fire fighters are insured against fires. A total of 247 (56%) respondents stated fire volunteers are not given any incentives for fighting fires in their communities around Tain II forest reserve while 191 (44%) respondents stated fire volunteers are given incentives for participating in fire fighting.

Table 22: Responses on Fire Volunteer Squads being insured against wildfires as well as given incentives for wildfire fighting

Respondent Responses on:	Community	Yes	No	Total
Are fire volunteer squads insured against fires?	Adoe	25	29	54
	Motoase	13	16	29
	Fiapre	71	84	155
	Dumesua	59	75	134
	Ayakomaso	32	34	66
	Total	200	238	438
Are fire volunteer squads given per-diem?	Community	Yes	No	Total
	Adoe	24	30	54
	Motoase	12	17	29
	Fiapre	68	87	155
	Dumesua	57	77	134
	Ayakomaso	30	36	66
Total	191	247	438	

CHAPTER FIVE

DISCUSSION

5.0 Effectiveness of Fire Management

5.0.1 Effectiveness of Indigenous Fire Management

The results indicate that indigenous fire management helped curb wildfires in the years before the 1983 El Nino engulfed Ghana. In their (respondents') estimation, indigenous fire management in general was successful in curbing wildfires because community members revered and feared their traditional leaders. As a result, they abided by the traditional rules and regulations associated with the use of fire that governed their farming activities and natural resources management. The assertion of the respondents thus confirm earlier findings by Ntiamo-Baidu, (1995) and Abayie Boateng, (1998) that in Ghana traditional natural resource management is shaped around local rules and regulations. These local rules and regulations instituted by local authorities usually came in the form of taboos and or bye laws/sanctions. Offenders were made to make sacrifices to community gods for disobedience to authority and for bringing the name of their clan and/or community into disrepute.

This particular finding is comparable to what is pertains in communities such as Agubies, Bowku, Kalbeon and Wulugu where indigenous fire management triumph through the use of taboos and sanctions given to culprits (Millar *et al.*, 2004). Sacrifices are made to maiden gods to appease them for protection from any calamity that might occur as a result of disobedience by burning. It is prohibited for anyone to set fire on his/her farm before the sacrifices are made (Millar, 2004). These rules and regulations are most often enshrined in religious or cultural beliefs and superstitions

and enforced by prohibitions which have no legal backing, but takes its efficacy from customary beliefs which were strong enough in the past, thus commanding strict adherence (Ntiamoa-Baidu 1995). Millar's (1995) position that the spirituality of local people serves as the basis for all human endeavours and is reflected in their worldview perhaps offers a verifiable reason for the central role of these beliefs. Responses gathered from focus group discussions lend credence to the stance of individual community members and institutions and it can thus be inferred that these rules and regulations might have also worked because community members revered and feared their local chiefs and as such obeyed laid down traditions. Tradition also did forbid any farmer to burn a farm land or any surrounding without first constructing clear fire breaks.

5.0.2 Effectiveness of Conventional Fire Management

Conventional fire management systems practiced in the study communities around Tain II Forest Reserve are prevention, pre-suppression and suppression. These conventional systems identified by respondents are in line with the assertion by Barnes *et al.*, (2005), Barnes *et al.*, (2004) and Ninnoni *et al.* (2003) as being the main conventional fire management systems used in Ghana.

From the results (Table 7) conventional fire management has reduced fire incidence around Tain forest reserve after 1983. Although this assertion was supported by responses (Table 8 and 9) on conventional fire prevention and that of the six institutions that conventional fire management helped curb wildfires, responses on conventional pre-suppression and suppression (Table 8) do not support the assertion that conventional fire management in general curb wildfires. Majority of the respondents remained neutral because wildfires still remain annual ritual around Tain

II Forest Reserve. This assertion is in line with the records (Figure 2) obtained from Ghana National Service (GNFS) that wildfires are a yearly affair around Tain II forest reserve. To this end, a firm conclusion cannot be made regarding the effectiveness of the conventional fire management system (prevention, pre-suppression and suppression) in curbing the menace of wildfires in the study communities.

In an interaction with personnel of the GNFS and the District Forestry Service Division (FSD), it was gathered that conventional fire management in the study area largely depended on wildfire prevention (law enforcement, and annual radio and mobile van education). But table 20 indicated that law enforcement is not effective to deter culprits, as they are not punished and even when culprits are punished, the punishment is not deterrent enough.

This situation follows FAO's (2007; 2009) argument that fire prevention is often hampered by unclear lines of institutional responsibilities and by conflicting policies and regulation. It is in line with this that Shields *et al.*(2006) wrote that without clear understanding of the linkages between fire cause and fire prevention actions, and more particularly, who causes them and why, it will remain a difficult task to effectively target sound fire management practices, particularly fire prevention. Nevertheless, FAO (2006) argue that effective monitoring and assessment of the prevention measures can reduce the occurrence of fires.

The unavailability and/or the lack of pre-suppression and suppression equipment (Plates 3 and 4) and the lack of incentives for stakeholders (Figure 4) at the grass roots; inability of GNFS to monitor the performance of fire volunteers in the

discharge of their duties; and lack of insurance schemes for fire volunteer squads (Table 18) were the reasons given by both respondents in the five communities and the six institutions interviewed as contributing to the ineffectiveness of the conventional fire management systems. But Ganz and Moore in 2002 stated that governments' responses to fires have tended to focus on fire suppression and costly technology based solutions to fight fires. Yet local citizens are not normally involved in fire suppression planning or pre-fire decision making processes (Everett, 2002).

