MAKERERE UNIVERSITY

SELF-REGULATION, AS A TOOL FOR ENSURING ENVIRONMENTAL REGULATION COMPLIANCE IN THE SUGAR MANUFACTURING INDUSTRY OF UGANDA:

CASE STUDY OF SUGAR CORPORATION OF UGANDA LIMITED

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DECLARATION

I, NALUKWAGO ANGELLA hereby declare that this research work is my own and it has never been submitted to any university or higher institution of learning for any award.

Sign .... Date ...26/8/2019...

APPRROVAL

This dissertation has been prepared under my supervision and it is now ready for submission.

Sign ……………………………… **Date** 27/8/2019

DR. PATRICK BYAKAGABA

DEDICATION

This dissertation is dedicated to my beloved parents, family, friends and everyone who has made a contribution towards my studies. To all my course mates and lecturers, thanks a lot for the continued support and advice. May the good Lord bless you.

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ACRONYMS

APHA	American Public Health Association
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
ETP	Effluent Treatment Plant
ISO	International Organization for Standardization
MDCs	Mechanical Dust Collectors
NEA	National Environment Act
NEMA	National Environment Management Authority
NWSC	National Water and Sewerage Cooperation
OECD	Organization for Economic Cooperation and Development
PPE	Personal Protective Equipment
SCOUL	Sugar Corporation of Uganda Lugazi
TDS	Total Dissolved Solids
USAID	United States Agency for International Development

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CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

Industrialization in Uganda is on a rapid increase and occupies an integral part of its social and economic development plan Vision 2040 (United Nations Economic Commission for Africa, 2018). However, new problems linked to industrialization are emerging, for example rising greenhouse gas emissions, air and water pollution, growing volumes of waste, desertification and chemicals pollution (Ahuti, 2015). It is for this cause that industrial processes in Uganda are required to comply with certain practices which could help in maintaining environmental integrity.

These requirements are reflected in a number of environmental regulations for example the National Environment (Standards for Discharge of Effluent into Water or on Land) Regulations 1999 and the National Environment (Waste Management) Regulations 1999. To achieve compliance with these regulations, there is need for enforcement and promotion of compliance by the regulatory authority.

Enforcement of environmental law is the set of actions that governments or its agencies and other stakeholders take to achieve compliance within the regulated community and to correct or halt situations that endanger the environment or public health (Matovu, 2006).In Uganda; this is done through inspections, negotiations and legal action. However, the insufficient resources to carry out enforcement by the regulating authorities pose a challenge in achieving compliance. In this view, regulatees often opt to undertake self-regulation as a tool for ensuring compliance. Self-regulation can be defined as the system of organizational and technical measures put in place and financed by regulatees subject to environmental permitting or general binding rules, in order to ensure their compliance with regulatory requirements (OECD, 2007). This helps to optimize monitoring systems, and establish priorities for inspection by the authorities. In addition, this instrument combines public and private interests especially through reducing public spending on governmental compliance monitoring and minimizing environmental liabilities to the industry.

While this approach of ensuring environmental sustainability is growing, in Uganda little is known about self-regulation among industrial players. It is against this background that the researcher opted to study the effectiveness of self-regulation interventions in the sugar manufacturing industry, using Sugar Corporation of Uganda Lugazi (SCOUL) as a case study. SCOUL is a sugar manufacturing company and relies on the River Musamya for water to carry out the industrial processes and also for discharge of effluent from the factory. Basing on this, the study investigated whether the self-regulation interventions at SCOUL promote compliance to the standards for effluent discharge as per National and International legislation. Five parameters were considered for the study and they included PH, temperature, electrical conductivity, biological oxygen demand as well as chemical oxygen demand.

1.2 Statement of the problem

Uganda's hope, like other developing countries to ensure compliance with the environmental regulations is highly dependent on efforts of local authorities, pressure groups and the self-management by industries. In this respect, some industries have undertaken self-monitoring as a corporate social responsibility operation to ensure compliance with environmental regulations.
Although it is increasingly clear that corporations have widely adopted self-regulatory structures, it is not clear whether these have improved legal compliance (Jodi and Toffee, 2010).

1.3 Objectives

1.3.1 General objective

To contribute more knowledge about the effectiveness of self-regulation so as to enhance its increased adoption among manufacturing industries in Uganda.

