EVALUATION OF INDUSTRIAL WATER POLLUTION CONTROL COMPLIANCE AND ENFORCEMENT IN LILONGWE AND BLANTYRE CITIES OF MALAWI

MSc. (ENVIRONMENTAL SCIENCE) THESIS

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DECLARATION

I, the undersigned hereby declare that this work is a result of own effort and that it has not been presented or submitted elsewhere for any award. Where other people‟s work has been used acknowledgment have been made.

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CERTIFICATE OF APPROVAL

The undersigned certify that this thesis represents he student‟s own work and effort and has been submitted with our approval.

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DEDICATION

To my daughters, Emmanuella and Thandizo
for their patience, love and inspiration they gave me all the way.

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ABSTRACT

This study evaluated mechanisms and practices for water pollution control adopted and applied by regulatory institutions and manufacturing industries in Lilongwe and Blantyre cities of Malawi. Data was collected through key informant interviews, direct observation, documentation analysis and secondary data analysis from 21 industries and seven regulatory institutions. Thematic analysis was employed to analyse qualitative data and quantitative data was analysed by SPSS 16.0 to obtain descriptive statistics including frequencies, mean, percentages and median; excel to generate tables and graphs. 100% of the industries have established management systems to support water pollution control. However, their waste management practices pose a risk to water resources as 100% of manufacturing industries, including 57% that reuse and recycle waste, dispose wastes into the environment, water and land, hence releasing nutrients, organic wastes and chemicals. Further regulatory practice is not adequate to curb water pollution by industrial activities due to lack of coordination among stakeholders, low frequency of monitoring exercises, lack of compliance assistance to the manufacturing industries and lack of public awareness. It is recommended that regulatory institutions increase frequency of compliance monitoring inspections and public and industrial awareness programmes. It is further recommended for, Government to consider changing policy towards pragmatic implementation of IWRM and strengthening regulatory institutions. Adoption of flexible pollution control mechanisms should be implemented to encourage adoption of more desirable waste management practices by industries

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LIST OF ABBREVIATIONS ANDACRONYMS

BCC	Blantyre City Council
BOD	Biochemical Oxygen Demand
BWB	Blantyre Water Board
COD	Chemical Oxygen Demand
CWL	Central Water Laboratory
DEA	Director of Environmental Affairs
EA	Environmental Audit
EAD	Environmental Affairs Department
EIA	Environmental Impact Assessment
EM	Environmental Monitoring
EMA	Environment Management Act
EPA	Environmental Protection Agency
ES	Environmental Standards
FC	Faecal Coliform
GoM	Government of Malawi
INECE	International Network on Environmental Compliance and Enforcement
IWRM	Integrated Water Resources Management
LCC	Lilongwe City Council
LGA	Local Government Act
LWB	Lilongwe Water Board
MBS	Malawi Bureau of Standards
MBSA	Malawi Bureau of Standards Act
MITC	Malawi Investment and Trade Centre

MoWD	Department of Water Development
NCE	National Council on Environmental
NRWA	National Water Resources Authority
NOSA	National Occupation Safety Association
OECD	Organisation of Economic Co-operation and Development
PHA	Public Health Act
SPSS	Statistical Package for Social Scientists
SWRB	Southern Region Water Board
TCE	Technical Committee on Environment
TSS	Total Suspended Solids
UN	United Nations
UNEP	United Nations Environment Programme
UNICEF	United Nations Children‟s Fund
WHO	World Health Organisation
WRA	Water Resources Act
WRB	Water Resources Board
WWA	Water Works Act
WWTP	Wastewater Treatment Plant

CHAPTER ONE

INTRODUCTION

1.1 Background

Environmental degradation such as water pollution is one of the major concerns of the international community. The Environment Management Act (EMA) of 1996 defines water pollution as „any direct or indirect alteration of the physical, thermal, chemical, biological, or radioactive properties of water caused by the discharge, emission or deposit of waste or any substance whether in a liquid, solid or gaseous form; into water bodies in such amounts and for such duration and under such conditions as to reduce its usefulness to humans and other organisms in nature" (Cap 69:01 of the Laws of Malawi).

According to UN Water (2013), 2 million tonnes of sewage and industrial and agricultural waste are discharged into world"s water. 70% of industrial wastes in developing countries are disposed untreated contaminating existing water supplies (UN Water, 2009). Improper disposal of these wastes has greatly posed both environmental and health risks. The wastes have polluted drinking water sources as 20-50% of wells in Africa and India have been found to contain nitrates above 50 mg/l. Water availability has been affected and excessive nitrates and phosphates have contributed to eutrophication of freshwater resources hence creating dead zones (UN Water, 2015).

In Malawi, major causes of water pollution include improper disposal of various types of wastes, deforestation and poor agricultural practices that encourage soil erosion and deposition of sediments (GoM, 2002). Studies have also shown that water bodies are polluted by improperly treated and disposed waste from industrial production in the cities of Malawi (Sajidu, *et al*., 2007). These wastes are known to release biological pollutants including pathogens, chemical pollutants such as heavy metals, inorganic ions, organic pollutants and physical pollutants such as hot water (Al-Rawi, 2005; Ramirezi, *et al.*, 2010) .

Pollution of water bodies can have detrimental effects on environmental and human health. Use of polluted ground and surface water for domestic, agricultural and industrial activities can lead to the occurrence of waterborne diseases such as bilharzia, giardiasis and gastroenteritis and other human ailments such as cancer due to toxic effects of chemical pollutants (Ramirez, *et al.*, 2010). Additionally, the water may not be suitable for uses, such as drinking, washing and industrial production, due to undesirable taste and odor (Ramirez, *et al.*, 2010). Chemical pollutants lead to disturbance and destruction of aquatic ecosystems. Nitrates and phosphates are nutritious to aquatic plants resulting in eutrophication of water bodies;heavy metals such as mercury and organic pollutants lead to loss of aquatic biodiversity (Zeng, *et al.*, 2011). Water pollution can thus cause degradation and scarcity of water resources. Although water pollution is an unavoidable feature of any industrialized or industrializing nation such as Malawi, it is imperative to have relevant laws that should be applied to control and manage pollution from industrial activities (Banda & Ngwira, 2007). Malawi has six Acts that have been enacted and are applied to regulate activities of industries in a quest to control polluting activities.

Malawi's six key Acts that provide for the control and management of water pollution from industrial sources include EMA of 1996, the Malawi Bureau of Standards Act (MBSA) of 1972, the Water Resources Act (WRA) of 2012, Public Health Act (PHA) of 1948, the Water Works Act (WWA) of 1995, Local Government Act (LGA) of 1998 and bylaws of Blantyre and Lilongwe City councils and Lilongwe and Blantyre Water Boards. These laws are implemented by government institutions which are mandated to protect water resources and regulate the polluting activities including those of industries. Key institutions include Malawi Bureau of Standards (MBS), Lilongwe Water Board (LWB), Blantyre Water Board (BWB), Water Resources Board (WRB), Environmental Affairs Department (EAD) and local authorities such as Blantyre City Council (BCC) and Lilongwe City Council (LCC).

It is generally expected that these laws provide mechanisms to curb water pollution, duly implemented by relevant regulatory institutions, from industrial wastes through proper discharge of industrial wastes without causing harm to human and environmental health (Banda & Ngwira, 2007). However without proper enforcement of and compliance with the laws they are little no more than symbols.

1.2 Statement of the Problem

Studies on water bodies in the major cities of Malawi have revealed high levels of pollution based on World Health Organization (WHO) water quality standards of 1993 and MBS drinking water quality standards of 2005. In Blantyre, water pollution has been reported for Limbe, Mudi and Nasolo streams, which have high levels of heavy metals such as lead, cadmium, iron, zinc, chromium and nickel above acceptable limits (Sajidu *et al.,* 2005). A separate study reported increased levels of biochemical oxygen demand (BOD), oil and grease and phosphates in Limbe, Naperi, Mudi, Nasolo and Chirimba streams which pass through industrial areas of Chirimba,

Makata and Mpingwe. These pollutants produce bad smell; encourage eutrophication and subsequent loss of aquatic organisms (Kuyeli *et al.*, 2009).

A similar study carried out on Lilongwe river, that passes through Malangalanga commercial area and Lilongwe Flea Market and receives effluents from Kauma Wastewater Treatment Plant (Kauma WWTP), revealed high levels of lead, cadmium, Chemical Oxygen Demand (COD), electrical conductivity, suspended solids, phosphates and faecal coliform (FC) in the dry and rainy seasons, which are indications of water pollution. This further suggests that the water was not suitable for agricultural, industrial and domestic use and detrimental to aquatic ecosystems (Nyasulu, 2010).

Pollution of water resources in the cities of Malawi is taking place despite the enactment of laws and establishment of institutions to control and regulate polluting activities by manufacturing companies. Although these laws contain rules for treatment of wastes in industries, disposing of untreated wastewater into drains and subsequently into city‟s major streams is very common (Sajidu *et al.*, 2005).

This study sought to evaluate two main issues of water pollution control in Malawi: the implementation and enforcement of Malawi‟s legal and institutional framework for water pollution control from industrial activities and the approaches and practices that manufacturing industries have adopted to enhance compliance with the legal and institutional framework for water pollution control.

1.3 Objectives

Main objective:

The main objective of the study was to evaluate mechanisms of compliance to water pollution control by manufacturing industries and enforcement by regulatory institutions in Lilongwe and Blantyre cities.

Specific objectives:

Specifically, the study seeks to:

a) Examine water pollution control practices of the water pollution regulatory bodies and the water pollution control practices and approaches of manufacturing industries;
b) Investigate the challenges facing water pollution control in the cities of Blantyre and Lilongwe;
c) Investigate the influence of regulatory practices on industrial water pollution control practices;

1.4 Research Questions

This study attempted to answer the following questions:

a) What measures are regulatory institutions taking to manage industrial water pollution in Lilongwe and Blantyre cities?
b) What measures are manufacturing companies taking to manage industrial water pollution in Lilongwe and Blantyre cities?

c) What influence do regulatory practices have on water pollution control practices in manufacturing industry?

d) What are the challenges affecting water pollution control in Lilongwe and Blantyre cities?

CHAPTER TWO

LITERATURE REVIEW

2.1 Chapter Summary

This chapter analyses literature on water pollution control. Water quality in Malawi‟s urban streams has been analysed to demonstrate the contribution of industrial activities to water pollution. It involves the review of literature on the legal and institutional framework for water control; exposes strengths and weakness of the tools provided for in the regulatory framework based on the existing literature while analyzing the evidence of such attributes on the regulatory framework. The chapter further analyses the implementing institutions that exist in Malawi. It has also reviewed approaches that proactive manufacturing companies are expected to take in water pollution control.

2.2 Manufacturing Industries as a Source of Pollution

The presence of pollutants in water is hazardous to the environment and humans. Pollutants affect water quality which refers to the physical, chemical and biological characteristics of water (Chinda, *et al.*, 2004). Water quality is determined through Water Quality Assessment, which is the overall process of evaluation of the physical, chemical and biological nature of water in relation to natural quality, human effects and intended uses, particularly uses which may affect human health and the health of the aquatic system itself (Chapman, 1996). The interpretation of water quality

assessment results is done in reference to a set of standards against which compliance can be assessed. These standards can be local, such as the Drinking Water Standards by the MBS in Malawi, or where necessary standards set by international organizations such as the WHO (Chinda, *et al.,* 2004).

Studies on Malawi urban water bodies have shown that they are polluted as water quality parameters are above WHO (2004) and MBS (2005) recommended limits (Mataka, *et al.,* 2005). Parameters studied include pH, heavy metals such as lead and BOD.

Studies on water quality in streams of Blantyre and Lilongwe cities have indicated that in most streams the pH values are within the range of the WHO (1993) and MBS (2005) limits of 6.5 to 9.50. However some streams pH values changed after passing through an industrial site. For example, the Nasolo Stream with pH of 8.5 before passing through the industrial site had a pH of 6.5 after passing through the industrial site (Kuyeli, *et al.,* 2009). Kumwenda, *et al.* (2012) found the pH of Mudi River to be within the range of 7.02 to 8.2. Yet another study by Phiri *et al.* (2005) indicated the pH of waters in Lilongwe River fell within the range of 7.5 ± 0.06 to 7.0 ± 0.06. In a similar study on Lilongwe River (Nyasulu, 2010) indicated that the pH of waters of Lilongwe River ranged from 7.6 ± 0.2 to 7.8 ± 0.1. These values deviated from the recommended pH of 6.5 (MBS, 2005). Most of the values changed as one moved downstream indicating that industrial activities were polluting water in the streams of the Blantyre and Lilongwe cities (Nyasulu, 2010; Phiri, et *al.,* 2005). These results conformed to the results on pH of acidic effluents (pH of 4.2 ± 0.5 to 4.8 ± 0.05) released from industrial activities in Kanengo industrial area into Lilongwe River.

These industrial effluents are likely to alter the pH of waters of the river (Phiri, *et al*., 2005).

Phiri, et *al*. (2005) reported high levels of Total Suspended Solids (TSS) in Lilongwe River ranging from 22.0 ± 1.15 mg/L to 253.7 ± 0.81 mg/L which was attributed to runoff and industrial effluents which had very high levels of TSS ranging from 37.0 ± 4.5 mg/L to 707.0 ± 5.5 mg/L. Nyasulu (2010) further described the Lilongwe River as polluted due to high levels of TSS, ranging from 10mg/L to 150 mg/L. In another study on water quality of Mudi, Nasolo, Limbe and Chirimba streams, passing through industrial areas of Blantyre city, found the TSS in the streams to be high above the recommended limits ranging from 40.00 ± 2.21 mg/L to 283.78 ± 6.58 mg/L. These values were obtained on water samples from within or after the industrial area except for the water of Limbe stream which was collected before the industrial area. However the results indicate that the water in the streams contained high levels of TSS especially as they passed through the industrial area (Kuyeli, *et al.*, 2009).