5.1.0 Changes in Fire Frequency and Losses

In comparing fire frequency before and after 1983, it came to light that wildfires continue to occur around Tain II forest reserve just as in most parts of Ghana. Wildfires have become an annual event in most parts of Ghana (Barnes, 2008; Barnes, 2004; and Swaine *et al.*, 1997). This trend was identified in the records (periods of 2000-2009) of the GNFS in Sunyani. This was also given as a reason by respondents who neither agreed nor disagreed that conventional fire pre-suppression and suppression have helped curb annual wildfires around Tain II Forest Reserve.

It also confirms the fact that uncontrolled fires were relatively uncommon especially in forest zones before 1983; invariably opposing the assertion of Nsiah-Gyabaah (1996) that Ghana experienced serious bushfires during the catastrophic Sahelian drought between 1973 and 1974. The severe droughts of 1982/1983 and the accompanying wildfires was the turning point (Korem, 1985) in the history of wildfires in Ghana, and since then wildfire has become an annual ritual in most parts of Ghana due to changes in weather pattern, composition of vegetation and increasing population (Barnes, 2008).

In separate discussions held with opinion leaders in the five communities, NADMO, GNFS and FSD, it was revealed that losses being incurred both at the individual and community levels are greater than those before 1983. These losses are mainly incurred in their farms and few occasions spread into their villages. This agrees with Nsiah-Gyabaah (1996) who indicated that in 1984 - 1985 the average size of farms affected was ca. 50 ha, with the largest covering about 10 ha. The reason given for the increase in losses is that, vast areas of the land are covered with grasses which aid fast spread of wildfires to other adjoining areas. Also the lack of suppression tools and equipments; weather patterns; infrequent monitoring by fire volunteer squads; and the lack of early detection mechanism were cited as contributing factors to the increase in losses.

5.2.0 Stakeholder Participation in Fire Management

Although information on involvement of communities in fire management is still scarce, widely scattered and only slowly evolving, the involvement of all stakeholders can play substantial role in forest fire management (Changchui, 2002). A prerequisite for the success of fire management is the active involvement of all stakeholders and raising their awareness (Kieft and Nur, 2002).

Stakeholders are generally not actively involved in fire management at the community level. Even though this was contested by the six institutions, discussion with fire volunteer leaders also indicated that where even they are involved they do so occasionally. It was observed that stakeholders such as GNFS and FSD occasionally train and equip the fire volunteers in preparation for the fire session. In Ghana, Fire Fight West African (FFWA) (2003) identified lack of inter-agency working relationship and little stakeholder participation in fire management.

The lack of active or frequent participation of stakeholders might have contributed to the fire incidence every year. Furthermore it is an indication that stakeholders' knowledge and resources which Brody (2003) stated as the underlying assumption of stakeholder participation will not be brought to the fore in fire management around the Tain II reserve. Also the lack of involvement of stakeholders in fire management will not bring about the sharing authority and decision making which McCay and Jentoff (1998) stated as the fundamental assumption for stakeholder participation. This will not enhance the processes of fire management, making it more responsive to a range of community as well as stakeholder needs.

An interesting outcome generated from the study is that stakeholders are not given incentives for their participation in fire management. Ganz and Moore (2002) are of the view that incentives are important ingredient for successful community fire management. Ganz and Moore (2002) further noted that focus should be on people and organizational structures rather than equipment or legal contract. Studies conducted by Lichang *et al.* (2003); Dampha, (2003); Alvarado *et al.* (2003); Nanda and Sutar (2003); London (2003); and Kurtulmuslu and Yazici (2003), in separate places revealed that the underlying reason for the local communities and their inhabitant's failure to control fires is not lack of awareness or carelessness but rather lack of incentives to protect forest resources.

The question is; if the stakeholders are not involved in community fire management on the whole, how then can they lay claim to incentives for themselves for partaking in community fire management processes? The supposedly lack of incentives for stakeholders to participate in fire management might account for the low participation

of stakeholders in fire management decision regarding logistic, finances and technical support in the study communities. Ganz and Moore (2002) are of the view that the existence of incentives is a factor that appears to intimately associate with sense of ownership. The provision of some sort of incentives, formally or traditionally, appears to be a key element in the active participation of communities or stakeholders in fire management (Ganz and Moore, 2002). The question raised by Fire Fight West African (FFWA) (2003) is the long-term sustainability of incentives used in forest fire management.

5.3.0 Gender Strategies in Fire Management

The results indicated that before 1983 gender ordering of fire management was carried out mainly by men. It was observed during a group discussion that women cooked and swept along the clear fire breaks created by men to remove any debris that could lead to the spread of fire across the clear fire breaks. They also carried water to their men counterparts when fighting wildfires. This agrees with the work of Amissah, (2008) in which it was identified that in the gendered fire management in local communities, men constructed fire breaks whilst women fetch water to be used in the outbreak of fires by their men counterparts in rural communities.

According to FAO (2005), there are different task and responsibilities of women and men that have enabled them to accumulate different types of local knowledge and skills. However, with the inception of fire volunteer squads by PNDC Law 229 both women and men according to respondents are engaged in the business of fighting wildfire around Tain II forest reserve. They further identified that women still play their traditional role of fetching water and cooking for their men counterparts and in some cases, some bold women join their men counterparts in physical fighting and

monitoring of fire around the forest reserve. The additional roles performed by women is based on the fact that whenever there is an outbreak of fire and the entire forest reserve and/or their farms are burnt, it is they women whose livelihood are greatly affected.

In general terms, equal participation in community based decision making remains a complex and difficult goal to achieve, especially in the context of high unequal gender and class relations. Community level participation often leaves women's views and concerns unacknowledged and even where women attend meetings or events, they may not feel free to voice their opinions, or their opinions and needs may not be taken seriously (Agarwal, 2003; Prokopy, 2004). Refreshingly however, in the context of the study communities, the participation of women in fire management is encouraging.