1.3.2 Specific objectives

1. To determine the factors motivating Sugar Corporation of Uganda Lugazi (SCOUL) to implement self-regulation environmental interventions.
2. To determine self-regulation environmental interventions implemented by SCOUL.
3. To assess effluent water quality at SCOUL plant.

1.4 Hypotheses

Objective 3

1. **Ho.** There is no significant difference between the properties of the effluent water and the national standards for effluent discharge.
2. **Ho.** There is no significant difference between the effluent water parameters on weekdays and weekends.

1.5 Research questions

1. Why is self-regulation a desired compliance monitoring tool by SCOUL?
2. What self-regulation interventions are implemented by SCOUL?
3. How effective are the self-regulation interventions by SCOUL on effluent quality?

1.6 Significance of the study

The findings from the study will be useful in providing the regulating authorities with information about the effectiveness of using self-regulation in sugar production. This may be useful in the revision of the enforcement and compliance monitoring strategies and procedures in the sugar manufacturing industries.

The study will also inform the manufacturing industry about the benefits of the approach so as to facilitate greater adoption by more industries.

Above all, the study will facilitate better understanding of the need to ensure environmental sustainability by both the regulating authorities and industrial players. This will enhance the country's strategies to achieve the UN-SDGs, especially with regard to ensuring sustainable management of water (SDG 6), as well as addressing the impacts of climate change through ensuring water availability for adaptation to the impacts related to water stress.

CHAPTER TWO: LITERATURE REVIEW

2.1 Interpretation of Self-regulation

In an era of mounting regulatory demands and shrinking regulatory budgets, government agencies have encouraged companies to adopt self-regulatory structure in the hope that they will increase compliance and achieve regulatory goals (Short and Toffel, 2010). Self-regulation, according to OECD (2007), can be defined as the system of organizational and technical measures put in place and financed by regulatees subject to environmental permitting or general binding rules, in order to ensure their compliance with regulatory requirements.

Industry self-regulation in the perspective of social self-regulation is usually taken to include mechanisms whereby firms or their associations, in their undertaking of business activities, ensure that unacceptable consequences to the environment, the workforce, or consumers and clients, are avoided (Neil and Rees, 1997).

According to Rees (1988), there are three main forms of self-regulation. One is voluntary self-regulation, which pictures rule making and enforcement both carried out privately by the firm or industry itself, independent of direct government involvement. The second is mandated full self-regulation, where both rule making and enforcement are privatized and the private regulatory program is officially sanctioned by the government, which monitors the program, and if necessary, will take steps to ensure its effectiveness. The third is mandated partial self-regulation which limits privatization to either regulatory function or enforcement, but not both.

In Uganda, self-regulation is provided for in regulations such as the Environmental Impact Assessment Guidelines, whereby the developers themselves are encouraged to monitor the impact of their activities and other times, enforcement monitoring done by government agencies such as National Environment Management Authority through environmental inspectors (MATLAB, 2006).

2.2 Motivation of self-regulation

Tietenberg and Wheeler (1998) noted that 'Over time...it became clear that these traditional regulatory approaches to pollution control were excessively costly in some circumstances and incapable of achieving the stipulated goals in others. They add that even the addition of market - based approach...has not fully solved the problem of pollution regulation.

Recognition of all these challenges could therefore have contributed to the growing interest among industries and even government regulators to adopt the self-regulation approach. What makes self-regulation attractive to regulators is that its costs are not borne (directly) by government. Some even argue that the absence of compulsion is important, primarily because some sectors of the community are strongly resistant to government intervention (Stoeckl, 2004). ACCC (1995) adds that self-regulation can be considerably less costly to tax payers than government-imposed regulations and offers the (theoretical) opportunity for least-cost/efficient solutions to a wide range of problems.

In a few cases, certification has become a condition of doing business: for example, some mines supply materials to manufacturers who require their suppliers to be ISO-certified. More typically, however, mining companies sign-up to these schemes because of the reputational benefit to be derived from participating (Brereton, 2002).

According to Williams & Montanari (1999), Self-regulation has diverse roots. To some extent it is rooted in neo-liberal beliefs that individual decision making, based on self-interest, is the most effective means of achieving predetermined goals, including consumer satisfaction. Such views are partly rooted in Von Hayek's (1988) writings emphasizing that maximizing individual freedom to take decisions, without state interference, allows markets to work more effectively in the service of individual interests.

A less extreme justification of self-regulation lies in the belief that, in western economies, there are limits to state regulation, for the latter tends to be more effective in the imposition of negative controls than in eliciting positive behavior by either consumers or producers.