Studies on water quality in streams of Blantyre city, such as Nasolo and Limbe and Lilongwe city, such as Lilongwe River, have indicated high levels of other heavy metals and have other heavy metals within tolerable limits. For example the recommended limits for lead and cadmium are <0.010 mg/L and 0.003 mg/L respectively (MBS, 2005; WHO, 1993); but studies on water quality in streams of Blantyre and Lilongwe cities revealed high levels of lead ranging from 0.08 mg/L to 0.96 mg/L and cadmium concentration as high as 0.16 mg/L. These levels have been attributed to vehicular emissions and careless disposal of industrial wastes that are eventually carried into the streams by runoff (Lakudzala, *et al*. 1999; Nyasulu, 2010).

High concentration of chromium, zinc and nitrate was reported in wastewater from a match producing factory in Blantyre (Schutz, 2013). This wastewater was ready to be released into sewer lines leading to city council‟s Wastewater treatment plant (WWTP). However, Sajidu, *et al* (2007) reported that wastewater treatment plants in Blantyre are unable to significantly reduce heavy metals in wastewaters as lead and cadmium concentrations were found to be too high in both influent and effluent wastewater at Limbe and Soche WWTP. This implies that wastewater treatment processes by both the city council and manufacturing industry are doing too little to protect water resources in the cities of Malawi hence posing a risk to both the environment and human health.

Pollution of water is likely to affect the health of urban dwellers as they use water in urban streams for domestic purposes (Kwanjana, 2009). As of 2008 only 25% of the population in urban areas had access to piped water and about 10.5% used water from unprotected sources, where about 0.5% of the population used streams as a water source (Kwanjana, 2009). This is most likely to enhance incidence of diseases due to presence of pollutants such as lead and cadmium.

Increasing water pollution by manufacturing industries over the years has been taken place despite reforms to address the same. EMA (1996) introduced the requirement of conducting an EIA before establishing an industry in order to reduce the impact of industrial activities on water resources. In addition, WRA (2012) calls for formation of Catchment Management Committees which may enhance catchment management; the Act further calls for the formation of National Water Resources Authority (NWRA) which is expected to be a stronger institution to curb water pollution. However, these reforms are yet to yield any positive results as GoM (2013) contends

that, while remarkable progress has been made in the development of legal instruments, such as EMA (1996) and WRA (2012), water resources management still faces challenges such as poor management of catchment areas and weak institutional structures for enforcing Acts that protect water resources.

2.3 Legal Framework for Water Pollution Control in Malawi

In Malawi the control of water pollution is guided by at least six pieces of legislation including the EMA (1996), WRA (2012), WWA (1995), MBSA (1972), LGA (1998) and PHA (1948). Just as the repealed WRA (1969), the WRA (2012) is the principal legislation as far as water pollution control legislation is concerned. These pieces of legislation provide for various tools for water pollution control from manufacturing activities. EMA (1996), WRA (2012), WWA (2013), PHA (1948), MBSA (1972) and LGA (1998) provide for tools including environmental monitoring, compliance enforcement, permits and licenses. Environmental Impact Assessment (EIA) and Environmental Audits (EA) are regulatory tools provided for by the EMA (1996) only, where as the Integrated Water Resources Management (IWRM) approach is provided for as a regulatory approach in WRA (2012) only.

2.3.1 Environmental Impact Assessment (EIA) and Environmental audits (EA)

Environmental impact assessment is an information gathering exercise carried out by a proponent of a development project which enables authorities and the general public to understand the environmental effects of the project before deciding whether the project should go ahead or not (GoM, 1996). It is provided for in the EMA (1996)

Part V sections 24, 25 and 26 in which EIA procedures that the EAD and developers should follow before establishing any factory are stipulated. EIA procedure may not foresee all possible impacts of a project. To cover for the information gap in the EIA, section 27 of the EMA (1996) empowers the Director of Environmental Affairs (DEA) to demand an EA on any project from any developer and make the reports of the audit available to the DEA. Environmental audit is the systematic documentation of periodic and objective evaluation of the protection and management of the environment and the conservation and sustainable utilization of natural resources (GoM, 1996).

The EIA and EA are instruments for water pollution control that apply the preventive principle which aims at preventing pollution from the source, hence minimizing environmental damage using readily available resources and technologies (Trouwborst, 2009). This implies that inadequate enforcement and implementation of EIA and EA can have detrimental effects on water resources. EIA and EA enforcement and implementation in Southern Africa including Malawi has been described as weak and inadequate (Burgess and Halle, 2006; Mbeko, 2012; Mhango 2007; Kosamu; 2010; Kosamu *et al*., 2013; Tarr, 2003). However, the authors blamed poor and inadequate enforcement and implementation of EIA and EA on institutional, legal and political factors.

Political influence on EIA and EA implementation was cited by Burgess and Halle (2006) who observe that during EIA and EA process, when there is apparent conflict between EIA and economic growth aspects, environment may be purposely overlooked. Similarly Mbeko (2012) and Tarr (2003) contend that EIA process in

Malawi is constrained by economic and political interests, which at times weigh more heavily than environmental values and EIA is considered as obstructive to development projects. Tarr (2003), further decried poor governance, characterized by lack of public participation, limited access to information, inadequate freedom of speech and corruption, as having a detrimental effect on EIA and EA implementation and enforcement. Kosamu (2010) generally blamed lack of political will to support the process.

In addition to political influences on EIA and EA enforcement and implementation literature point to institutional factors as one of the areas derailing the enforcement and implementation of EIA and EA. The implementation of EIA has been marred by low compliance by developers due to inadequate awareness and lack of referral to EAD by licensing authorities (Wamsley and Pong, 2003). In addition, Burgess and Halle (2006) blamed low compliance by developers on ministerial strategies and action plans that are not harmonized creating confusion and conflicts of interest across departments responsible for implementation. In another study which concentrated on perception of building contractors, Kosamu (2010), blamed weak implementation of EIA and EA on limited experience and practice of practitioners, cost of EIA process, limited links between EIA and urban planning, lack of data for predictive models of environmental impacts and lack of effective monitoring and auditing. Mhango (2007) further described the implementation and quality of EIA in Malawi as unsatisfactory and poor due to failure to meet requirements of EIA standard practice. It was further indicated that analysis of alternatives, public consultation and participation and scoping did not meet standard practice requirements. This was mainly attributed to problems of administration of the EIA process by regulating institutions. Kosamu *et al*. (2013) described EIA in Malawi as inadequate due to lack of public awareness and improper

staffing of the EAD; where the expertise is heavily of science background. However according to Tarr (2003) implementation of EIA and EA is sometimes sector selective where those industries in oil, mining and gas are the most policed industries and other manufacturing industries are not followed much hence giving an opportunity to manufacturing industries to pollute water resources because they know they will not be inspected.

Mhango (2007) blamed weak implementation of EIA on deficiencies that exist in the EIA legislation itself. Kosamu *et al*. (2013) further stated that lack of provision on independent public hearing during the EIA process is one of the weaknesses that hinder the smooth implementation of EIA. This is further a pitfall when the project has government as a proponent hence the same government will act as police and judge (Tarr, 2003).

Despite much of the literature describing EIA and EA as poorly and inadequately implemented; Walmsley and Pong (2003) pointed out a number of positive developments that have taken place since the EIA legislation was passed in Malawi, such as increased awareness among government departments, private sector and general public and increased opportunities for training of EIA practitioners.

2.3.2 Environmental monitoring

In Malawi EIA was introduced in 1996 after some manufacturing industries were already established hence they did not undertake an environmental impact assessment (Mhango, 2007). To protect the environment, including controlling pollution of water resources, section 28 of the EMA (1996) empowers the DEA to conduct environmental monitoring of manufacturing companies, through continuous or

periodic assessment of the actual or potential impact of any of their activities on the water resources (GoM, 1996).

It is recognized that environmental monitoring problems are an important pitfall for environmental regulation (Laplante and Rilstone, 1996). This implies that absence of or inadequate environmental monitoring through inspections of manufacturing firms can be a major contributing factor to water pollution. Laplante and Rilstone (1996) observed that inspections and threat of inspection have a strong negative impact on pollution emissions hence reducing emissions. Threat to inspection is maintained through surprise element in the inspection schedule where industries are not forewarned of the inspection schedule (Banda and Ngwira, 2007). A similar observation was made by Helland (1998) who concluded that inspections that detect violations, such as discharging of effluent that is above set standards, encourage firms‟ desire to cooperate with regulators by reducing violations. This was echoed by Monk (2012) who described inspections as an opportunity for detecting irregularities, causes of the regularities and determining ways of correcting the irregularities. Chipofya *et al.* (2012) further observed that inspections aimed at policing industries with pollution potential without providing incentives and alternatives for compliance and cooperation with factory operators encourages noncompliance among the operators. In addition high frequency of inspection is key to increased level of compliance among factory operators (Gupta and Saksena, 2002). However, it was argued that in Malawi the frequency of inspection might not be as high due to inadequate human, material and financial resources to conduct inspections frequently as required (UNEP, 2001; Banda and Ngwira, 2007).

Further studies have been conducted to compare the impact of inspections to other pollution control mechanisms such as pollution charges and penalties. Dasgupta *et al.* (2001) compared the impact of inspections and pollution charges on the firm‟s compliance to water pollution control. In this study, it was observed that pollution charges represent an important pillar of the environmental regulatory system; but inspections dominated and better explained the environmental performance of the industrial polluters. Yet in another study, Stafford (2002) compared the effect of increasing penalties and inspections on number of violations of environmental requirements and the study revealed that inspections have greater effect on the reduction of violations on firms.

2.3.3 Environmental standards

For the sake of easy monitoring of the activities of factory operators, section 30 of the EMA (1996) empowers the DEA to set environmental standards that are in line with scientific and environmental principles and practicality and availability of technology. According to this section, all factory operators are required to adhere to the set standards. This approach to pollution control, where the law specifies set limits and standards to be met and often with specified technologies and management practices that have to be adopted is referred to as command and control or regulatory approach or standard based system (Shortie and Abler, 2001). Malawi pollution control system adopted this regulatory system where the decisions on pollution control by manufacturing industries are based on standards that are set by the MBS (Banda and Ngwira, 2007).

Wade-Benzoni *et al.* (2000) commended the standard based system because it provides guidelines that encourage optimal, healthy and moral environmental

decisions. While this system is dependable and predictable it has been criticised by a number of players in the field because it lacks flexibility, it is costly in enforcement and compliance and has a number of times proved to be inefficient (Gunningham and Siclair, 1999; Khanna, 2001). The regulatory approach is further criticized for producing a means versus focus in which conformance to a standard takes priority over improving the environment (Wade-Benzoni *et al.* 2000). Other players have also criticized the regulatory approach because it is said to encourage end of pipe pollution control, it is fragmented and medium specific (Khanna, 2001). Banda and Ngwira (2007) concurred when they argued that this approach has also proved difficult for developing countries like Malawi, since the system requires adequate resources for policing polluters and polluting activities, which are difficult to come by.

Cole and Grossman (1999) noted that the studies that have shown command and control to be less efficient and inherently inefficient, make such decisions due to the difficulties faced in implementing the regulatory system. Some countries and organizations such as Organization of Economic Cooperation and Development (OECD) have chosen to adopt purportedly more flexible and less costly approaches such as voluntary and non-mandatory approaches to pollution control (Khanna, 2001). More flexible compliance options such as effluent charges, emission trading and environmental bonds were compared to command and control approach; it was discovered that the flexible approaches are less costly to the regulator as the cost is assigned to the polluter and proactive companies are awarded prizes (Rondinelli and Berry, 1998). In the same vein Innes and Sarn (2008) compared efficiency of command control to voluntary pollution reduction when they analysed determinants of firm‟s participation in voluntary pollution reduction programme. The study revealed a win-win situation in which a firm‟s participation is rewarded by relaxed

regulatory scrutiny and anticipation of this reward spurs firms to participate and the programme rewards regulators and society with reduced pollution. Milliman and Prince (1989) further compared direct control, emission taxes, auctioned permits and free permits on their ability to provide incentives for technological change for water pollution control. The study concluded that direct control mechanism provide least incentives whereas emission taxes and auctioned permits provide highest incentives for technological change.

However, Gunningham and Sinclair (1999) argue that single strategy approach for pollution control is misguided, because all instruments have their weaknesses and strengths. Aalders and Wilthagen (1997) further contend that direct command and control has limited success in dealing with non-compliance, hence moving beyond the regulatory approach can be feasible and desirable; at least to a certain extent, but policy pitfalls are omnipresent. Gunningham and Sinclair (1999) argue for designing policy mixes to ensure enhancement of the instruments on each other‟s weaknesses and strengths. Kathuria (2005) analysed case studies of pollution control policies of Poland, Malaysia and Columbia and concluded that pollution levels went down due to a combination of instruments including pollution licence fees, subsidies, standards and subsidies. However, Kathuria (2005) argues that adoption of the market based instruments can face considerable resistance in developing countries due to virtually non-existence of important ingredients of market based instruments namely transparency, accurate monitoring, realistic investment to trade and trust. However, Cole and Grossman (1999) argue that there is no simple answer and policy panacea as to when command control, market based or voluntary mechanism will be efficient when adopted. Hanh and Stavins (1992) argue that though policy efficiency and cost-effectiveness are the most important elements in deciding a policy choice, other

criteria to determine policy choice include overall effectiveness, political feasibility, monitoring and enforcement capability and clarity to general public. The most important aspect is to make a policy choice that achieves environmental objectives such as curbing water pollution control.

2.3.4 Compliance enforcement

Water pollution control legislation in Malawi provides for compliance enforcement through prescribed punitive actions that can be taken against manufacturing firms that pollute water resources. These punitive punishments are either monetary, such as civil penalties and payments for cleanup of the pollutants or non-monetary such as prosecution, warning, suspension of operations and order to conduct an environmental audit.

Civil penalties are fines payable to the government following a breach of the relevant governing statute. When determining the civil penalties the formulators of the laws need to determine the economic benefit of non-compliance and ensure that the penalty burden is at least as great as the benefit of the violation (INECE Secretariat staff, 2011). Banda and Ngwira (2007), UNEP (2001) argue that fines for polluters in Malawi are too low to deter polluters with huge resources. Gupta and Sheksena (2003) contend that low punitive fines do not discourage non-compliance among polluters. Thornton, Gunningham and Kagan (2005) support the effectiveness of civil penalties that are stringent enough in curbing non-compliance among firms. In a study to determine the effect of civil penalties on firm behaviour, it was concluded that stringent penalties on one firm, are deterrent on other firms that may have been involved in non-compliant behaviour. In the same vein Shimshack and Ward (2007) further conclude that issuing fines induce industries to reduce emission further to

much lower limits than the set standards, even when the fine was issued on another industry.