Also, it was found out that women are willing to participate in fire management in the five communities. This is in contrast, albeit positively, with the commonly held indication that despite attempts to mainstream gender at all levels of participation, few women actually participate. And that men tend to dominate in decision making while women's limited participation in decision making restricts their capacity to engage in decisions that can impact their specific needs and vulnerabilities (Denton, 2002; Masika, 2002)

5.4.0 Challenges of Community Fire Management Systems

5.4.1 Challenges of indigenous fire management systems

Traditional leaders and authorities who once wielded power and control over their subjects to manage fire effectively before the 1983 El Nino through the use of

traditional rules and regulations no longer exert that absolute control over their subjects. This break of traditional authority according to community members and six institutions could be traced to the introduction of Christianity and Islam in these communities coupled with the influence of modernization which has impacted on the biophysical and socio-economic activities of the people around Tain II Forest Reserve.

This does not deviate from the literature as Sarfo-Mensah and Oduro (2007) reported that it is increasingly being acknowledged that the rapid loss of control by the chieftaincy institution is due to the breakdown of traditional beliefs and associated taboos. However, Dorm Adzorbu *et al.* 1991; Fargey 1991; Falconer 1992; Ntiamoabaidu 1995; Gyasi 1996; Abayie Boateng 1998, agree with the respondents who still believe that traditional norms could be used to curb the current fire menace. They argue that although traditional beliefs and taboos are undergoing changes, they have retained some of their intrinsic practice despite pressures. This has partly been attributed to the fact that local people still perceive them to be associated with gods and ancestors who are still revered.

The study further discovered that the indigenous practice of early burning can no longer be used as a measure to reduce fire incidence. The factor adduced by the respondents as accounting for this outcome is that, loss of tree cover makes suppression and pre-suppression difficult due to large areas of grass cover.

5.4.2 Challenges of conventional fire management systems

Another challenge uncovered by the research is interference by political parties and state officials. Culprits are arrested for fire offences, but are not punished. The community members were however quick to allege and register their displeasure at the

continuous intervention and interference from officialdom especially political parties in the use of the law thereby rendering the law ineffective. This according to them has culminated in the release of culprits and their confiscated items. Also, punishments meted out to culprits for setting fires were not deterrent enough to stop the continuous occurrence of fires in the study communities. This assertion agrees with Karki's (2002) suggestion that community-enforced fines and penalties work better than government legislation in enforcing wildfire sanctions.

It was also gathered from the study that wildfire management was carried out by various government agencies which in the opinion of the study communities do not help the current situation of annual fires because it brings with it conflicting implementation strategies and programmes. In Ghana, Fire Fight West African (FFWA) (2003) identified lack of inter-agency working relationship. The study also found that there are no properly laid down coordination channels for monitoring the activities being carried out by these agencies that have different mandate by law to manage wildfires. FAO (2007; 2009) confirms this and further states from its empirical observation that fire prevention and control is hampered by unclear lines of institutional responsibilities and by conflicting policies and regulations. It is therefore not surprising that, although the structures are available, yet they are not working.

Fire fighting equipment, the study discovered are not available and even where these fire fighting equipment are available they are not enough to be distributed among fire volunteers. This according to community members does not allow fire volunteers to give off their best in fighting wildfires. In a discussion with some staff of the Ghana National Fire Service, it was further stressed that the Department of Rural Fire and

Fire Volunteers are not equipped for effective wildfire management. The Department is under-staffed and has limited logistics for their educational campaigns and training of communities.

Although, the Ghana National Fire Service get some support from the District Assembly and Regional Coordinating Council during the annual National Farmers Day Celebration and the annual dry season campaign which is also done during the Farmer's day celebration, these are only isolated cases and often the support is given on one – off basis. Furthermore the Ghana National Fire Service is not able to monitor the activities of fire volunteers and neither are the fire volunteers able to give feedback to the Service due to lack of resources and feedback channel for them to do so.

5.4.3 Challenges of stakeholder participation in fire management

The study identified that there is lack of insurance schemes for fire fighters in the study area. For instance, there are no insurance packages for fire fighters in case of injuries and/or death regarding fighting fires. This somewhat explains their reluctance to actively participate in fire fighting whenever there is wildfire outbreak around Tain II Forest Reserve. This was confirmed in separate group discussion with opinion leaders in the five communities and the Ghana National Fire Service and the District Forestry Services Division.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.0 Indigenous Fire Management

Findings from the study revealed that indigenous fire management helped to curb wildfires for years before the 1983 El Nino that engulfed Ghana. It was gathered that indigenous fire management systems practiced are similar to the conventional fire management system. The indigenous fire management worked efficiently and effectively through the use of traditional norms and taboos which were enforced by traditional leaders.

Majority of the respondents interviewed were of the view that traditional authorities no longer have power and or control over their subjects due to the influx of Christianity and Islam. This phenomenon according to the communities is the main reason for the continuous wildfires in their communities. The study therefore concludes that indigenous fire management can still play a major role in wildfire fire management if it is integrated into current wildfire management programmes. It is recommended that traditional authorities should be empowered to enforce laws on wildfires as they are the authorities on the ground. Communities should also be given training in the management of communal property such natural resources in order for them to see the need to control annual fires.

Furthermore, the finding showed that Communities complained that fire suppression and pre-suppression can no longer reduce annual wildfires around Tain II forest reserve as the once thick vegetation and forest which enhanced suppression and pre-suppression have been removed. This implies that suppression and pre-suppression are no longer

efficient wildfire management strategies around Tain II Forest Reserve. The policy implications are that the suppression and pre-suppression systems must be re-examined, developed and maintained in the fringe communities to ensure that forests are protected from recurrent wildfires. It is recommended that the wildfire management programme be based on cordial relationship between community and resource managers. This can be created through participatory approach.