A third, entirely pragmatic, argument stresses that self-regulation will be effective where the parties perceive the alternative to be greater, and potentially more constraining, state-imposed regulation.

There are three main groups of criteria which firms are assessed against, and these can be seen as conformity, embeddedness and formalization:

- Conformity: adherence to all formal state laws and regulations on the environment.
- Embeddedness: use of local products.
- Formalization: having in place environmental policies for waste treatment, air quality, energy use, the soil, transport and noise, and information provision for visitors and staff.

The identification of self-interest with this programme of largely self-regulation is reinforced by the high level of local ownership of resources and general acceptance of the marketing advantages of a higher environmental quality tourism product.

In Uganda, self-regulation is driven by requirements in environmental regulations such as the National Environment Act of 2019, which provides that the authority shall, in consultation with a lead agency, monitor the operation of any industry, project or activity with a view to determining its immediate and long-term effects on the environment. The Act prohibits environmental pollution contrary to the standards or guidelines set by NEMA and thus operators must ensure that they comply with the environmental pollution standards and guidelines (Kasimbazi, 2012).

Among these standards are air quality standards**,** water quality standards, standards for the discharge of effluent into water, standards for the control of noxious smells, standards for the control of noise and vibration pollution, soil quality standards and solid waste disposal.
According to Sharma et al, (2010), in some cases an industry perceives that it must police itself because governments are involved too little or government intervention is perceived as a threat and see regulatory actions are a means to prevent or forestall outside regulations. Social movement activists have similarly encouraged corporations to adopt self-regulatory structures in areas in which formal legal remedies are weak or nonexistent, like international labor and environmental standards (Bartley, 2003; Davis et al., 2008; Reid and Toffel, 2009)

On the other hand, organizations and their individual members are also motivated by a complex set of normative concerns. Organizations might comply with the law to demonstrate their legitimacy (Meyer and Rowan, 1977; DiMaggio and Powell, 1983; Edelman and Suchman, 1997), because they have come to see compliance as integral to their corporate culture or identity (Selznick, 1969; Howard-Grenville, Nash, and Coglianese, 2008), or simply because individuals within the organization believe it is the right thing to do (Morrison, 1991; Coglianese and Nash, 2001a; Gunningham, Thornton, and Kagan, 2005; Tyler, Callahan, and Frost, 2007). Successful regulatory design must recognize and engage these diverse motivations (Ayres and Braithwaite, 1992; Parker, 2006).

The most important motivation for companies to engage in self-regulation is self-interest to gain a positive image, prevent reputational and economic damage or prevent stricter regulation (Van

Driel, 1989). For the regulated community, reliable data on emissions, and the environmental impact of their production, can be significant from an economic viewpoint. This data helps better identify and reduce environment-related costs and minimize environmental liabilities. Disclosure of facility-specific data can help citizens to take individual decisions that affect not only their health but also economic well-being, such as where to buy property. Other industries are also motivated by the various benefits associated with it, for example Self-monitoring data can provide a basis for verification of compliance with legal requirements and enforcement, and for calculation of environmental or administrative charges (OECD, 2007). They also help to optimize national, regional, and local ambient monitoring systems, and establish priorities for inspection.

2.3 Self-regulation implementation

According to OECD (2007), self-regulation implementation starts with the development of self-monitoring programs and the monitoring may be targeted towards operation (process) monitoring, emissions monitoring or impact monitoring.

A self-regulation programme will be designed proceeding from the need to obtain the most relevant information on the compliance status and it aims at both the quality of the results and the cost-effectiveness of data collection, management, and analysis. Before self-regulation begins, operators and authorities will develop a clear understanding of why the self-regulation programme is necessary. The objectives will be documented at the start, and kept under systematic review. Over time, the self-regulation data will regularly be compared with the programme objectives to check that they are being met.

This program specifies the aim of self-regulation, responsibilities of the various players, identifying the scope of the exercise, monitoring requirements, clarifying the recording and reporting requirements, as well as the compliance assessment procedures and non-compliance response.

OECD (2007) adds that self-regulation involves the following;

- Monitoring of: (i) operations; (ii) emissions and other impacts regulated by permits or general binding rules; (iii) ambient conditions in the vicinity of the facility concerned with a scope that would optimally balance environmental effectiveness with costs of monitoring.
- Record keeping of data obtained through monitoring of any unforeseen circumstances, non-compliance episodes, corrective measures, and complaints from the general public.