Shimshack and Ward (2005) conducted a comparative study on the impact of non-monetary sanctions such as warnings to monetary sanctions; non-monetary sanctions were found to have no detectable impact on compliance, however, marginal fines were found to have substantially greater impact on compliance of both sanctioned plants and other plants. Though warnings have less impact on reducing firm non-compliance as compared to monetary sanctions, they are preferred by regulators than prosecution of non-compliant firms, especially in cases where violation ceases upon receipt of such a warning (Nyborg and Teke, 2004). With limited regulatory budget it is likely that prosecution will be insufficient and yield low penalties (Nyborg and Teke, 2004). Priyadarshini and Gupta (2003) contend that prosecutions can be advantageous where a court imposes stringent imprisonment term, however most court cases take time to be completed as most of the times they cannot be dictated upon how much time they take to deal with cases before them. Banda and Ngwira (2007) further observed that where water pollution control legislation imposes both a fine and a custodial sentence courts will normally impose a fine.

2.3.5 Integrated Water Resources Management

Integrated water resources management is a process which promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (Global Water Partnership (GWP), 2002). GWP (2002) emphasized that water should be managed in basin-wide

context under the principles of good governance which are illustrated in equity, efficiency, sustainability, participation, coordination and integration.

IWRM has unquestionably become one of the mainstream initiatives being adopted by governments. In Malawi, the legal foundation for IWRM has been provided in sections 26, 131 and 141 of the WRA (2012) (GoM, 2012). However, the main hurdle remains the practical implementation of the theoretically agreed upon IWRM initiatives; which could reduce the IWRM to an idealistic buzzword if professionals in the water sector do not overcome this hurdle (Rahaman and Varis, 2005). Merrey (2008) further contends that the IWRM has led to misguided priorities and paralysis of development, since water basin managers have considered IWRM as a normative concept, without focusing on realism and action to prioritize the critical needs of poor people in Africa. Chereni (2007) blamed the implementation problems of the IWRM on the conceptual weaknesses of IWRM. As much as it is agreeable that institutions need to be integrated in practice, the concept falls short of a methodological approach that addresses ways in which the existing differences in these institutions could be harmonized. In addition Biswas (2008) bemoaned the absence of real application of the IWRM to improve water policy and programmes due to the ambiguity of the pillars of the concept.

Swatuk (2005) agreed that IWRM is facing serious difficulties to implement, but pointed out that political reasons are the major cause where governments have been blamed for failing to devolve power to stakeholders. However, Phalira (2006) observed that, looking at the Malawi scenario, failure to enforce water and water-related legislation poses a major threat to successful implementation of IWRM. However, Mulwafu and Msosa (2005) blamed lack of human and financial resources

as major constraints on implementation of reforms necessary for IWRM implementation in Malawi.

Despite being criticised by other quarters IWRM, as a water resources management concept, has been commended for inspiring water managers and researchers to act creatively and for instilling mutual respect and understanding among professionals (van der Zaag, 2005). Implementation of IWRM can improve if the managers identify priority problem areas and focus specifically on finding solutions to the problems within an integrated framework, rather than starting with a broad set up of principles and trying to implement them (Merrey,2008). Similarly, Swatuk (2005) further suggested that it is imperative to reflect on the political nature of the principles of IWRM. The stakeholders including governments should be ready to revise or discard other assumptions and ideologies in an attempt to reform water resources management.

2.4 Institutional Arrangement for Water Pollution Control in Malawi

In Malawi the regulatory framework for water pollution control mandates a number of institutions to implement provisions provided in the framework. These institutions include EAD, MBS, water boards, city councils and WRB.

2.4.1 Environmental Affairs Department

Environmental Affairs Department is an umbrella government institution on environmental issues, including water pollution control, which was established under the DEA in section 9 of the EMA (1996). It is mandated to coordinate environmental policies and programmes and monitor programme compliance to principles of sustainable development (GoM, 1998). The department is politically led by the

Minister responsible for environmental affairs who has the duty to promote the protection and management of the environment and conservation and sustainable utilization of natural resources (GoM, 1996). The minister performs his duties with advice from the National Council of the Environmental (NCE) which is established under section 10 of the EMA (1996). The NCE ensures cooperation of individuals, communities, government agencies and nongovernmental organizations on environmental issues, integration of environmental issues in all aspects of economic development and promotes compliance with legislation (GoM, 1996). The NCE is advised on technical issues of the environment by the Technical Committee on the Environment (TCE) which is established by section 20 of the EMA (1996). The EAD provides secretarial duties to both the TCE and NCE, hence fulfilling its mandate as an umbrella institution on environmental matters.

The EAD has been described as ineffective in the implementation of water polices, legislation and strategies (Mulwafu *et al.,* 2002). This has been attributed to inadequate staffing at all levels and poor financing (Kosamu *et al.*, 2013). The staffing has been applauded for having well qualified staff in sciences and engineering required for water resources management (Mulwafu *et al*., 2002); however, (Kosamu *et al.*, 2013) bemoans the general lack of other equally important cadres such as social scientists and legal practitioners. A blend of scientists and other cadres would form a team that is capable of engaging stakeholders and the general public.

2.4.2 Water Resources Board

The Water Resources Board was established in 1969 by section 4 of the WRA (1969) (GoM, 1969). However, the WRA (2012) which repealed the WRA (1969) has provided for the establishment of the National Water Resources Authority (NWRA) which is not functional yet; hence the WRB is currently implementing the WRA

(2012). The WRB is responsible for monitoring water quality, conduct inspections on pollution levels in effluent and waste discharge in public waters. Earle *et al.* (2008) described the board as weak and ineffective due to limited staff to carry out the duties of the board and having a highly centralised system. (Hranova *et al.* 2006) further bemoaned the inability of the WRB to punish offenders and conduct monitoring works. The major drawback is lack of staff and laboratory for this activity. Instead the board engages the Central Water Laboratory (CWL), which is under the Ministry of Water Affairs, which itself does not have adequate staff and equipment to conduct the water quality assessment (Hranova *et al.* 2006). The board being an ad hoc committee without a stable management committee and lack independent members cannot be expected to be effective in controlling water pollution (Mulwafu *et al.*, 2002).

2.4.3 City Councils

City Councils such as Blantyre and Lilongwe City councils were established by section 4 of the Local Government Act (1998); described in the Act as local government areas (GoM, 1998). Through the provisions of the second schedule of the LGA (1998), section 2 and the PHA (1948) sections 59 and 61 are mandated to control pollution of water resources (UNEP, 2001). The local authorities are mandated to manage wastes through collection, treatment and disposal of wastes, at the same time compel manufacturers to either connect to the public sewer line or properly dispose their wastes in designated places. However, in this section only the capacity of the Blantyre and Lilongwe city councils will be discussed.

The BCC has the engineering department within which a pollution control sub-section exists. This sub-section is responsible for provision, monitoring and control of trade effluent discharges and for the monitoring and control of public waters. However, in

Lilongwe water pollution control activities such as inspection of premises and watercourses is done by the health and social services department (UNEP, 2001). It is expected that Blantyre and Lilongwe city councils are better placed to control water pollution than other institutions such as the WRB, through the prosecution of those who pollute water as stipulated in section 105 of the PHA (1948). Criminal prosecutions provided for in the section are more deterrent and embarrassing than penalties stipulated in the other Acts (Banda and Ngwira, 2007). On the contrary the city councils are unable to take advantage of this provision due to challenges including inadequate budget, essential plant and equipment and transport. These problems affect the performance of city councils in water pollution control (UNEP, 2001).

2.4.4 Water Boards

Water Boards, including Lilongwe, Blantyre, Central Region, Southern Region and Northern Region water boards were established by section 3 of the WWA (1995) with the main duty to provide clean, safe and sufficient water supply to the residents of their water areas (GoM, 1995). In addition to this water boards control pollution of any water connected to their water works in order to fulfil their duty to supply portable water to the inhabitants of their water areas (Banda and Ngwira, 2007).

2.4.5 Malawi Bureau of Standards

The Malawi Bureau of Standards is a government institution that was established in 1972 by an Act of Parliament (Cap 51:02) of the Laws of Malawi (GoM, 1972). The bureau is important in the control of water pollution since it is responsible for setting and enforcing trade effluent tolerance limits through mandated inspections of any premises (GoM, 1972).

2.5 Industrial Compliance Practices and Approaches

In the face of legal and institutional arrangement to control water pollution the manufacturing industry remains an important player in the process. Industrial compliance is through the adoption of environmental technologies that a firm deems fit to improve its manufacturing performance hence reducing its effluents to the required standards as prescribed in the legal framework and even further below. Environmental technologies can be categorized into pollution prevention, pollution control and management systems (Klassen and Whybark, 1999). Environmental technology adoption has evolved overtime, earlier the motivation was mere desire to adhere to environmental standards as industrial pollution control strategy was dominated by command and control, then was later motivated by benefits of market based instruments which were introduced to support the command and control strategy. A third and most recently introduced approach is disclosure (Tientenbergy, 1998). In this strategy industries disclose voluntarily their environmental performance to the regulators and regulators publish environmental performance of industries publicly; making industries become more proactive on water pollution control.

Rondinelli and Berry (1998) contend that progressive corporations have become proactive and are looking at environmental performance from a far different perspective than they did before. Beyond complying with increasingly more stringent regulations, they must protect their ethical image, avoid serious legal liabilities, respond to government regulators and stakeholders and develop new business opportunities. In addition firms want to attract clientele of green consumers willing to pay more for goods produced using clean production processes (Daily and Huang, 2001). Brunnermeier and Cohen (2003) also indicated that environmental innovation is more likely to occur in industries that are internationally competitive. Daily and

Huang (2001) further argued that the companies are no longer simply using compliance plans to deal with environmental concerns, they have developed internal Environmental Management Systems to gain competitiveness on the market.

To effectively implement the Environmental Management Systems, businesses have adopted a human resource approach which includes elements such as top management support, environmental training, employee empowerment, teamwork and rewards for those who perform well (Daily and Huang, 2001). Klassen and Whybark (1999) further confirmed that managerial allocation of investment towards pollution control technologies, coupled with provision of latitude and incentives to personnel at the plant to engage in pollution control activities, is likely to improve both environmental and manufacturing performance.

2.6 Summary

Degradation of water resources is one of the environmental problems in Malawi, posing a threat to human and environmental health. One of the sources of water pollution is manufacturing companies. Literature suggests that water pollution is taking place in the presence of the legal framework and institutional arrangement to manage water pollution due to weak legal framework to dissuade violation of the law by the industries, conflicting mandate between various government agencies, inadequate public participation in the process and limited recognition of the purpose and value of water pollution control practices.

However, these assertions are anecdotal and do not include views of the manufacturing industry. In addition, the information is too generalized for all sectors of the environment such as water, forestry, wildlife and land and there is no study

which specifically covered water pollution control. This calls for the need of an empirical analysis of the factors affecting water pollution control.

Though much of the literature reviewed is on studies done outside Malawi, it has provided elements of industrial compliance including water pollution control technology and management systems. The literature has further isolated elements of water pollution regulation including compliance monitoring, enforcement, IWRM specifically participation and coordination and compliance assistance.

CHAPTER THREE

METHODOLOGY

3.1 Study Area

The study was conducted in the cities of Blantyre 35^{o} E and 15^{o} $42^{''}$ S and Lilongwe lying along 13^{o} $53^{''}$ S and 33^{o} $48^{''}$ E, which were selected because they are most industrialized cities of Malawi. In the two cities industrial sites and locations of water pollution regulatory authorities operating in the cities such as EAD, MBS, LCC, BCC, BWB, LWB and WRB were visited for data collection.

In Blantyre industrial sites include Makata, Limbe, Ginnery Corner, Maselema, Chirimba and Maone. Makata industrial area is located on the land bordered by Mudi and Nasolo streams and Makata Road, Ginnery corner industrial site is located along Masauko Chipembere Highway and Mudi stream, Maselema industrial site is located along Chipembere Highway and Naperi stream, Limbe industrial site is located along Tsiranana Road, Chirimba industrial site is located along Chileka Road and Chirimba stream. All these locations were part of the study area as they harbor various categories of industries that are the sources of information required for this study (Figure 1).

Kanengo industrial area, located in the northern part of Lilongwe City (Areas 28 and 29), is the main industrial site in the city as such it was an important area in this study. The industrial activities taking place in the area include food production, seed production tobacco processing and pharmaceutical production. The area is surrounded

by high density locations of Mgona, Mchezi and Area 25 whose population is characterized by low income and middle income earners with the majority being employees of industries in the industrial area. The industrial area is surrounded by streams such as Nankhaka, Nafisi and Mchezi (Figure 2).