6.1 Conventional Fire Management

Conventional fire management was identified to be an important management strategy in curbing wildfires. The findings however revealed that the major setback for the conventional fire management strategies as effective fire management practices around Tain II Forest Reserve are, failure of communities to report culprits because of family ties; politicians and persons in high social status do not allow for effective enforcement of the law.

It is therefore recommended that, those who interfere in the enforcement of wildfire laws be made to face the laws of Ghana irrespective of their social and or economic status. This will empower implementing agencies to enforce the wildfire laws to the latter.

It was also concluded from the study that fire volunteer squads are not well equipped and where equipment are available they are unevenly distributed. This, according to community members, does not allow fire volunteers to give off their best in fighting wildfires. Wildfire management carried out by various government agencies in the opinion of the communities does not help the current situation of annual wildfires because it brings with it conflicting implementation strategies and programmes. This

particularly affects the planning, implementation and monitoring of wildfire management.

This was also stated as accounting for stakeholders at the community level not being actively involved in wildfire management. It is recommended that wildfire management should be under an authority status called National Authority on Fire Management solely responsible for the implementation and monitoring of fire management instead of the piece meal attitude currently being practiced.

6.2 Stakeholder Participation in Fire Management

Wildfire situations in Ghana can be successfully controlled and managed by experienced ground crews of fire-fighters, particularly fire volunteers at the local level. The empirical result showed that the absence of incentives and lack of insurance serves as disincentive for effective functioning of fire volunteer squads around Tain II Forest Reserve. They are not insured against wildfires in case of injuries and or death resulting from fighting fires.

Fire volunteer squads should be provided with health insurance and also insured against unforeseen hurts and burns in combating fires to serve as motivation for them to go the extra mile. It is further recommended that fire volunteers with minimum qualification should be enlisted into Ghana National Fire Service. The National Youth Employment Programme (NYEP) secretariat can effectively coordinate this exercise.

6.2.1 Gender Participation in Fire Management

The study revealed that women were willing to participate in wildfire management in the five communities. Women have a lot of knowledge which wildfire agencies can harness to have a holistic representation of ideas in wildfire management which was previously mainly men dominated. Women participation will break the complexity and difficulty of the unequal and class relations.

Wildfire management agencies and stakeholders should therefore endeavor to inculcate gender analysis and mainstreaming into the general planning, implementation and monitoring of their programmes. This will ensure a broader based stakeholder analysis and participation in wildfire management not only in Tain II Forest Reserve but the country as a whole.



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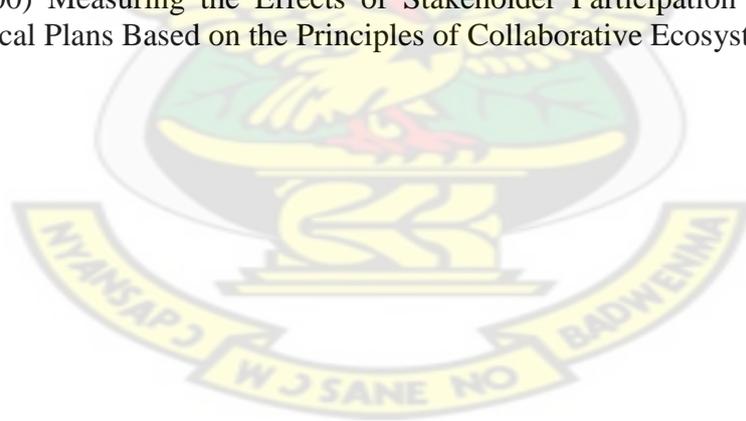
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APPENDIX I

Research on Community Fire Management around Tain II Forest Reserve Household Questionnaire

General Information

Questionnaire Number: Date: Name of Researcher:
Name of Community: please tick Adoe Motoase Fiapre Dumesua
Ayakomaso
House Number: (Please for purposes of cross checking
information)

Section A: Demographic Characteristic of Respondent (please tick the appropriate box)

1. Sex: Male Female
2. Age: 20-25 26-30 31-40 41-50 60+
3. Formal Education: None Primary J.S.S S.S.S./Vocational/ Technical
Tertiary/Post Sec.
4. Occupation:
5. Status: (a) Indigene (b) Settler (c) Transferee (d) Others specify

Tick when necessary, however where more than one answer is needed tick as much as possible

Section B: Community fire Management systems used around the Tain II forest reserve

I. Indigenous (local) fire management systems available and used in the community (Before 1983 fires)

1. Is there the need to manage fire? Yes No If yes, why
2. When your ancestors did not want fires to occur in the community what did they do?
3. Were there any indigenous rules and regulations used in community fire management? Yes No If yes, which are these rules and regulations in community fire management?
4. Do traditional customs allow bush burning in the community and why? Yes (if yes, give reason) No if no, why
5. Who enforces the sanction of fire burning in the community?
(a) Chief/Elders (b) Clan heads (c) Fire volunteers (d) Others (mention)
6. How was the sanctions enforced?.....
7. These measures have helped in curbing the menace of fire in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree
(e) Strongly agree
8. When there was fire outbreak in the community how did your ancestors stop the fires?.....

9. What tools were they using?.....
10. These measures have helped in curbing the menace of fire in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
11. Before fires occur, what activities did your ancestors put in place to reduce it intensity?
12. These measures have helped in curbing the menace of fire in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
13. Indigenous fire management systems before 1983 fires have helped in curbing the menace of fire in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree How
14. Which of these do you think was most effective in reducing fire incidence? (a) prevention (b) pre-suppression (c) suppression (d) None (e) don't know
15. What are the challenges do the community face in using their indigenous knowledge?
16. How can indigenous fire management be improved?