- Providing reports to the competent authorities in mandated cases with a specified regularity, and in a duly aggregate form.
- Other internal measures, such as providing basic environmental training and conducting self-inspection.

Besides analysis and reporting, the operator will have to take actions for improvement when self-monitoring data show noncompliance with regulatory requirements.

It should be noted however, that self-monitoring does not change the duty of the competent authorities to assess compliance by means of inspection, and by using its own monitoring data. The accuracy and reliability of self-monitoring systems will influence the frequency of inspection.

2.4 Effectiveness of self-regulation

Literature on the effectiveness of intra-firm regulatory mechanisms is relatively scarce and this could be because these internal systems are relatively new and still evolving.

One empirical study of the effectiveness of self-regulation discussed by Tietenberg and Wheeler, (1998), is that of 'PROPER' – a programme for pollution control, evaluation and rating-initiated by Indonesia's National Pollution Control Agency. PROPER rates and publicly discloses the environmental performance of Indonesian factories. 'The data suggest that PROPER's . . . implied cost is about . . . $1/day. . . . Recalling that the previous regime was almost totally ineffective, it is difficult to avoid the conclusion that PROPER has been very successful in improving environmental performance at very low public cost.' (Brereton, 2002).

However, different people bear different perceptions about the effectiveness of this tool. According to proponents, the benefits of industry self-regulation are apparent: speed, flexibility, sensitivity to market circumstances and lower costs (Neil and Rees, 1997). In addition, there is also the potential for utilizing peer pressure and for successfully internalizing responsibility for compliance and raising standards of behavior.

On the other hand, critics say, self-regulation often fails to fulfill its theoretical promise, more commonly serving the industry rather than the public interest (Neil and Rees, 1997). They claim that regulatory standards are usually weak, enforcement is ineffective and punishment is secret and mild.

Self-regulation is frequently an attempt to deceive the public into believing in the responsibility of an irresponsible industry. Sometimes it is a strategy to give the government an excuse for not doing its job (Braithwaite, 1993: 91).

According to Brereton, (2002) the standard complaint from critics is that most of the schemes lack effectiveness because: (a) the companies that sign up are normally the better performers to begin with; (b) there are few consequences for those companies which do not participate in the schemes; (c) the schemes often lack specificity and independent verification processes, which makes it relatively easy for signatories to evade the spirit, if not the letter, of the document; and (d) there are no effective sanctions for those companies which sign and then fail to comply with requirements.

CHAPTER THREE: METHODOLOGY

3.1 Description of the study area

The study was conducted at SCOUL factory, one of the largest sugar manufacturing companies in Uganda, milling over 1,583 tons of sugar cane per day that is located in Lugazi town in Buikwe District. The factory obtains water from River Musamya and then returns the waste water after treatment, back to the river. Due to this, a number of water pollution issues have arisen in the past from the surrounding communities as concluded by Turinayo (2013). Turinayo stated that the results of his study showed that pollutant concentration in effluent from SCOUL were above permissible discharge limits by NEMA. In response to this, the factory adopted self-monitoring to ensure compliance to the environmental standards and regulations to prevent environmental pollution.

3.2 Research design

The study applied the descriptive and exploratory designs, where information was collected in an informal and unstructured manner. According to Hale (2018), the descriptive design is one that describes the details of the topic without prediction or explanation and includes the observational, case study and survey methods. These methods helped down scale and prioritize aspects to be studied. On the other hand, the exploratory design focuses on explaining the aspects studied and its adoption was due to the fact that self-regulation has not been well researched before and the findings can be used to conduct further research by future researchers. The flexibility of the data sources while using the exploratory design was also an added advantage, for example literature reviews, depth interviews and case analysis could be applied.

Both qualitative and quantitative approaches were used and the qualitative research approach involved a combination of desk reviews of existing documents, interviews with recordings and observations accompanied by photography. Purposeful and snowball sampling was used to identify relevant information sources, while semi-structured interviews were used to ensure detailed discussions about the topic. The interviews involved key informants who were all members of the Environment Health and Safety department of the company, determined by purposeful sampling

Quantitative data was obtained through sampling of treated waste water at three different times of a day, for three days. The three sampling times per day were divided into morning, afternoon and evening and these were to help minimize errors in obtaining the mean daily effluent parameter value while the sampling days were selected by dividing the week into weekdays and weekend. This was aimed at finding out the possibilities of non- compliance by the industry on some days of the week probably due to the limited chances of the National Environment Management Authority inspections on such days. However, due to the limited access to the plant, two weekdays were selected; one at the start of the week (Monday) and the other later in the week (Thursday), and the Saturday was selected for the weekend. Water analyses were then done, with physical parameters being tested onsite while the bio-chemical parameters were analyzed at the National Water and Sewerage Corporation (NWSC) laboratory in Bugolobi.