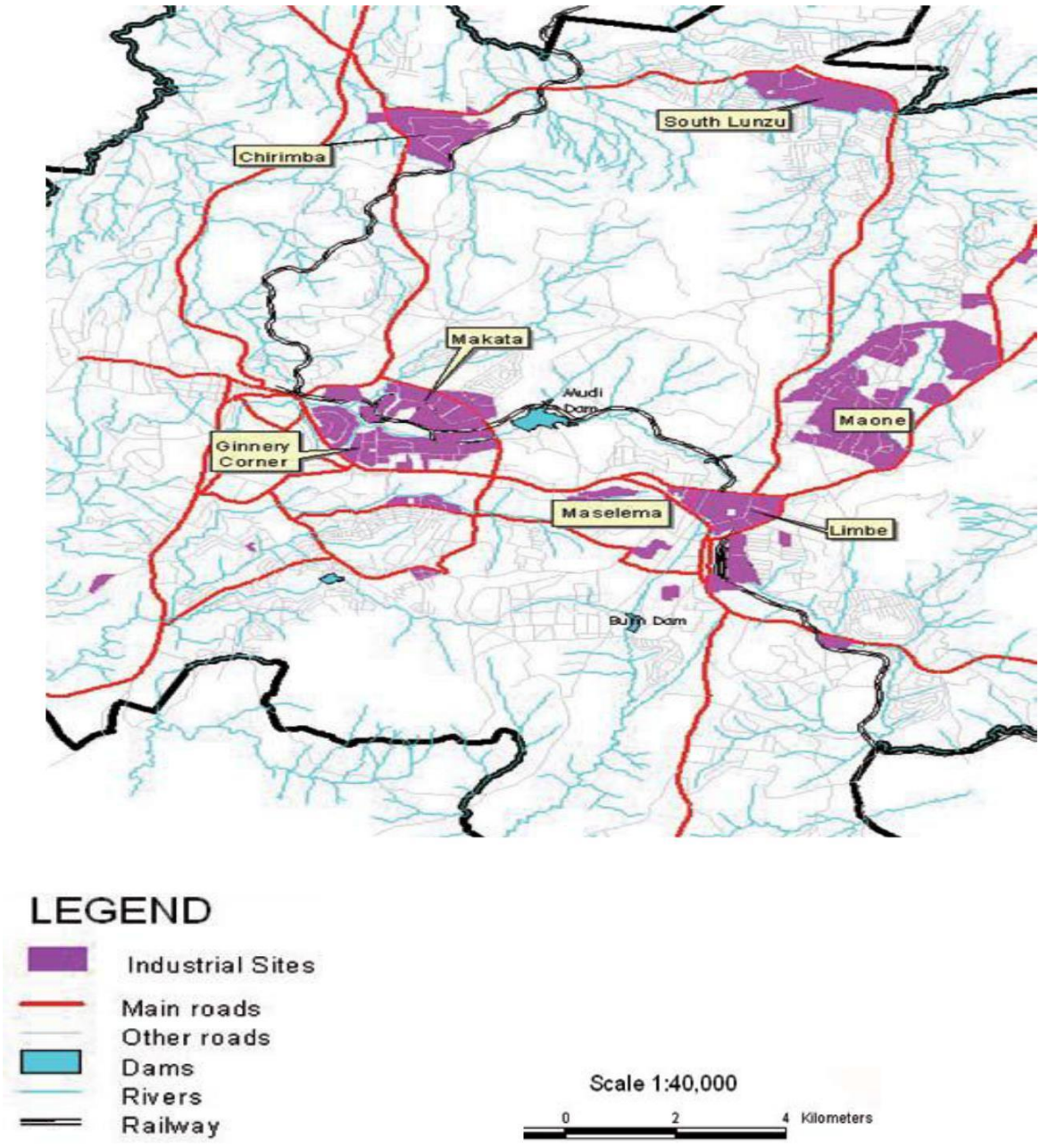

Figure 1: Map of industrial sites in Blantyre City

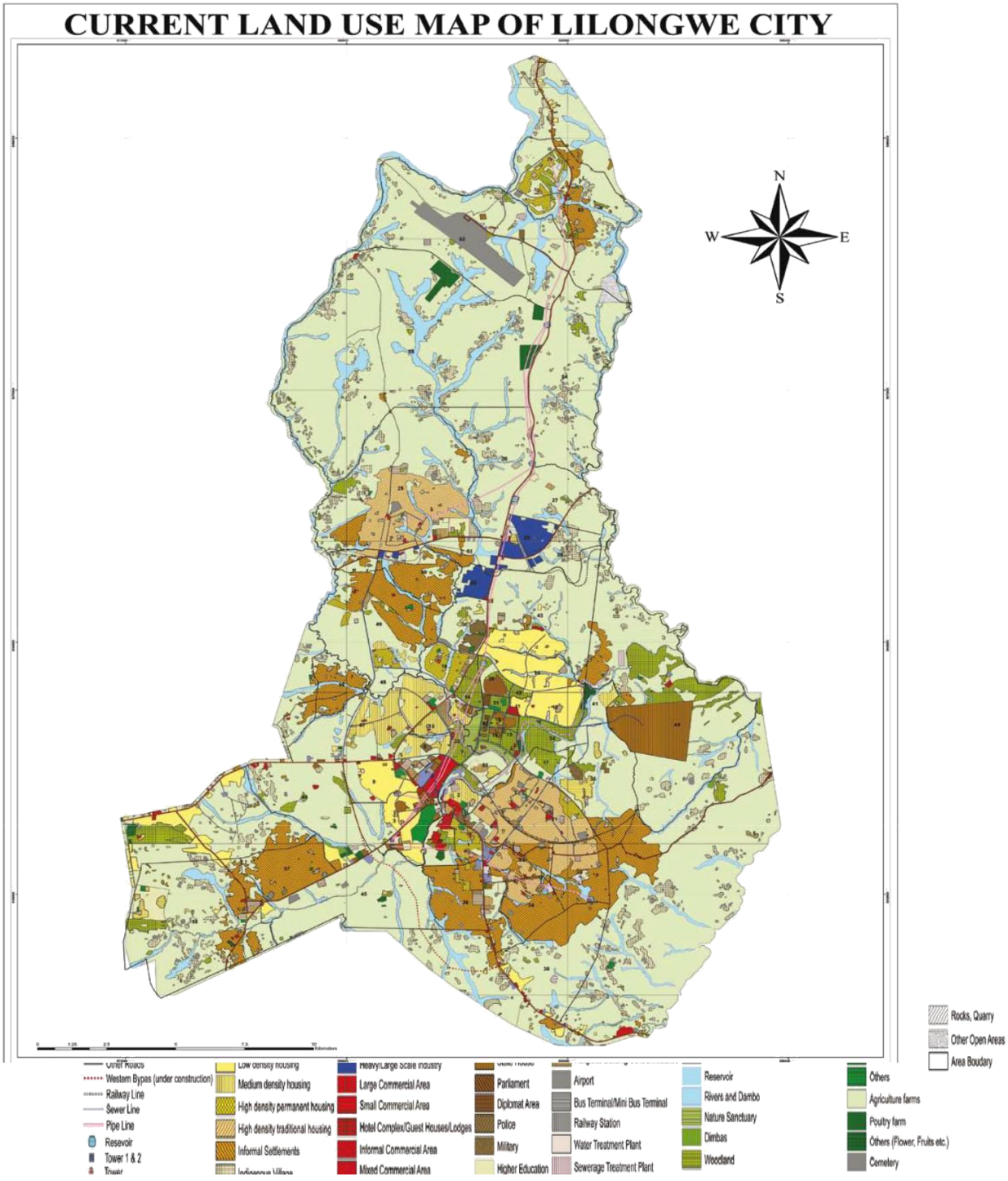

Figure 2: Land use map of Lilongwe showing heavy industrial areas

3.2 Sample Size and Sampling Techniques

This study targeted seven water pollution regulatory bodies namely LCC, BCC, WRB, MBS, EAD, LWB and BWB and manufacturing companies. In the manufacturing companies, key informants composed of employees of the industries involved in environmental management, quality assurance or production, were identified using purposive sampling and interviewed to collect data on the industrial water pollution control practices, perception of manufacturing companies on the regulatory bodies and water pollution control legislation. One key informant was targeted on each manufacturing company. The industrial sites were sampled using multistage sampling where industries were categorized into two clusters of Blantyre and Lilongwe cities. Industries in these two clusters were further categorized into tobacco processing, food production, pharmaceutical, chemical industries, paint, textile, plastic and agro-processing. The industries in each category were coded using numbers 1, 2, 3...n: where n is the number of industries in each category. From each category, simple random sampling, using excel generated random numbers, was used to select industries that were involved in the study. The clustering, categorization and subsequent random sampling were followed to avoid picking industries from one category and one city while missing industries from another category and city (Tuckman, 1978).

The number of industries to be sampled was determined using the following formula:

$$N = \frac{Z^2(P)(1-P)}{e^2}$$

where the confidence level is 90%, N is sample size, Z is standard score (1.645), e is proportion of sampling error (0.10) and p is estimated proportion of cases in the

population (0.75). The number of industries to be sampled in each cluster and then category was determined proportionately based on the manufacturing companies‟ population data available from the Malawi Investment Trade Centre (MITC) as shown in Tables 1 and 2. The list indicates that there are 172 manufacturing companies operating in the cities of Blantyre and Lilongwe, with 78 (45%) located in Lilongwe and 94 (55%) located in Blantyre.

Table 1: Distribution of manufacturing companies sampled in Lilongwe City

Type of industry	Number of industries	% of Total	Number sampled
Chemical	12	15.38	3
Paint	2	2.56	1
Tobacco	5	6.41	2
Pharmaceutical	5	6.41	2
Textile	9	11.53	3
Food	25	32.05	7
Agro-processing	12	15.38	3
Plastic	8	10.27	2
Total	78	100	23

Table 2: Distribution of manufacturing companies sampled in Blantyre city

Type of industry	Number in each category	% of Total	Number sampled
Chemical	14	14.89	4
Paint	4	4.26	1
Tobacco	1	1.06	0
Pharmaceutical	1	1.06	0
Textile	21	22.34	6
Food	30	31.91	10
Agro processing	13	13.83	4
Plastic	10	10.64	3
Total	94	100.00	28

Key informants from regulatory institutions were sampled using purposive sampling; where government officials with specific responsibilities and knowledge in water pollution control were specifically targeted to provide data and in-depth information on water pollution control practices and their effectiveness. In each of the seven regulatory institutions two government officials who are directly involved in industrial water pollution control were sampled to avoid biasness in the responses.

3.3 Data Collection Techniques

This study involved collection of both primary and secondary data from two sources: water pollution regulatory institutions and manufacturing companies in Lilongwe and Blantyre cities; where techniques employed included key informant interviews, systematic analysis, secondary data analysis and direct observation.

3.3.1 Key Informant Interviews

Key informants from both the industry and regulatory institutions were directly interviewed with the guide of semi-structured questionnaires (Appendices A and B). These questionnaires were designed to generate data and information pertaining to water pollution control practices, challenges facing regulatory institutions in implementing water pollution control activities. It further sought to identify measures for improving water pollution control practices in both the industry and regulatory institutions.

For proper organization of these interviews, advance booking with the key informants was made through their superiors who were given full details of the study and a date for the interviews was set.

3.3.2 Direct Observation

Direct observation was used to record waste management practices of the industries such as dumping of wastes within the industrial site, availability and adequacy of WWTP, infrastructure and environmental management records. The method was used to substantiate responses provided during the interviews.

3.3.3 Secondary data analysis

In all the regulatory institutions visited, secondary data was sought on chemical, physical and biological water quality parameters including BOD, pH, TSS and cadmium. It was expected that the institutions would have the data as they would use it to monitor water quality in the cities. However, secondary data was available only at LCC, on Lilongwe River as reported by the Central Water Laboratory (CWL) in Lilongwe in October, 2012. These parameters are indicative of the state of surface water resources in streams of Lilongwe City hence giving insight into the extent of water pollution from human activities such as agriculture and domestic activities and industrial operations.

3.3.4 Systematic analysis

Systematic analysis included critical review of relevant literature and documentation analysis. Critical review of literature provided an in-depth understanding of elements of water pollution control in both manufacturing companies and regulatory institutions. Documentation analysis method was employed to verify responses that were provided by the respondents. The libraries at the EAD and WRB had documentation on companies that had been punished through fines, ordered to conduct environmental audits and warned for water polluting activities. This provided

an insight into the efforts that the government institutions are making to reduce water pollution.

3.4 Data Analysis

The study involved the collection of qualitative and quantitative data which was analysed using selected methods deemed correct to present the best output. Qualitative data was in form of text and was analysed using thematic analysis which provided in-depth understanding of themes that were generated from the responses of the key informants. This analysis was aided by existing concepts, theories and knowledge as documented in literature.

Quantitative data on water quality and key informant interviews was analysed using SPSS to generate descriptive statistics in terms of mean, median and frequencies. The frequencies were presented in tables and graphs which were generated on MS Excel. The frequencies of responses provided an insight into the mechanisms and practices that the manufacturing companies and regulatory institutions employ to control and manage water pollution.

3.5 Limitations of the Study

This study faced numerous limitations, however, only three major challenges to do with difficulty in data collection, financing of the data collection and complexity of the study have been highlighted. Data collection for the study proved difficult to because most of the manufacturing industries were not willing to release information due to the sensitivity they attached to the information required. This was compounded by the busy schedule of employees in the industries who felt conducting an interview with them was a disturbance. This was overcome by multiple visits to one industry such that some industries complied and responded to the questionnaire. The multiple

visits to a single industry inflated the budget for data collection hence proving costly to finance the study.

The response rate in Lilongwe, 38% (n=23), was lower than response rate in Blantyre, 46 % (n=28); however the overall response rate was 42% (n=51) which is deemed adequate to achieve the objectives of this study. The 42% response rate is higher than 32% response rate which was obtained by Fryxell and Vryza (1999) in a study on corporate environmental management and functional coordination involving 700 Environmental Directors from across the United States. The response rate obtained in this study is also just above 41.1% response rate achieved by Richards, Glegg, Cullinane and Wallace (2002) in a study on policy, principles and practices in industrial pollution control. In these two studies it was observed that the response rates were satisfactory considering that environmental issues are sensitive matters for most companies (Richards *et al.,* 2002).

The subject understudy was found to be complex requiring experts from different fields such as legal studies, chemistry, environmental economics, statistics and biology. This limitation would undermine the comprehension of the subject matter. The effect of this limitation on the study was reduced through inclusion of a legal expert, chemist and biologist/ environmentalist in the supervisory team and comprehensive review of literature. A statistician was incorporated at sampling stage and data analysis.

3.6 Ethical Considerations

The study involved employees of both the public and private sectors. It was realized that in both sectors there is bound to be information restricted for public consumption.

In addition, industries might not be willing to disclose their names in the research paper or any report associated with this research. Further, it was realized that the opinions of the individuals to be interviewed might differ from the opinion of their employers and superiors. These factors could compel industries and their employees to hide important information, provide inaccurate answers or refrain from the whole study, hence undermining the results obtained.

To overcome these issues the researcher assured the key informants that the study is purely academic, as this was supported by a letter of introduction from the faculty of science at Chancellor College. Further, the identities of the key informants and industries involved in the study were concealed and only categories of industries and names of institutions were used in the discussion of results and recommendations.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Chapter Summary

This chapter documents the practices of manufacturing industries and government regulatory institutions to curb pollution of surface water in the cities of Lilongwe and Blantyre. It has gone further to document the challenges that manufacturing companies and regulatory institutions are facing in the control of water pollution. In addition, an analysis on the influence of regulatory practices on the practices of manufacturing companies has been presented. The chapter further contains strategies suggested by key informants on improvement of water pollution control practices in the cities of Blantyre and Lilongwe.