II. Exotic (Conventional/scientific) fire management systems available and used in the community. After 1983 Fires

1. Which of these measures of conventional on fire prevention is practiced in the community? (a) community durbars (b) incentives and awards (c) law/sanctions (d) education/Radio/TV programmes (e) Drama (f) mobile van education/public awareness (g) None
2. Are culprits punished for burning in the community? Yes No if yes by who, if no why
3. If no, do you think it is the reason why burning continue in the community? Yes No
4. If yes, what punishments are given to culprits for burning?
5. Are the punishment deterrent enough? (a) Yes (b) No
6. Are you aware of any National Laws and Policies on fires? Yes No if yes state mention (PNDC L229; PNDC L46; GNFS Act 537; NWMP 2006)
7. Are these laws and policies effectively enforced in the community? Yes No , if no why
8. These measures have helped in curbing the menace of fire in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
9. Which of these measures of conventional fire pre-suppression practiced in the community? (a) green fire breaks (b) cleared fire breaks (c) early burning (d) high risk identification (e) patrols/early detection and communication
10. These measures have helped in curbing the menace of fire in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree Any examples

11. Currently how is fire dealt with when they occur in the community?
12. What are the tools for conventional fire pre-suppression?.....
13. These measures have helped in curbing the menace of fire in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
14. The introduction of conventional fire management systems after 1983 have helped in curbing the menace of fire in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
How
15. In which order would you rank the following fire management measures in curbing fires and why? Use; 1- most effective; 2 - effective; 3 - less effective
 - a) Prevention
 - b) Pre-suppression
 - c) Suppression
16. These exotic fire management systems have helped reduced fires frequency in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
17. Are fire volunteers given any motivation by the community? Yes No if yes, what kind of motivation
18. Are fire volunteers well resourced? Yes No Don't know
19. If yes, who provides the resources? (a) Community/Chief (b) Fire Service (c) Forestry (d) Agriculture (e) NGOs/CBOs
20. What challenges does the community face in using the conventional (exotic) fire management systems?
 - a. Prevention
 - b. Pre-suppression
 - c. Suppression

General Views on system effectiveness

1. Indigenous fire management is more effective than conventional fire management system (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree how?
2. What is the change in fire frequency? a) increasing b) decreasing c) no change
How?
3. What is the change in losses? a) increasing b) decreasing c) no change
How?
4. What is change in recovery? a) increasing b) decreasing c) no change
How?

Section C:

I. Key Participants/Stakeholders in fire management

1. Pick the identified stakeholders in fire management in the community (a) Fire volunteers (b) Chief/Elders (c) Opinion leaders (d) Unit committee

- members/Assembly person (e) Youth Environmental Club groups (f) Youth Leaders (g) Forestry Officer (h) Do not Know
2. Do these stakeholders actively involved in fire management? Yes No
Don't know
 3. Are stakeholders involved in logistical support for fire management? Yes No
 Don't know
 4. Are stakeholders involved in financial support for fire management? Yes No
 Don't know
 5. Are stakeholders involved in technical support for fire management? Yes No
Don't know
 6. Do stakeholders receive any form of incentives or motivation for participating in fire management? Yes No if yes, which incentives or motivation are they given
 7. If no, do you think it is the reason why stakeholders do not give their possible best in fire management? Yes No
 8. How regular do stakeholders participate in fire management regarding planning? Always Often Occasionally Rarely Never
 9. How regular do stakeholders participate in fire management regarding implementation? Always Often Occasionally
Rarely Never
 10. How regular do stakeholders participate in fire management regarding monitoring and evaluation? Always Often Occasionally
Rarely Never

II. Indigenous gender strategies for fire management used around the Tain II forest reserve

1. Which of these gender group(s) participate in fire management activities in the community in the past? (a) Male only (b) Female only (c) Both male and female (d) don't know (e) Mainly men
2. What is the current situation? (a) Male only (b) Female only (c) Both male and female (d) don't know
3. What are their roles (both women and men) in fire management?
 - a. Women roles
 - b. Men roles
4. Do both men and women take part in fire management regarding decision making/planning? Yes No if no, why.....
5. How many women are in the fire volunteer squad? In term of ratio (woman to man ratio)
6. Do both men and women take part in fire management regarding implementation? Yes No If no, why
7. Do both men and women take part in fire management regarding monitoring and evaluation? Yes if yes, why No if no, why
8. Are women willing to participate in fire management? Yes No if no, why

9. Are you aware of laws and policies which support gender balance in fire management? Yes No if yes, state them (NWM policy 2006)
10. How do we ensure a gender balance in fire management?
- (a) Education
 - (b) Quota systems in policy and laws
 - (c) Mechanisms for women encouragement
 - (d) Others views (specify)

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APPENDIX II

Research on Community Fire Management around Tain II Forest Reserve

Questionnaire for Fire Volunteer Squad

General Information

Questionnaire Number: Date:

Name of Community: please tick Adoe Motoase Fiapre Dumesua Ayakomaso

House Number: (Please for purposes of cross checking information)

Section A:

Demographic Characteristic of Respondent (please tick the appropriate box)

1. Sex: Male Female
2. Age: 20-29 30-39 40-49 50-59 60+
3. Formal Education: None Primary J.S.S/Middle S.S.S./Vocational/Technical Tertiary/Post Sec.
4. Occupation:
5. Status: (a) Indigene (b) Settler (c) Transferee (d) Others specify.....