It should be noted, however, that the biochemical parameters were tested only once for each day due to the expenses involved in the laboratory analysis.

3.3 Sample collection

Sampling of the effluent discharged involved the composite sampling method and specifically the time-proportional samples as stated in OECD (2007). Here a fixed amount of sample is taken for each time unit and an average value of the parameter during the period over which the sample was collected can then be obtained.

Samples of the effluents discharged from the Effluent Treatment Plant (ETP) of the factory were collected at the point of discharge where the effluent was fast running to ensure proper mixing and homogeneity of the sample. The samples were taken in the mornings (9:00am), afternoons (2:00pm) and evenings (5:00pm) each day, for three days (2 weekdays and 1 weekend) for one week. Due to the presence of only one point of discharge for the factory’s ETP, the sampling resulted into three samples per day and a total of nine samples over the study period.

The samples were collected in half litre (500ml) plastic bottles rinsed with distilled water and then with an appropriate amount of sample, before final sample collection. The sample bottles were fully filled tightly sealed and then kept in darkness before being taken to the National Water and Sewerage Corporation laboratory in Bugolobi for analysis.

The parameters considered for this research were pH, temperature, Electrical Conductivity (EC), Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) and these were selected from those indicated on the waste water discharge permit of the factory, suggesting that they are vital and thus can be studied. On-site data for pH, temperature and EC was taken using the Wagtech Maji Meter, a multi parameter meter while data for the bio-chemical parameters (BOD and COD) were obtained from laboratory analytical tests.

3.4 Data analysis

Being an applied policy research, the study employed both qualitative and quantitative data analysis methods, as stated by Yin (2003), ‘’…..The use of multi methods not only provides a more in-depth data set but also allows the researcher to validate findings and thus increase the reliability of the findings.

3.41 Qualitative data analysis

The qualitative data for objectives 1 and 2, was collected, recorded and analyzed using the framework approach, as recommended by Srivastava and Thomson (2009). The flexibility of the framework analysis allowed for the analysis of data after all the required data has been collected.

Ritchie and Spencer (1994) state that the framework approach involves a five step process: 1. familiarization; 2. identifying a thematic framework; 3. indexing; 4. charting; and 5. mapping and interpretation.

Familiarization refers to the process during which the researcher becomes familiarized with the transcripts of the data collected and gains an overview of the collected data (Ritchie & Spencer, 1994). It starts with transcription of the recorded data and then the researcher will become aware of key ideas and recurrent themes and make a note of them.

Identifying a thematic framework involves recognizing emerging themes or issues in the data set. The researcher uses the notes taken during the familiarization stage and the key issues, concepts and themes that have been expressed by the participants now form the basis of a thematic framework that can be used to filter and classify the data (Ritchie & Spencer, 1994).

Indexing means that one identifies portions or sections of the data that correspond to a particular theme. This process is applied to all the textual data that has been gathered (i.e. transcripts of interviews). For the sake of convenience, Ritchie and Spencer (1994) recommend that a numerical system be used for the indexing references and annotated in the margin beside the text.

During Charting, the specific pieces of data that were indexed in the previous stage are now arranged in charts of the themes. This means that the data is lifted from its original textual context and placed in charts that consist of the headings and subheadings that were drawn during the thematic framework. Gale et al. (2013) adds that a spreadsheet is used to generate a matrix and the data are 'charted' into the matrix. Charting involves summarizing the data by category from each transcript. Good charting requires an ability to strike a balance between reducing the data on the one hand and retaining the original meanings and 'feel' of the interviewees' words on the other.

The final stage, mapping and interpretation, involves the analysis of the key characteristics as laid out in the charts. This analysis should be able to provide a schematic diagram of the event/phenomenon thus guiding the researcher in their interpretation of the data set.

3.42 Sample Analysis

3.421 Physical properties of wastewater

The physical properties of pH, temperature and electrical conductivity were measured and recorded using a hand-held multi-meter. The reading was taken at three different times of the day and the average recorded as the final parameter reading for the day.

3.422 Laboratory analysis

The analysis of the BOD and COD was carried out at the NWSC laboratories in Bugolobi.