4.2 Industrial Water Pollution Control Practices

This study has identified waste management and management systems as two main water pollution control practices that industries in Blantyre and Lilongwe have adopted during the implementation stage of their projects. Though the industries seem not to have adopted EIA, the study further probed industries on their EIA practice, as it has been a legal requirement since 1996, before the implementation of their projects to guide their environmental practice in all phases of the project.

4.2.1 Environmental impact assessment (EIA)

Among the 21 industries that responded to the questionnaire, 81% (n=17) were established before 1996 and 19% (n=4) were established after 1996. The companies

that were established before 1996 indicated that they did not conduct EIA because it was not a legal requirement by then. This is a normal arrangement as the EIA was made mandatory by section 24 of the EMA (1996); hence all manufacturing companies that opened before 1996 did not conduct any EIA. The industries that opened after 1996 stated that they had not conducted EIA because they had found it unnecessary, without further clarifying how they made such a determination. This is contrary to section 24 of the EMA (1996) that limits such determination to the Minister responsible for environment and the DEA only. According to section 24 of the EMA (1996) the DEA can only make the decision on whether EIA should be conducted or not after the developer has presented a project brief that describes the nature of activities that will be conducted on the project, likely impact on the environment and segment of the environment likely to be affected. This illustrates weaknesses in the implementation of the EIA legislation as outlined in the EMA (1996). The developments that run without EIA prior to their establishment are likely to cause serious harm on water resources as they lack technical guidance on the water pollution control

.

Inadequate public awareness and participation, is one of the challenges facing EIA practice and implementation in Malawi (Mbeko, 2012). It is observed that public participation is inadequate on the key stages of the EIA in Malawi (Kosamu, *et al.*, 2013). However, public awareness of environmental regulations is one of the factors that are likely to influence compliance to environmental regulations (Mputhia and Makulu, 2012). Further, sections 3 and 4 of the EMA (1996) recognize the need for public awareness and participation in environmental protection. Inadequate public awareness and participation might have made it easy for a manufacturing industry to start operating without consulting the EAD; since the communities that are likely to

be affected by the activities of the manufacturing industry have no means to alert the authorities of the malpractice. Section 26 of the EMA prohibits any licensing authority from issuing a licence of operation without prior approval of the DEA or the minister responsible for environment. The ability of these industries to avoid the EIA is an exposition of lack of coordination between EAD and the licensing officers from other departments, for example agriculture and city councils, would be expected to refer the developers to the EAD for environmental scrutiny of their projects.

4.2.2 Waste management

Waste management practices of industries have a greater influence on water quality in urban streams within the cities since industrial wastes such as industrial effluents end up in the streams either directly or through run off if improperly disposed. Figure 3 is a graph showing a summary of the responses that the industries provided when asked on their waste management practices.

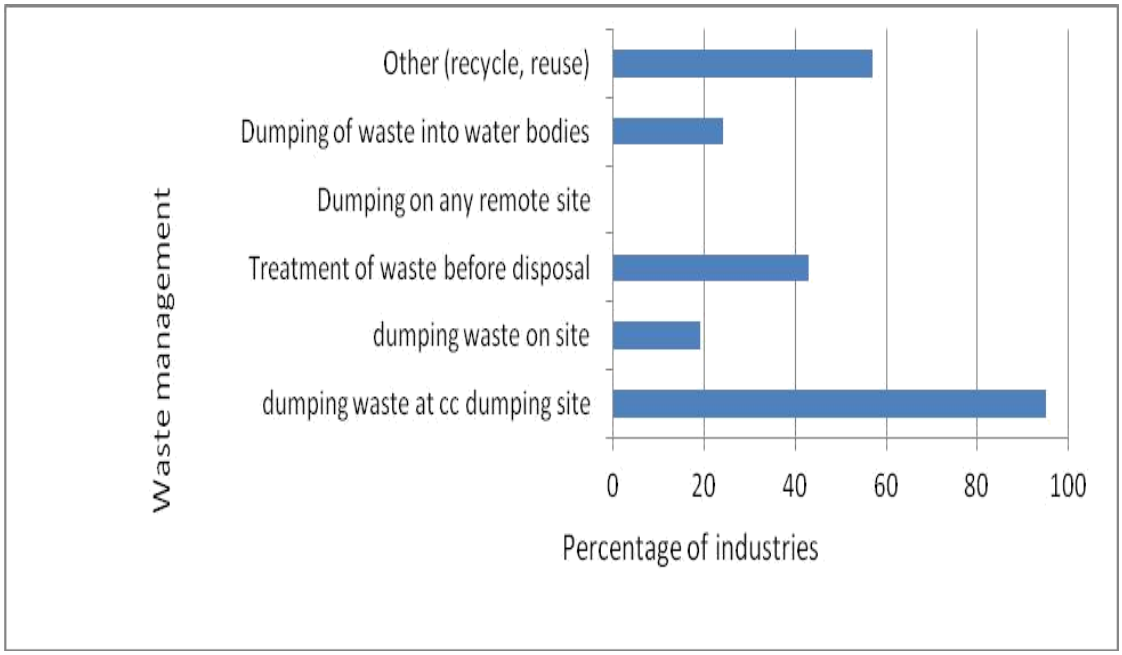

Figure 3: Waste management practices

Among the 21 industries that responded 57% (n=12) mentioned good innovative waste management practices such as recycling and reuse of their wastes (Figure 3). Though section 31 of the EMA provides for incentives for firms to invest into these innovations, there is no implementation of the section in practice; hence the firms are being proactive by investing into innovative pollution control mechanisms without waiting for government incentives such as soft loans, tax breaks and subsidies. These innovative programmes reduce the amount of waste that can be washed or dumped into water bodies hence reducing water pollution. These companies are largely influenced by their status as exporting companies since they have international requirements on environmental management to adhere to. In addition they make extra income through selling of products made from the wastes or the waste themselves. At one of the industries visited, it was directly observed that coal ash is being used to mould building blocks which will be used as building materials. Another industry is reusing water from WWTP to water its surroundings; where as another industry encourages farmers to use its waste as farm manure. These are notable innovative developments which the industries should be encouraged to adopt to reduce the pollution of water from improper management of waste.

Further the study revealed three waste management practices, dumping waste on manufacturing site, disposing waste into water bodies and disposing untreated wastes, which are likely to facilitate pollution of water resources. Of the 21 manufacturing companies that responded, 4.8% (n=1) of the companies and 14% (n=3) of the industries dump waste on the manufacturing site and 57% (n=12) of the companies (four food, four plastic, one chemical, one paint and two agro-processing industries) do not treat their waste before disposal (Figure 3). These improper waste management practices are against the spirit of water pollution control legislation and are likely to

encourage water pollution. The nature of the industries involved in the activities have the capacity to release pollutants such as organic matter (food industries and agro-processing) that increases the BOD of the water, heavy metals such as lead, cadmium and chromium (paint and chemical industries) and organic solvents (pharmaceutical industries). This explains the analysis of secondary data from LCC which indicated high concentration of pollutants in Lilongwe River such as cadmium (mean of .029mg/L against MBS standard of 0.01mg/L), BOD (median of 61.50 mg/L against the MBS standard of ≤ 20mg/L) and total suspended solid (median 81.50 mg/L against the MBS standard of ≤ 30mg/L).

Dumping waste at city councils‟ designated dumping site was mentioned by 95% (n=20) of the industries. This implies that even the industries that have been proactive by coming up with innovations indulge in this practice. This practice is legal as it is in tandem with the provisions of the law, section 37 of the EMA, which provides ministers responsible for environment and local authority with powers to formulate rules for the collection, transportation and disposal of waste. However, it is not a good water pollution control practice as it is a least desirable waste management practice as defined by waste management hierarchy (Figure 4).

Figure 4: Waste management hierarchy

Source: http://www.epa.gov/waste/nonhaz/municipal/hierarchy.htm

(22.10.2014)

Waste management hierarchy (Figure 4) refers to the 3rs reduce, reuse and recycle which classify waste management strategies according to their desirability in terms of waste minimization (Plesea and Visan, 2010). It is likely that these wastes will find their way into water bodies causing water pollution. These industries are just following exactly what the legal framework for water pollution control is demanding without even putting in place any innovations.

These wastes contain pollutants that pollute water resources; hence require proper management to control pollution of water resources (Sajidu, *et al.,* 2005). Recognizing the effects of improper waste management on water quality in streams, the legal framework for water pollution control provides for proper waste management as stipulated in section 37 of the EMA (1996), sections 91 to 103 WRA (2012) and sections 59 to 62 of the PHA. These sections call for proper waste collection, storage, handling, treatment, transport and disposal.

Despite engaging in ineffective water pollution control practices, manufacturing companies‟ key informants expressed awareness of the legal requirements for water pollution control. The key informants from 100% (n=21) of the manufacturing companies were able to state the legal framework of water pollution control. They are knowledgeable of Acts such as EMA, WRA, city bylaws and MBS standards on parameters such as BOD, COD, heavy metals, phosphates and nitrates. The key informants from 100% (n=21) of the manufacturing industries were able to state general legal requirements such as treatment of chemical and organic wastes before disposal and proper disposal of wastes. The key informants further expressed awareness of the consequences of failure to adhere to the legal provisions; imposition of fines by the regulatory authorities or even suspension of the operations of the company. The variation between knowledge and action in the industries could partly be attributed to a command and control system of pollution control in Malawi; which Harrington and Morgenstern (2004) observed that it only encourages innovations that reduce cost on the industries but without necessarily reducing the volumes of effluents released. These industries are aware that there is weak regulatory mechanism for monitoring their activities in addition they are reducing cost of operations at the expense of the human and environmental health.

4.2.3 Management systems

This study has revealed that manufacturing industries have developed a management systems approach which include establishment of environmental department and management support towards water pollution practices. This proactive approach is not provided for in water pollution control legislation however it is aimed at enhancing industrial water pollution control practices.

Environmental management department

It was revealed through key informant interviews that 100% (n=21) of the industries that responded to the questionnaire had established environmental management department which among other things was responsible for water pollution control practices. Table 3 is table showing the number of industries that have assigned particular officers to manage environmental management department.

Table 3: Human resource for water pollution control in industries

Assigned officer	Number of industries
None	0
Environmental Officer	3
Quality Controller	11
Personnel Officer	7
Total	21

The employees working in the environmental management department were assigned duties that all aimed at compliance to environmental management standards including control of water pollution. According to the key informants, the departments were headed by officers who were assigned duties such as ensuring compliance of environmental management standards in line to EMA (1996) as interpreted by the EAD, report to the EAD any environmental damaging incidents, whether minor or serious, ensure that wastes are properly and safely disposed, conduct environmental audits, orient other staff of the company on good environmental management practices and collaborate with government authorities on good water pollution control practices.

Officers heading the environmental departments had varying designations, qualifications and duties depending on specific systems of the companies. The designations varied from Safety and Health Coordinator and Environmental Officer who in this study were considered as Environmental Officers; Quality Assurance Manager, Quality Controller, Factory Manager, National Quality Manager, Assurance Manager and Production Manager, were all considered as Quality Controller; Human Resource Officer and Personnel Officer who were all considered as Personnel Officers (Table 3). This categorization was done basing on the understanding of the main duties of the designations by the researcher.

The key informants were asked to rate the expertise of the officers. The key informants based their rating on the qualifications of the officer in relation to the demands of the post, expertise displayed by the officer in the execution of his duties and understanding, interpretation and implementation of laws and regulations governing water pollution control. Figure 5 shows a summary of the rating of the heads of environmental management.

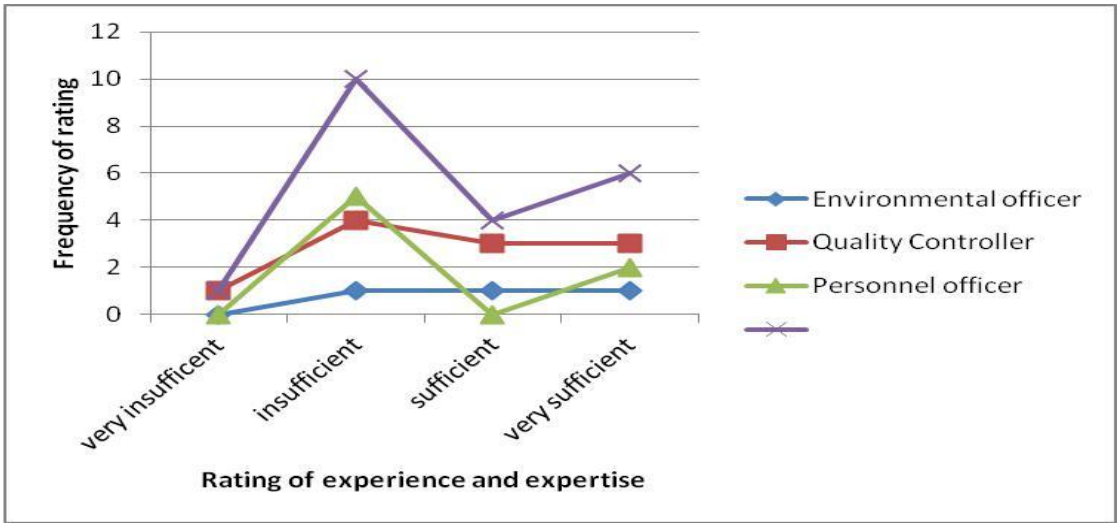

Figure 5: Rating of head of environmental management department

Overall key informants rated 52.4% of heads of the environmental management departments as either very insufficient or insufficient. Of the seven personnel officers who were assigned to manage water pollution control activities only 28.6% (n=2) were rated as sufficient by the key informants (Figure 5); whereas 71% (n=5) were rated as insufficient. The key informants found the performance on duty by the personnel officers as insufficient and their qualifications as low and irrelevant to water pollution control. However of the three environmental officers 33% (n=1) and 36% (n=4) of 11 quality controllers were rated as insufficient to manage water pollution control activities though they had tertiary qualifications, because the qualifications were irrelevant to water pollution control and their performance was described as below expectation.