Tick when necessary, however where more than one answer is needed tick as much as possible

Section B:

Community fire Management systems used around the Tain II forest reserve

II. Indigenous (local) fire management systems available and used in the community Before 1983 fires

1. Is there the need to manage fire? Yes No If yes, why
2. Which of these fire management strategies is often practiced in this community? a) fire prevention b) pre-suppression c) fire suppression d) none
3. Which of these measures of local knowledge on fire prevention is practiced in the community? (a) Community durbars for fire education (b) taboo (c) by-laws/sanctions (d) None (e) others, specify
4. Are there any indigenous rules and regulations used in community fire management? Yes No if yes, which are these rules and regulations in community fire management?.....
5. Who enforces the sanction of fire burning in the community? a) Chief/Elders (b) Clan heads (c) Fire volunteers (d) others (mention)
6. The enforcement of rules and regulation is effective. a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree Why your answer
7. These indigenous fire prevention measures have helped in curbing the menace of fire in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree

8. Which of these measures of indigenous knowledge on fire pre-suppression practiced in the community? (a) green fire breaks (b) cleared fire breaks (c) early burning
9. Are there any indigenous pre-suppression measures for high risk areas and period identification in the community? Yes No if yes, what are they
10. Are there areas in the community where it is not allowed to set fire, please name such places? Yes (if yes name such places) No
11. When fire occurs, how is it communicated to the people (a) Gong gong beating (b) shouting (c) drum beating (d) others specify
12. These fires pre-suppression measures have help in curbing the menace of fire in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
13. Which indigenous fire suppression measures are practiced in the community?
14. What tools were they using?.....
15. These indigenous fire suppression measures have helped in curbing perennial fires in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
16. Did tradition allow burning on your farms? Yes (if yes, give reason) No if no, why.....
17. Indigenous fire management systems before 1983 fires have helped in curbing the menace of fire in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree How.....
18. What challenges does the community face in using their indigenous fire management systems?
19. How can these challenges be addressed?

II. Exotic (Conventional/scientific) fire management systems available and used in the community. After 1983 fires

1. Which of these conventional fire management systems are used in the community fire management? (a) Prevention (b) Pre-suppression (d) Suppression
2. Which of these measures of conventional fire management on fire prevention are practiced in the community? (a) community durbars (b) incentives and rewards (c) law/sanctions (d) communication (e) Drama (f) mobile van education/public awareness and education or Radio/TV programmes (g) None
3. Are culprits punished for burning in the community? Yes No if yes by who, if no why
4. If no, do you think it is the reason why burning continue in the community? Yes No
5. If yes, what punishments are given to culprits for burning?
6. Are you aware of any National Laws and Policies on fires? Yes No if yes mention
7. Are these laws and policies effectively enforced in the community? Yes No if no why
8. Who enforces the laws?
9. What are some of the challenges in the enforcement of the laws?

10. How can the laws be made effective?
11. These prevention measures have helped in curbing the menace of fire in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
12. Which of these measures of conventional fire pre-suppression are practiced in the community? (a) green fire breaks (b) cleared fire breaks (c) early burning (d) high risk identification (period/areas) (e) patrols/early detection
13. How is fire communicated? (a) whistling (b) radio (c) Gong gong (d) others specify
14. These pre-suppression measures have helped in curbing the menace of fire in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
15. Which are the conventional fire management tools for fire pre-suppression? (a) protective clothing (b) mattocks (c) cutlass (d) shovel (e) drip torch (f) backpack pumps (g) others mention
16. Are these tools used as it is required of them? Yes No if no why
17. Which of these measures of conventional fire suppression are practiced in the community? (a) direct attack (b) indirect attack (c) parallel attack
18. These measures have helped in curbing the menace of fire in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
19. Which are the conventional fire management tools for fire suppression? (a) axe (b) rake (c) cutlass (d) shovel (e) whistle (f) torch-light (g) Wellington boot (h) goggles (i) helmets (j) others mention
20. In which order would you rank the following fire management measures in curbing fires and why? Use; 1 most effective; 2 effective; 3 less effective
 - a) Prevention
 - b) Pre-suppression
 - c) Suppression
21. These exotic fire management systems have helped reduced fires frequency in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
22. Does the introduction of the conventional fire management systems decrease the occurrence of wildfires in the community? Yes No
23. Are fire volunteers motivated by the community? Yes No
24. Are fire volunteers accepted in the community as they do their work? Yes No
25. Are fire volunteers resourced to work effectively? Yes No Don't know
26. Who resource the fire volunteers squads in the community? (a) Community/Chief (b) Fire Service (c) Forestry (d) Agriculture (e) NGOs/CBOs (f) Don't know
27. What challenges do fire volunteers face in carrying out their duties?
28. What are the challenges in the use of conventional (exotic) fire management systems?
 - a. Prevention
 - b. Pre-suppression
 - c. Suppression

General views on system effectiveness

1. Indigenous fire management is more effective than conventional fire management system (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
2. Both indigenous and exotic (conventional) fire management systems have helped reduced fire frequency (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
3. Are the incidences of fires increasing in the community? Yes No
If yes, what is the possible reason? If no, why
4. What is the change in fire frequency? a) increasing b) decreasing c) no change
How?
5. What is the change in losses? a) increasing b) decreasing c) no change
How
6. What is change in recovery? a) increasing b) decreasing c) no change
How

Section C:

III. Key Participants/Stakeholders in fire management

1. Pick the identified stakeholders in fire management in the community (a) Fire volunteers (b) Chief/Elders (c) Opinion leaders (d) Unit committee members/Assembly person (e) Youth Environmental Club groups (f) Youth Leaders (g) Forestry Officer (h) Do not Know
2. Are these stakeholders actively involved in fire management? Yes No if no, why
3. Do stakeholders participate in fire management concerning: (A) Decision making/Planning? a) Yes b) No c) don't know if no, why
- (B) Implementation? a) Yes b) No c) don't know if no, why.....
- (C) Monitoring and Evaluation (a) Decision making/Planning? a) Yes b) No c) don't know if no, why
4. Are stakeholders involved in logistical support for fire management? Yes No Don't know
5. Are stakeholders involved in financial support for fire management? a)Yes b)No c) Don't know
6. Are stakeholders involved in technical support for fire management? a)Yes b)No c) Don't know
7. Do stakeholders receive any form of incentives or motivation for participating in fire management? a)Yes b) No c) Don't know if yes, which are they
8. If no, do you think it is the reason why stakeholders do not give their possible best in fire management? Yes No
9. How regular do stakeholders participate in fire management regarding planning? Always Often Occasionally Rarely Never
10. How regular do stakeholders participate in fire management regarding implementation? Always Often Occasionally Rarely Never