A key informant who rated the Environmental Officer as insufficient expressed dissatisfaction with an officer who holds a tertiary qualification but not directly related to water pollution control when he stated that "*the officer's qualification is not adequate for environmental management though he holds a degree in Engineering, because it is not adequate for water pollution control. His education does not fit the job he does; hence he needs more training to fit in*".

Another key informant who rated the environmental officer as very sufficient stated that

> "*the Environmental Officer has gone through university education as environmental scientist and is capable of implementing safe use of raw materials, develop innovations in waste management, safe disposal of waste and discharges and understands government and city regulations in relation to pollution of the environment"*.

Though water pollution control legislation has no specific requirement for the employment of pollution control officers in the manufacturing industries, the need for well trained human resource for water pollution control is well articulated in the NEP (2004) (GoM, 2004) and the NWP (2007) (GoM, 2007). The policies particularly stated the need for human resource development in important areas such as pollution, toxicology and environmental law. Implementation of these policies is likely to introduce on the labor market human resource qualified to manage water pollution hence ensuring that industries employ staff with adequate knowledge and skills for improving water pollution control practices.

Management support

The study further looked at the support that water pollution control activities received from the management of manufacturing industries. Management support of water pollution control programmes in the industries was rated by the key informants based on the involvement of management in water pollution control programmes, budgetary allocation and provision of training opportunities to enhance water pollution control skills. Figure 6 is a bar graph summarizing the rating of management support by key informants.

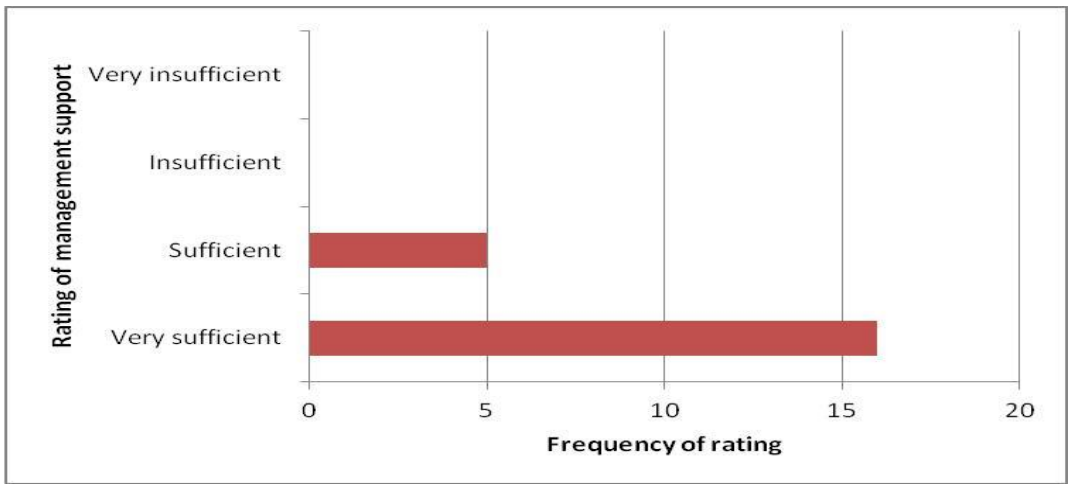

Figure 6: Rating of management support by key informants

All the 21 key informants (Figure 6) expressed satisfaction with adequacy of support they get from management through provision of financial resources for environmental management programmes though the business environmental is harsh. They stated that management encourages their employees and support them to attend environmental management courses hence attain knowledge and skills to develop innovations on water pollution control practices and develop a positive attitude towards water pollution control. Management support is also shown when top management actually sets the standards and targets for the employees in the environmental management department; hence challenging them to improve all the time.

4.3 Water Pollution Control Practices by Regulatory Institutions

This study identified four key regulatory practices; compliance monitoring, compliance enforcement, regulatory coordination and compliance assistance, used by regulatory institutions to proscribe water pollution by manufacturing companies. Among these, the most commonly used is compliance enforcement followed by compliance monitoring where as regulatory coordination is the least used mechanism. Compliance enforcement is preferred because it is the cheapest, since it is not routine based, as the regulatory institutions just depend on either suspicion or report of polluting activities already taking place.

4.3.1 Compliance monitoring

Viscusi and Magat (1990) reported that inspections are one of the most important components of any compliance monitoring program and thus merit special attention. It is thus of paramount importance that government engages inspections in its water pollution control programmes; if the programme is to yield any positive results. In

Malawi inspection of manufacturing companies is provided for in section 46 of the EMA (1996), section 140 of the WRA (2012), section 101 of the LGA (1998) and section 131 of the PHA (1948). These sections provide government regulatory institutions with powers to inspect any premises of manufacturing companies that are likely to cause water pollution. In this study assessment of compliance monitoring concentrated on inspections by regulatory institutions on manufacturing firms and the manner in which these inspections are conducted; which involved key informants from both regulatory institutions and manufacturing firms who provided their views on compliance monitoring.

In the study 62% (n=13) of the 21 industries that responded indicated that they had once been inspected by the water pollution regulatory institutions where as 38% (n=8) indicated that they had not been inspected. The industries that were inspected, however could not recall when last they were visited because the inspections are not frequent. Industries that were not inspected did not have information on why they were not visited nor did they know any criteria used for selecting which industries to inspect. Of the 13 industries that were inspected 85% (n=11) of the industries expressed satisfaction with the inspections and only 15% (n=2) expressed dissatisfaction. The satisfaction of the industries emanated from the advice that water pollution regulatory authorities provided to the industries in form of feedback on observations made during the inspections. Feedback and advice from the regulatory authorities has helped them to improve on their water pollution control practices. Lack of feedback from the authorities resulted in dissatisfaction with the inspections.

Surprise element during inspections as provided for in water pollution control legislation, such as in section 41 of the EMA (1996), section 140 of the WRA (2012)

and section 131 of the PHA (1948), is an important element of the exercise. The 7 government officials that were interviewed acknowledged paying surprise visits to the industries and the 13 industries that were inspected indicated that they were not forewarned before the inspections. The regulatory institutions pay surprise visits to the institutions during inspections to ensure that the industries are not aware of the days and time they will be inspected hence always maintain the standards.

Legislation on water pollution control, such as the section 46 of EMA (1996) and section 140 of the WRA (2012), stipulate activities that the regulatory institutions may engage in during inspection of manufacturing companies. The activities include wastewater and water sample collection, site inspection, analysis of environmental management records and discussion and questioning of the occupiers of the manufacturing site. The 13 industries that were inspected mentioned a number of mechanisms employed by inspectors to verify the water pollution control practices of the manufacturing industries. The mechanisms include wastewater sample collection, inspection of environmental records, site inspection and discussion with operators of the manufacturing company which according to the key informants from the industries was done in a professional manner (Figure 7). Though the mechanisms" effect cannot stand out alone; the most comprehensive of the mechanisms is inspection of environmental records and the least is site inspection. However, the inspectors opted to employ site inspection more often than inspection of environmental records (Figure 7). This could render the inspections less comprehensive and may not yield the intended results

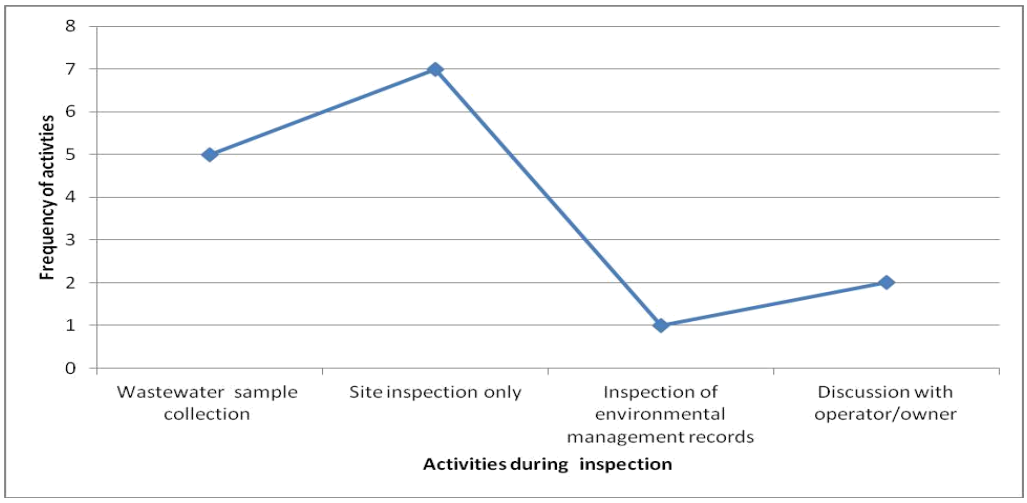

Figure 7: Inspection mechanisms

Professionalism of the inspectors was determined by the key informants based on the manner in which the inspections were done. Of the 13 industries that were inspected 92% (n=12) indicated that the inspectors were professional. According to the key informants, the inspectors introduced themselves, had documented proof of identity, explained the aim of the visit and performed more on the advisory role rather than being corrupt, punitive and harsh.

Despite an indication that inspections are taking place to monitor compliance, the general perception by the industries and the government officials is that monitoring is not adequate. The industries complained of the low frequency with which they are inspected. The general perception of officials from the water pollution regulatory bodies from the EAD, LCC, WRB, MBS, LWB, BWB and BCC is that the institutions are not doing enough to monitor the activities of the manufacturing companies.

4.3.2 Compliance enforcement

Section 144 of the WRA (2012) and sections 43, 44, and 61 to 67 of the EMA (1996) stipulate offences associated with water pollution control and the applicable punishments for the offences. The offences include improper disposal of wastes,

failure to comply with an order to stop polluting activities, obstruction of inspectors and failure to adhere to EIA practice as stipulated in the Acts. The legal framework provides for compliance enforcement mechanisms such as punishments (fines, closure of premises, imprisonment, and withdraw of licences) and warnings to manufacturers found to have polluted water resources.

All the industries that were interviewed indicated that they have never been punished or warned for any incident associated with water pollution. However, of the seven government officials that were interviewed, two reported that they are not aware of any industry that was punished and five indicated to have information on industries that have been punished and warned of water pollution. According to three key informants offences committed by the companies that were punished included improper disposal of wastes either on land or into water bodies. Four key informants indicated that the industries were punished through fines, order to stop production processes or conduct an environmental audit; in some instances the industries were just warned. Further, through documentation analysis at the EAD and WRB, it was clear that there were communications of warnings and punishments that had been administered to manufacturing companies that were found to have been involved in water polluting activities. This trend illustrates that manufacturing industries have been involved in water polluting activities which attracted punishments. Since in their responses to the questionnaire, none of manufacturing industries admitted to have been punished for any offence related to water pollution, making it difficult to determine whether the punishments are deterrent enough or not.

4.3.3 Regulatory coordination

Regulatory coordination is provided for in sections 10, 23, 25 and 26 of the EMA (1996) and sections 25, 122, 131 and 141 of the WRA (2012). These sections establish institutions that will encourage coordination both locally and internationally on water resources management and also promote public participation and stakeholder integration in water resources management. According to Linde and Porte (1995) regulatory coordination can be implemented in three main ways: among government regulatory institutions, between government regulatory institutions and manufacturing industries and government regulatory institutions with their counterparts in other countries.

The key informants find coordination among water pollution regulatory institutions beneficial though challenging. The departments work together as a team and this helps them to share the limited resources they have such as transport, human resources, infrastructure and equipment hence enhancing their capacity. For example the LCC currently has a laboratory that is not functional due to vandalism and WRB do not have laboratories but use the CWL for sample analysis at a reasonable fee. At times the departments have engaged in joint inspections.

However, the key informants indicated that coordination among them has not been adequate leading to duplication of roles and fragmented implementation of water pollution control activities. They pointed out that fragmented implementation of water pollution control activities is seriously affecting achieving positive results. One of the key informants pointed out that "*to improve water pollution control there is a need for quick and harmonized review of laws, regulations and implementation strategies of pollution control*". It is of paramount importance that different parts and levels of

government coordinate and organize themselves if meaningful water pollution control is to be achieved. This helps to reduce the burden of companies dealing with multiple parties with inconsistent desires and approaches (Porter and Linde, 1995).

The key informants from the manufacturing companies bemoaned lack of coordination between industrial players and government regulatory institutions. One of the key informants from the industry suggested that "*there is need for an integrated approach by the industrial player and other stakeholders including city councils, Malawi Confederation of Chambers of Commerce and Industry, Ministry of Trade, EAD, to formulate the legal machinery and framework for water pollution control and necessary infrastructure for the same".* Coordination between government and industrial operators involves the participation of the industrial players in the regulatory process right from the beginning. This approach helps stakeholders to identify and agree on their specific roles and the industry accepts the regulations hence put in place measures to address the demands of the regulations (Porter and Linde, 1995).

Apart from coordination among the government institutions and coordination between government and industrial players; key informants from multinational companies expressed the need for government regulatory institutions to coordinate their activities with regulatory institutions in other countries. Engaging regulatory institutions in other countries will improve water pollution control while minimizing possible competitive disadvantages relative to foreign competitors and maximize export potential of Malawi‟s industrial players (Porter and Linde, 1995).

4.3.4 Compliance assistance

Compliance assistance is clearly stipulated in NEP (2004) and the NWP (2007) where the policies set objectives to provide technical assistance, public awareness and education on water resources management. The legal basis for compliance assistance in NEP (2004) and NWP (2007) is provided for in section 3 of the EMA (1996) and section 4 of the WRA (2012) which promotes public participation and awareness on environmental management and proper management of effluents.

On compliance assistance the interest was to identify measures that regulatory institutions take to enhance compliance among industries. The key informants from the regulatory institutions indicated that they arrange seminars, radio and television programmes and produce manuals to provide guidance on water pollution control to the manufacturers (Figure 8).

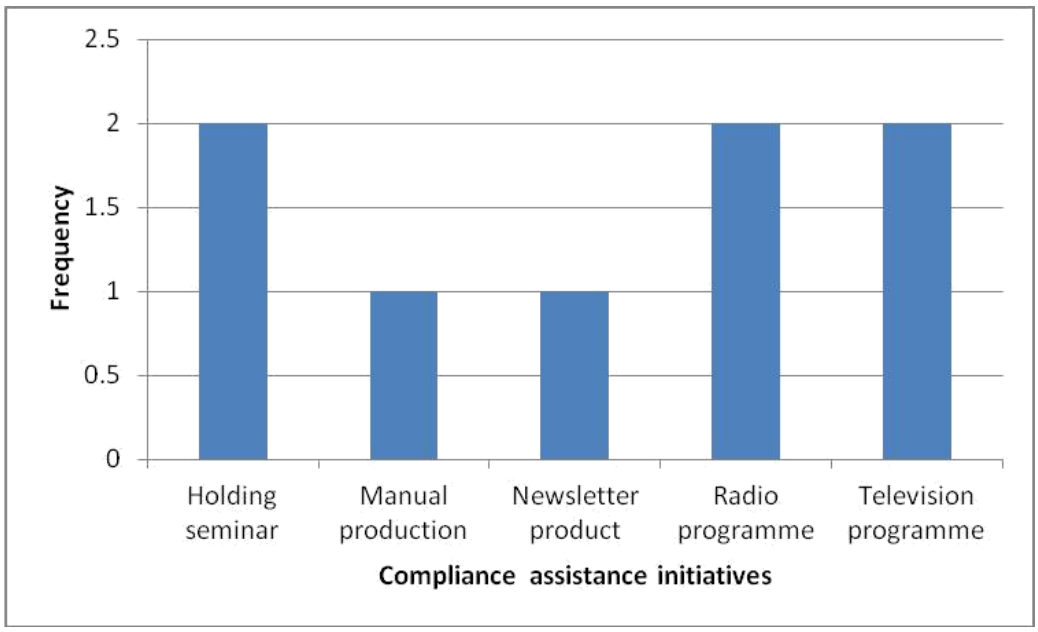

Figure 8: Compliance assistance initiatives

However Figure 8 shows indicates information that was provided by EAD only; the LCC, BCC and WRB did not indicate compliance assistance mechanism that they were implementing. However, one would expect efforts by all regulatory institutions which, surprisingly, is not the case hence one may conclude that not much is being done on compliance assistance. Key informants from the manufacturing industry bemoaned the absence of comprehensive compliance assistance programmes to improve water pollution control among industries. They lamented non-existence of compliance assistance programmes such as "*technical support, educational programmes, awareness campaigns, awareness seminars and trainings on good water pollution control practices such as EA and the EIA*". The manufacturing companies expect the government to take the initiative in organising the activities so that water pollution **control** practices by the industrial operators would improve; hence practice cleaner production, while at the same time encouraging public participation in water pollution control.

4.4 Influence of Regulatory Practices on Industrial Water Pollution Control Practices

Through key informant interviews, this study has identified inspections on manufacturing plants and punishment of water polluting industries as two main regulatory practices that are anticipated by manufacturing industries hence influence their practice.

Manufacturing industries anticipate an inspection by regulatory institutions such as EAD, LCC in Lilongwe city or BCC in Blantyre city. This anticipation is based on knowledge of the provisions of the legal framework such as EMA (1996) or WRA

(2012). At times the anticipation is based on previous experience when the industry was actually visited; sometimes knowledge of inspections made on other industries. Though the industries appreciate the inspections as an opportunity to interact with the regulators, they consider the inspections as a policing exercise aimed at finding faults on their water pollution control practices. Manufacturing industries are thus all the time vigilant and try to minimize water polluting activities in anticipation of a policing visit by the regulatory authorities.

Key informants revealed that manufacturing industries are aware of and anticipate punishments, such as fines, closure of their premises, order to clean up and even conduct an environmental audit, from regulatory authorities whenever they are found indulging in water polluting activities. The most dreaded punishment among the industries is a fine. They have learnt of the punishments from the provisions in the legal framework and knowledge of other industries that have been punished before. The punishment inflicted on other manufacturing industries, other than their company affirms the possibility of a punishment on their company in case of any malpractice. The anticipation of a possible punishment in case of a violation of the law, instils in the industries the zeal to stick to the provisions of the legal framework. As one of the key informants stated that "*the company can be severely punished if it operates outside the law; as such the company continuously strives to operate within the law*".

4.5 Challenges Facing Water Pollution Control in Lilonwge and Blantyre Cities

The study has revealed that the performance of both the manufacturing companies and regulatory institutions in water pollution control has been seen to be facing a number of challenges. The challenges have been categorized into those facing regulatory

institutions and those facing manufacturing companies, as individual institutions in the two categories face similar challenges.

4.5.1 Challenges facing regulatory institutions

The study identified both legal and institutional challenges facing regulatory institutions in their attempt to manage water pollution by manufacturing industries. The institutional challenges include lack of resources such as inadequate equipment, good infrastructure, human resources and lack of commitment among regulatory institutions. The only legal challenge identified was absence of councillors affecting city councils only. These challenges have paralyzed implementation of compliance monitoring, enforcement and regulatory coordination by regulatory institutions.

Inadequate human resource is one of the challenges facing the regulatory institutions. One of the important human resources in the regulatory institutions is inspectors. These inspectors have a duty to monitor practices of manufacturers in the cities. Key informants from the regulatory institutions indicated that their institutions do not have adequate inspectors (Figure 9).

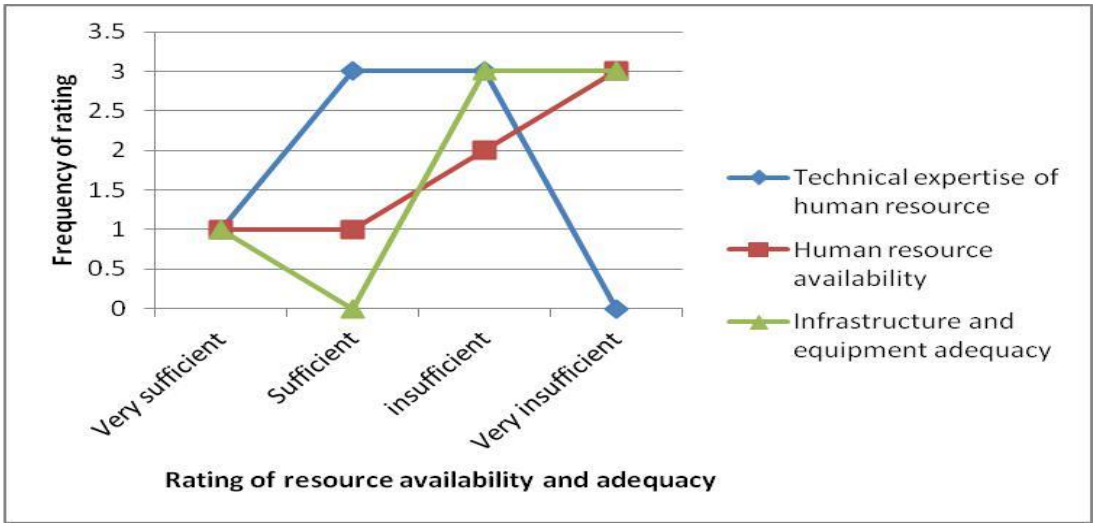

Figure 9: Human resources, equipment and infrastructure adequacy

One of the reasons cited was that the post of inspectors has just been established and it was yet to grow. In other institutions where they had an establishment the main problem was that the establishment limits the number of inspectors as the funding of salaries from central government is done according to the establishment. In case of a vacancy on the post of inspectors the key informants bemoaned the delay in filling the post due to long hiring processes.

The key informants also blamed the weak compliance monitoring of water pollution control on the lack of infrastructure and equipment due to lack of funds to maintain the existing facilities such as laboratories and equipment (Figure 9). The equipment and laboratory are used to collect data that can be used to monitor the activities of the manufacturing industries. For instance LCC laboratory at Kauma WWTP which was vandalized in 2010 has not been refurbished up to now due to inadequate finances, forcing the city council to engage services of the CWL at a fee which it is failing to pay.

The overall effect of the challenges is that inspections are not done according to work plans but they are usually done when there is suspicion of polluting activities instead of running routine checks on effluents and receiving waters in the streams of the cities. The key informants from the city councils bemoaned their inability to police and punish offenders adequately in the absence of councillors who are mandated to make final decisions on behalf of the council secretariat. This has further worsened because the councils cannot review their bye laws and policies in the absence of councillors; hence councils are using outdated tools for example byelaws and policies which do not march with current status.

Lack of commitment is negatively affecting regulatory coordination among the institutions. It is characterized by failure of the departments to fulfil their roles as discussed in meetings. For example it was revealed that institutions, such as Lilongwe city council, have failed to meet their financial obligations for sample analysis at the CWL. Lack of commitment to water pollution control by regulatory institutions is also observed through failure of the city councils to maintain their infrastructure; which puts the regulatory institutions at a disadvantage. One official from the WRB stated that "*If you go to Blantyre City, the main culprit of pollution is BCC; the reason being that industries get connected to BCC sewer lines but the city does not maintain the sewer lines when they get broken. I were to rate polluters in Blantyre City the council there is number one.*"

WRB and city councils are expected to coordinate in controlling pollution from manufacturing companies, but in the event where one of them is a polluter, it jeopardises their effectiveness in dealing with polluting companies.

4.5.2 Challenges facing manufacturing companies

Key informants bemoaned the substandard regulatory framework in Malawi, which put exporting companies at a disadvantage on the world market because their customers demand that they satisfy certain international standards on environmental management standards. To solve the problem the key informants stated that "*their companies have engaged an environmental management system that is certified and annually appraised by National Occupation Safety Association (NOSA) based in South Africa".* This has proved cumbersome and expensive for the manufacturing companies.

In addition, manufacturing companies decried lack of finances to fund water pollution control activities and lack of infrastructure, such as laboratories and equipment to run environmental analysis. Other industries complained of lack of capacity of the city councils to management waste collection, transportation, treatment and disposal putting the manufacturers under pressure to manage wastes against their own programmes.

4.6 Suggestions to Improve Water Pollution Control

The key informants made four main suggestions through which water pollution control can be enhanced in Blantyre and Lilongwe cities. The suggestion included increasing the financial allocation to the regulatory institutions, development of water pollution control infrastructure, increasing the frequency of inspections and penalties for water pollution and development of pollution control awareness programmes.

The key informants observed that the city councils do not collect wastes in time from manufacturing sites. This creates pressure for the waste management on the industries giving a lee way for some wastes to end up in water bodies. The key informants attributed this to lack of financial and human resources and materials. The key informants suggested that city councils should be allocated adequate funds, human resources and materials to enhance their programmes for water pollution control such as waste collection. This will further make sure that waste collection is not left in the hands of industries which at times can be negligent in waste management leading to water pollution.

The key informants bemoaned lack of investment for adequate and good infrastructure for water pollution control by both government and manufacturers. They suggested

that it is necessary to upgrade and maintain the few wastewater treatment plants available and plant new wastewater treatment plants to cater for all players in the manufacturing industry while taking into consideration their unique needs. This will provide industries with an opportunity to treat their wastewater before discharge and at the same time discourage industries from discharging their waste into water bodies but sewer lines.

The key informants expressed the need for regulatory authorities to engage the public and manufacturing companies through public awareness programmes. The programmes should include education on water pollution control, awareness on environmental assessment and seminars through which government and manufacturing company officials could share sentiments on water pollution control. These programmes according to the key informants would increase awareness of government regulations hence improve water pollution control practices of the manufacturing industries.

Key informants from government departments that were visited suggested improvement in government compliance monitoring and enforcement of regulations. This was also suggested by the key informants from the manufacturing firms who called for intensification of inspections of the manufacturing firms. As one of the key informants stated that "*the regulatory bodies should seriously track water pollution sources and enforce the already existing regulations or review the regulations if they are not deterrent enough"*. They suggested that this could be achieved if the government increased its human resource capacity and financial resources to improve the enforcement machinery as it is very weak.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter draws conclusions on the practices that the manufacturing industries have adopted to prevent pollution of water resources and the measures that the regulatory institutions are taking to protect water resources in the cities of Malawi. Further, looking at the challenges facing the regulatory institutions the chapter has come up with recommendations that can enhance water pollution control.

5.2 Conclusions

5.2.1 Water pollution control practices of the industries

Manufacturing industries in Lilongwe and Blantyre cities have not engaged in more innovative ways of waste management to protect water resources. They have maintained the minimum effort by just practicing much of waste disposal though a few are putting in effort to adopt more desirable means of waste management such as recycling and reuse. Some have gone further to break the law on water pollution control through improper disposal of waste risking punishments. This is likely to lead to the pollution of water resources as the wastes are washed into water bodies. However, the fact that manufacturing companies are putting in place management systems for water pollution control is a clear indicator of the awareness and effort of industries to comply with water pollution control legislation.

5.2.2 Water pollution control practices of regulatory institutions

This study has revealed a weak water pollution regulatory system which has given manufacturing industries the opportunity to pollute water resources with impunity. Water pollution control in Malawi is characterized by inadequate compliance monitoring, weak compliance enforcement, poor regulatory coordination and low compliance assistance.

This study has revealed that water pollution regulatory institutions conduct inspections in industries to monitor compliance of the manufacturing industries to water pollution control. These inspections are conducted in a professional manner and follow procedure as stipulated in the water pollution control legislation; as such they have assisted the water polluting institutions to maintain good operating standards. However, the inspections are not frequent enough to keep the manufacturers vigilant against malpractice, due to inadequate resources including, human resources, infrastructure, equipment and financial resources.

Without adequate inspections it is difficult to identify the manufacturers that are polluting water resources, hence the companies that are polluting water resources may not be identified and punished for the malpractice. No matter how harsh the punishments can be without compliance monitoring through adequate inspections, water pollution control will remain a nightmare. It is either the offenders will not be identified or the punishments will be unleashed on the offenders after substantial damage has already been done.

There is poor coordination among water pollution regulatory institutions nor does it exist between water pollution regulatory institutions and manufacturing industries and

regulatory bodies on the international scene. This has led to fragmented implementation of the legal framework for water pollution control in Malawi and failure of the manufacturing companies to appreciate the regulatory framework. Lack of coordination with international regulatory institutions has led to failure of industries to compete on the international market, forcing them to adopt an international standard which is an expensive undertaking and a path pursued by few companies.