11. How regular do stakeholders participate in fire management regarding monitoring and evaluation? Always Often Occasionally Rarely Never
12. In your opinion which of these are responsible for fire management decisions making/planning? (a) Community (b) Forestry officers (c) National Fire Service (d) NADMO (e) District Assembly (f) Unit committee members (g) Village fire volunteers squads h) don't know
13. Which of these are responsible for fire management regarding implementation? (a) Community (b) Forestry officers (c) National Fire Service (d) NADMO (e) District Assembly (f) Unit committee members (g) Village fire volunteers squads h) don't know
14. Which of these are responsible for fire management regarding monitoring and evaluation? (a) Community (b) Forestry officers (c) National Fire Service (d) NADMO (e) District Assembly (f) Unit committee members (g) Village fire volunteers squads (h) don't know
15. Are community members involved in fire management regarding planning? a)Yes b)No c) Don't know if no, why
16. Are community members involved in fire management regarding implementation? a)Yes b)No c) Don't know if no, why
17. Are the community members involved in the development of laws and policies? a)Yes b)No c) Don't know if no, why
18. Are community members involved in fire management regarding monitoring and evaluation? a)Yes b)No c) Don't know if no, why
19. What are the motivation for community involvement in fire management regarding planning, implementation, and monitoring and evaluation?

IV. Community gender strategies for fire management used around the Tain II forest reserve

1. Which of these gender group(s) usually participate in fire management activities in the community before 1983? (a) Male only (b) Female only (c) Both male and female (d) mainly men (e) don't know
2. What is the situation after 1983? a) Male only (b) Female only (c) Both male and female (d) mainly men (e) don't know
3. What are their roles (both women and men) in fire management?
 - a. Women roles
 - b. Men roles
4. Do both men and women take part in fire management regarding decision making/planning? a)Yes b)No c) Don't know if no, why
5. Do both men and women take part in fire management regarding implementation? a)Yes b)No c) Don't know If no, why
6. Do both men and women take part in fire management regarding monitoring and evaluation? a)Yes b)No c) Don't know if no, why
7. Are women willing to participate in fire management? a)Yes b)No c) Don't know if no, why
8. Are you aware of laws and policies which support gender balance in fire management? Yes No if yes, state them

9. How regular do women participate in fire management regarding decision making/planning? Always Often Occasionally Rarely Never
10. How regular do women participate in fire management regarding implementation? Always Often Occasionally Rarely Never
11. How regular do women participate in fire management regarding monitoring and evaluation? Always Often Occasionally Rarely Never
12. How regular do men and women participate in fire management at the community level? Always Often Occasionally Rarely Never
13. Are there women in the community fire volunteer's squad, please give the ratio in relation to men? (a) Yes if yes, what is their motivation (b) No If no why
14. What are the challenges in using community gender fire management strategies?
.....
15. How do we ensure a gender balance in fire management?
 (a) Education
 (b) Quota systems in policy and laws.....
 (c) Mechanisms for women encouragement
 (d) Others views (specify)



APPENDIX III

Research on Community Fire Management around Tain II Forest Reserve

Questionnaire for Key informants

General Information

Section A:

Demographic Characteristic of Respondent (please tick the appropriate box)

1. Sex: Male Female
2. Age: 20-29 30-39 40-49 50-59 60+
3. Organization:
4. Position:

Tick when necessary, however where more than one answer is needed tick as much as possible

Section B:

Community fire Management systems used around the Tain II forest reserve

III. Indigenous (local) fire management systems available and used in the community Before 1983 fires

1. Which of these measures of local knowledge on fire prevention is practiced in the community? (a) community durbars for fire education (b) taboo (c) bye-laws/sanctions (d) communication (using the Gong-gong beating) (e) None
2. Do local custom allow bush burning in the community?
.....
3. Does indigenous fire management use incentives and rewards as a fire prevention measure? Yes No if yes, mention them
.....
4. These fire prevention measures have helped in curbing the menace of fire around Tain II forest reserve (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
5. Which indigenous fire pre-suppression measures are practiced around Tain II?
.....
6. Are there any indigenous pre-suppression measures for high risk areas and period identification in communities around Tain II? Yes No
 if yes, what are they
.....
7. These fires pre-suppression measures have helped in curbing the menace of fire in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
8. Which indigenous fire suppression measures are practiced in around Tain II?
.....
9. Which are the indigenous/local tools for fire suppression?.....

10. These measures have helped fires suppression in curbing the menace of fire in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
11. These indigenous methods (prevention, suppression and pre-suppression) are effective in curbing perennial fires (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree How?
12. Which indigenous methods (prevention, pre-suppression and suppression) is not important fire management tool for the communities?
13. What challenges does the community face in using their indigenous knowledge?
 - a. Prevention
 - b. Pre-suppression
 - c. Suppression
14. In your opinion how can the challenges be addressed?
 - (b) Prevention
 - (c) Pre-suppression
 - (d) Suppression

II. Exotic (Conventional/scientific) fire management systems available and used in the community. After 1983 fires

1. Which of these exotic fire management systems are used by communities around Tain II? (a) Prevention (b) Pre-suppression (d) Suppression None
2. Which of these measures of conventional fire management on fire prevention is practiced around Tain II? (a) community durbars (b) incentives and awards (c) law/sanctions (d) communication (e) Drama (f) mobile van education/public awareness and education or Radio/TV programmes (g) None
3. Are culprits punished for burning in the community? Yes No if yes by who, if no why
4. If no, do you think it is the reason why burning continue in the community? Yes No
5. If yes, what punishments are given to culprits for burning?
6. Are you aware of any National Laws and Policies on fires? Yes No if yes mention
7. Are these laws and policies effectively enforced in the community? Yes No , if no why
8. How can the laws and policies be made effective?.....
9. These fire prevention measures have helped in curbing the menace of fire in Tain II (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree

10. Which of these measures of conventional fire pre-suppression are practiced in and around Tain II? (a) green fire breaks (b) cleared fire breaks (c) early burning (d) high risk identification (e) patrols/early detection
11. These measures have helped in curbing the menace of fire in Tain II (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
12. Which of these measures of conventional fire suppression are practiced in and around Tain II? (a) direct attack (b) indirect attack (c) parallel attack
13. These measures have helped in curbing the menace of fire in the community (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
14. Prevention is more effective in curbing wildfires than pre-suppression and suppression (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
15. Pre-suppression is more effective in curbing wildfires than prevention and suppression (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
16. Suppression is more effective in curbing wildfires than prevention and pre-suppression (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
17. These exotic fire management systems have helped reduced fires frequency in Tain II (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
18. In which order would you rank the following fire management measures in curbing fires and why? Use; 1 most effective; 2 effective; 3 less effective
 - a) Prevention
 - b) Pre-suppression
 - c) Suppression
19. What are the challenges in the use of conventional (exotic) fire management systems?
 - a. Prevention
 - b. Pre-suppression
 - c. Suppression
20. How can these challenges be addressed?.....

General views on system effectiveness

1. Indigenous fire management is more effective than conventional fire management system (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
2. Both indigenous and exotic (conventional) fire management systems have helped reduced fire frequency (a) Strongly disagree (b) Disagree (c) Neither agree nor disagree (d) Agree (e) Strongly agree
3. Are the incidences of fires increasing in the community? Yes No
If yes, what is the possible reason? If no, why

Section C:

V. Key Participants/Stakeholders in fire management

1. Pick the identified stakeholders in fire management in the community (a) Fire volunteers (b) Chief/Elders (c) Opinion leaders (d) Unit committee members/Assembly person (e) Youth Environmental Club groups (f) Youth Leaders (g) Forestry Officer (h) Do not Know
2. Are these stakeholders actively involved in fire management? Yes No
3. Are stakeholders involved in logistical support for fire management? Yes if yes, specify..... No
4. Are stakeholders involved in financial support for fire management? Yes No
5. Are stakeholders involved in technical support for fire management? Yes if yes, specify No
How effective are these contributions?
6. Do stakeholders receive any form of incentives or motivation for participating in fire management? Yes No if yes, which incentives or motivation are they given.....
7. If no, do you think it is the reason why stakeholders do not give their possible best in fire management? Yes No
8. How regular do stakeholders participate in fire management regarding planning? Always Often Occasionally Rarely Never
9. Are stakeholder's decisions effective in fire management regarding planning? Yes No
If no, give reason
10. How regular do stakeholders participate in fire management regarding implementation? Always Often Occasionally
Rarely Never
11. Are stakeholder's decisions effective in fire management regarding monitoring and evaluation? Yes No (if no, give reason)
12. How regular do stakeholders participate in fire management regarding monitoring and evaluation? Always Often Occasionally
Rarely Never
13. Are stakeholder's decisions effective in fire management regarding implementation? Yes No (if no, give reason)
14. In your opinion which of these are responsible for fire management decisions making/planning? (a) Community (b) Forestry officers (c) National Fire Service (d) NADMO (e) District Assembly (f) Unit committee members (g) Village fire volunteers squads
15. Which of these are responsible for fire management regarding implementation? (a) Community (b) Forestry officers (c) National Fire Service (d) NADMO (e) District Assembly (f) Unit committee members (g) Village fire volunteers squads
16. Which of these are responsible for fire management regarding monitoring and evaluation? (a) Community (b) Forestry officers (c) National Fire Service (d) NADMO (e) District Assembly (f) Unit committee members (g) Village fire volunteers squads
17. Are community members involved in fire management regarding planning? Yes No if no, why

18. Are community members involved in fire management regarding implementation?
Yes No if no, why
19. Are community members involved in fire management regarding monitoring and evaluation?
Yes No if no, why

VI. Community gender strategies for fire management used around the Tain II forest reserve

1. Do both men and women take part in fire management regarding decision making/planning at community level? Yes No if no, why
2. Do both men and women take part in fire management regarding implementation at the community level? Yes No If no, why
3. Do both men and women take part in fire management regarding monitoring and evaluation at the community level? Yes No if no, why
4. What are their roles (both women and men) in fire management?
 - a. Women roles
 - b. Men roles
 - c. Both women and men roles
5. Are women willing to participate in fire management? Yes No if no, why
6. Are you aware of laws and policies which support gender balance in fire management? Yes No if yes, state them
7. How regular do women participate in fire management regarding decision making/planning? Always Often Occasionally Rarely Never
8. How regular do women participate in fire management regarding implementation? Always Often Occasionally Rarely Never
9. How regular do women participate in fire management regarding monitoring and evaluation? Always Often Occasionally Rarely Never
10. How regular do men and women participate in fire management at the community level? Always Often Occasionally Rarely Never
11. Are there women in the community fire volunteer's squad? Yes No If no why
12. What are the challenges in implementing indigenous/local gender fire management strategies?
13. Are there any community innovative strategies to improve gender balance in community fire management?
14. What challenges do your organizations face in carrying it activities regarding fire management in and around Tain II?
15. How can these challenges be addressed?
16. How do we ensure gender balance in fire management?
 - (a) Education
 - (b) Quota systems in policy and laws
 - (c) Mechanisms for women encouragement
 - (d) Others views (specify)