This study has revealed that the water pollution regulatory institutions have done so little to engage the manufacturers in awareness campaigns and technical assistance. Public awareness campaign is almost non-existent. The regulatory institutions have just played an advisory role during inspections of other manufacturers. This has led to lack of information among manufacturing industries and the public leading to low compliance levels and public awareness.

5.3 Recommendations

5.3.1 Improve the monitoring mechanism

Improvement of the monitoring mechanism by the regulatory institutions is one of the most efficient ways to improve water pollution control by manufacturing industries. This mechanism surpasses prosecution as cases may take long to be concluded and the fines charged by courts may not be deterrent enough. In addition this mechanism is preventive in nature as it will signal any polluting activities well in advance other than waiting for a report on polluting activities which may be made after adequate damage has already been done. Since regulatory institutions may not have adequate resources to collect data from all industries every month, they should ask for monthly reports from all industries on the quantity, quality and management practices of their wastes as a voluntary self-reporting mechanism; while planning for verification

exercise which could be done whenever the institution can afford to conduct inspection exercises.

5.3.2 Intensify awareness programmes

It is of paramount importance that there is continuous communication and dialogue between regulatory authorities and manufacturing industries. This can be achieved through seminars and workshops on the relevant legislation and aspects of pollution. This will encourage a preventive approach where industries will be sensitised and encouraged to adopt innovations for waste minimization and prevention by reusing, recycling wastes and further adopting technologies for cleaner production. The industries will look at regulators as advisors and stakeholders other than rivals.

In a similar manner, awareness programmes of the local communities, both rural and urban, can help reduce environmental ignorance among communities which are the victims of water pollution. The local communities should be sensitised on the effect of water pollution on human and environmental health and signs of polluting activities such as foul smell and changes in colour of water. The communities will also be sensitised on channels of communication in case of any polluting activities by any manufacturing industry. These messages will provide a bad image of any industry that is polluting water resources hence encouraging them to adopt cleaner production approaches. Use of print and electronic media, public hearings are affordable means that can be adopted to reach out to the community.

5.3.3 Change policy direction in pollution control

Without sound technical, financial and political backing all policies and legislation are bound to fail; however lobbying for such backing is a long term process and polluting activities cannot wait for such a long time before they are handled. However, long

term policy changes still remain an important element to achieve meaningful pollution control. This study recommends three main policy changes that can be adopted: adoption of the IWRM, strengthening water pollution regulatory institutions and adoption of more flexible approaches to water pollution control.

Adopt Integrated Water Resources Management

Regulatory institutions such as EAD, city councils and WRB should adopt the concept of IWRM and put it into practice. Though the concept has been criticized, if practiced in context, it still remains an important step towards improving water pollution control as it will involve participation and coordination among local and international stakeholders and integration of various pieces of legislation and policies to achieve a consolidated compliance enforcement mechanism. Water pollution regulatory institutions should come up with a master plan on stakeholder engagement to harmonize their policies, laws and activities; involving the manufacturers in the process. This will help to share roles hence reduce duplication of activities serving resources in the process. The industries will also know their roles and accept the requirements of the laws and regulations hence avoid unnecessary offences. The final product of these efforts will be to bring stakeholders together and develop a comprehensive regulatory framework and strategy that is acceptable by all stakeholders locally and internationally.

Strengthen water pollution regulatory institutions

The central government, including Office of President and Cabinet and line ministries such ministries responsible for water development and local government should strive to strengthen water pollution regulatory institutions like the, WRB, EAD and city councils through improvement in their financial income, hence enabling them to have

adequate human resources, equipment and infrastructure. In this way they will be able to inspect the activities of manufacturers, identify their weaknesses and challenges hence provide them with technical support and advice. One of the ways to strengthen the institutions financially would be to wean them from financial dependency on central government by transforming them into a parastatal that would be able to offer services like licensing of manufacturing companies and inspections on environmental management of industries hence collect and spend revenue with a greater degree of independence.

Adopt flexible approaches to water pollution control

Waste management practices practiced by the manufacturers are least desirable in the protection of water resources from pollution due to a command and control regulatory system that the regulatory institutions have adopted. The regulatory institutions should demand and provide the manufacturers with incentives to adopt more innovative ways of managing wastes such as recycling, reuse and energy recovery and minimise waste production through adoption of cleaner technologies for production. Abandoning the rigid command and control approach might not be feasible; introducing a policy mix approach, which is mixing command and control approach and some economic approaches such as effluent taxes and subsidy, might enhance adoption of innovations among manufactures.

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APPENDICES

Appendix A: Questionnaire for Water Pollution Regulatory Institutions.

In partial fulfilment for the award of the MSc (Environmental Science); Students are required to conduct a research based study. This questionnaire is for the study by Emmanuel Kaitano titled „„Evaluation of industrial water pollution control compliance and enforcement in Lilongwe and Blantyre cities of Malawi". Information that will be provided in response to this questionnaire will remain confidential and used for the purpose of this study only. Are you ready to participate in this study?

1. Yes 2. No

QUESTIONNAIRE NUMBER……..

BACKGROUND INFORMATION

1. Name of institution: _____

2. Location of Institution : 1. Blantyre

2. Lilongwe

3. Designation of respondent: ……

WATER POLLUTION CONTROL MEASURES AND CAPACITY OF REGULATORY INSTITUTIONS

a. What mandate does your institution have to control water pollution?
   [1] Administration of EIA process
   [2] Setting industrial effluent standards
   [3] Ensuring industrial compliance to industrial effluent standards through inspection of industrial operations
   [4] Others (specify)
   _____

b. How would you rate the enforcement of water pollution control legislation by your regulatory institution?

   [1] Very sufficient [2] sufficient [3] insufficient [4] very insufficient

c. **If insufficient or very insufficient,** explain the areas that make the enforcement insufficient.

_____
_____
_____
_____
_____
_____

d. Does your institution have adequate inspectors to control water pollution?
[1] Yes [2] No

e. **If no**, why doesn‟t your institution have adequate inspectors?
[1] Lack of political commitment to appoint inspectors
[2] Lack of trained personnel to fill the positions.
[3] Other (specify)
_____

f. How do inspectors from your institution ensure positive results from their inspection exercise?
[1] They pay surprise visits to any factory premises.
[2] They visit the factory premise anytime they find reasonable.
[3] Other (specify)
_____

g. What activities are involved in the monitoring exercise?
[1] Collection of pollutant samples
[2] Retention and examination of documents relating to water pollution.
[3] Interrogating owner, occupant or agent of owner on matters concerning water pollution.
[4] Inspect vehicles deemed to have been taking on board pollutants.
[5] Other (specify)
_____

h. How do you rate the assistance that owners, occupiers or agents of owners render to inspectors during inspection exercises?
[1] Very sufficient [2] sufficient [3] insufficient [4] very insufficient

i. **If insufficient or very insufficient,** explain why the assistance is not sufficient?

_____
_____
_____

_____
_____
_____
_____

j. How would you rate the following aspects of your institution?
Key: [1] Very Sufficient [2] sufficient [3] insufficient [4] very insufficient

Aspect of laboratory	**Rating: 1, 2, 3 and 4.**	**Remark**
Human resource availability		
Technical expertise of human resource		
Adequacy of infrastructure and equipment		

LEGAL FRAMEWORK

a. Has your institution punished any factory operators for noncompliance with water pollution control regulation for the past twelve months? [1] Yes [2] No, if no go to d.

b. What offences were committed by the industries?
[1] Releasing improperly treated wastes into water bodies
[2] Dumping wastes at any site other that the city councils‟ designated site
[3] Not keeping environmental management records
[4] Failure to report environmental accidents that is likely to cause water pollution
[5] Other (specify)
_____

c. What punishment was given to the industries?
[1] Imprisonment
[2] Fine
[3] License withdraw
[4] Warning
[5] Ordered to stop operating
[6] Factory operator was asked to conduct and environmental audit
[6] Other (specify)
_____

d. What measures has your department undertaken to help industries improve water pollution control?

[1] Holding seminars

[2] Production manuals on water pollution control best practices

[3] Production of newsletters

[4] Educational radio programs

[5] Educational TV programs

[6] Other (specify)

_____

INSTITUTIONAL COORDINATION

a. Which other institutions does your institution collaborate with in water pollution control?
   [1] Malawi bureau of standards
   [2] Environmental affairs department
   [3] Department of water affairs
   [4] Lilongwe city council
   [5] Blantyre city council
   [6] Lilongwe water board
   [7] Blantyre water board
   [8] Other (specify)
   _____

b. What challenges do you face in working with these institutions in controlling water pollution from industrial activities?
   _____
   _____
   _____
   _____
   _____
   _____
   _____

c. What benefits does your institution get from coordination with other institutions in water pollution control?
   _____
   _____
   _____
   _____
   _____
   _____

SUGGESTIONS TO IMPROVE WATER POLLUTION CONTROL

a. What measures should be taken to improve water pollution control by industrial operators in the country?

b. What measures should water pollution regulatory bodies take to improve water pollution control in the country?

Appendix A: Questionnaire for the Industrial Operators official Information

In partial fulfillment for the award of the MSc (Environmental Science); Students are required to conduct a research based study. This questionnaire is for the study by Emmanuel Kaitano titled „„Evaluation of industrial water pollution control compliance and enforcement in Lilongwe and Blantyre cities of Malawi". Information that will be provided in response to this questionnaire will remain confidential and used for the purpose of this study only. Are you ready to participate in this study?

2. Yes 2. No

a. Questionnaire number:_____
b. Enumerator :_____
c. Date of interview :_____
d. Location of industry : 1. Lilongwe 2. Blantyre
e. Type of industry : 1. Food 2. Tobacco 3. Plastic 4. Chemical 5. Agroprocessing 6. Paint 7. Pharmaceutical 8. Textile
f. Code of industry :_____
g. Designation of respondent : _____

Objective of Questionnaire: This questionnaire seeks to document the water pollution control practices of manufacturing industry operators and how these practices are influenced by legal and institutional framework for water pollution control.

WATER POLLUTION CONTROL MEASURES

a. What products your produce?

_____

_____

b. When did your factor start producing these products?

1. Before 1996
2. After 1996

a. **D**id your institution conduct any environmental impact assessment (EIA) before commencement of production?

[1] Yes [2] No.

b. **If no,** Why didn‟t your institution conduct environmental impact assessment?

[1] Not aware of the requirement
[2] It was not necessary
[3] Did not have the finances for the exercise
[4] Others (specify) _____

c. Who official designate is responsible for environmental management in your company?

[1] None

[2] Environmental Officer

[3] Quality Controller

[4] Personnel Officer

c. What are the responsibilities of the official with regard to environmental management in your company?

_____

_____

d. How would you rate the support of the top management of your company towards environmental management?

[1] Very insufficient [2] insufficient [3] sufficient [4] very sufficient.

e. **If insufficient or sufficient, explain** why the support is rated as such.

_____

_____

_____

f. How would you rate the qualifications and technical expertise of the head of section or official responsible for environmental management?
[1] Very insufficient [2] insufficient [3] sufficient [4] very sufficient

Explain why they are rated that way:._____

_____

g. What waste management practices does your company practice? [1] Dumping wastes on site

[2] Treatment of waste before disposal
[3] Disposal of waste at city council‟s designated place
[4] Disposal of waste at any remote place
[5] Disposal of waste into water bodies
[6] Other (specify)

_____

EFFECTS OF REGULATORY INSTITUTIONS PRACTICE ON INDUSTRIAL PRACTICE

a. When last was your industry inspected by water pollution regulatory institutions?
[0] No [1] yes

b. Which government departments did these inspectors come from?

_____

_____

c. **If yes**, how have these inspections affected water pollution control practices of you company?

[1] Frustrated
[2] No effect
[3] Improved
Explain:

_____

_____

_____

d. **If yes,** was your company forewarned of the pending inspection exercise?
[0] No [1] Yes

e. **If yes**, what activities did the pollution control bodies conduct during the exercise?
[1] Water sample collection
[2] Site inspection only
[3] Wastewater sample collection
[4] Inspection and retention of environmental management records
[5] Investigating the owner, occupant or agent of owner of factory on matters concerning water pollution.

[6] Other (specify) _____

f. How would you rate the professional conduct of inspectors on how they handle industrial operators?
[1] Very unprofessional [2] unprofessional [3] professional [4] very professional

g. **If unprofessional or very unprofessional,** explain the behaviour of the inspectors?

_____
_____
_____
_____

h. **If unprofessional or very unprofessional,** how has the unprofessional behaviour of the inspectors affected water pollution control practices of industrial operators?

_____
_____
_____
_____

INFLUENCE OF LEGAL FRAMEWORK ON INDUSTRIAL PRACTICE

a. What legal obligations does your industry have as regards water pollution control?

_____
_____
_____
_____

b. To what extent has your industry obliged to the legal obligations stated in a. above?

_____
_____
_____

c. What barriers is your company facing to apply or implement the above stated legal obligation?

_____
_____
_____
_____

d. Has your company ever been punished by water pollution regulatory institution for not adhering to legally binding water pollution control practices?

[1] Yes [0] No, if No go to i.

e. What offence did your company commit?

[1] No EIA before installation of a manufacturing plant
[2] Did not oblige to conditions set on operation licences
[2] Did not treat wastes before disposal
[3] Disposed wastes in another place other than city council‟s designated places
[4] Not keeping environmental management records
[5] Other (specify)

_____

e. Why did your industry commit the offence?

[1] Negligence
[2] Lack of technical knowledge to avoid the offence
[3] Lack of equipment
[4] Lack of awareness
[5] Other (specify)

_____

f. What type of punishment did the regulatory institutions impose on your industry?

[1] Fine
[2] Withdraw of licence
[3] Injunction to halt production
[4] Imprisonment
[5] Warning
[6] Other (specify)

_____

g. In your opinion how do you rate the punishment?
[1] Very lenient [2] lenient [3] harsh [4] very harsh.
Explain:

_____
_____
_____

h. What is the chemical, physical and biological composition of wastes released by your industry?

Type of Waste	Chemical	Physical	Biological
Waste A			
Waste B			
Waste C			

SUGGESTIONS TO IMPROVE WATER POLLUTION CONTROL

c. What measures should be taken to improve water pollution control by industrial operators in the country?

d. What measures should water pollution regulatory bodies take to improve water pollution control in the country?