3.423 Quantitative data analysis

A Student T-test was used to test the difference of the weekday and weekend results of the properties of the effluents discharged using a 5% level of significance. The mean daily values of the parameters were compared with the national standards for effluent discharge to determine compliance on the particular days.

CHAPTER FOUR: FINDINGS

4.1 Factors motivating SCOUL to implement self-regulation environmental interventions

The interviews conducted revealed that pressure from the local communities due to pollution of the river Musamya waters by effluents discharged from the factory was one of the major factors that brought about the implementation of the interventions. This was then backed up by the national environmental regulations that required specific levels of parameters of the effluents discharged although there were limited authority inspections. The desire to prevent more strict regulation by the national authorities inspired the adoption of interventions.

SCOUL is also certified by the International Organization for Standardization and thus complies with ISO standards for example the ISO 9001 for quality management, ISO 14000 for environmental management and the Occupational Health and Safety Assessment Series for occupational health and safety. To meet the various requirements in these standards, the factory then identified the need for various interventions. This would also in turn improve the company's legitimacy.

Being an international company, SCOUL also adopted self-regulation interventions to improve on its competitiveness with other sugar manufacturing industries. This would also bring with it reputational benefits through tourism and research and in turn prevent economic and environmental losses.

There were also complaints from employees regarding their safety and health while at the work place and this also prompted the implementation of some interventions for the promotion of the occupational health and safety.

4.2 Self-regulation environmental interventions implemented by SCOUL

Field observations and interviews conducted revealed that there were various interventions implemented within the factory processes to ensure compliance to the national regulations and standards while also achieving efficiency. With the effluents discharged from the factory, there was a fully functioning effluent treatment plant from which hourly sampling is carried out at three different points, that is, the inlet, anaerobic pond, as well as the aerobic pond.

This is accompanied by daily laboratory analysis of the samples and then record keeping. From this, daily, weekly, monthly and quarterly reports are made.

Self-inspections and daily housekeeping is also carried out to ensure a safe environment for the staff. This is then backed up by the use of Personal Protective Equipment (PPEs) and staff trainings in occupational health and safety. Noise levels are also measured using a portable noise level meter to prevent noise pollution.

To prevent leakages and improve efficiency, machines and equipment are regularly monitored and maintained. Other interventions to achieve this include installation of mechanical dust collectors (MDCs) and use of a spray pond for cooling water that is later recycled.

Regarding solid waste disposal at the factory, a biogas digester and compost plant is used to ensure zero waste disposals.

4.3 Effluent water quality at SCOUL plant

Effluent sampling and analysis (both on-site and off-site) provided results that are summarized in table 1:

Table 1: Results of the samples taken at the different times of the sampled days during the study period.

DAILY RECORDINGS						
DAY	**TIME**	**PH**	**TEMPERATURE**	**EC**	**BOD**	**COD**
SATURDAY	**9:00**	8.17	26	800	21	320
	2:00	8.06	26	421	_	_
	5:00	8.09	25.9	846	_	_
MONDAY	**9:00**	8.01	26.76	792	_	_
	2:00	8.19	26	448	18.6	250
	5:00	8.19	26	889	_	_
THURSDAY	**9:00**	8.19	26.3	854	_	_
	2:00	8.15	25	503	_	_
	5:00	8.12	25.3	554	25.2	102.5

Table 2: Mean daily parameter values of the samples taken.

AVERAGED DAILY RECORDINGS					
DAY	**PH**	**TEMPERATURE**	**EC**	**BOD**	**COD**
SATURDAY	8.107	25.97	689	21	320
MONDAY	8.13	26.25	709.67	18.6	250
THURSDAY	8.153	25.53	637	25.2	102.5

Comparison of the means of the sample data and the national standards for effluent discharge

The mean daily parameter values were analyzed and compared with the national standards for effluent discharge as presented below:

Table 3: Comparison of the observed data with the national standards.

	PERMISSIBLE LIMITS	**OBSERVED VALUES**		
		SATURDAY	**MONDAY**	**THURSDAY**
PH	6 (standard for acidity) 8 (standard for alkalinity)	8.107	8.13	8.153
TEMPERATURE	20^0C (lower standard limit) 35^0C (upper standard limit)	25.97	26.25	25.53
EC	1500 µS	689	709.67	637
BOD	50 mg/l	21	18.6	25.2
COD	100 mg/l	320	250	102.5

PH

Comparison of the mean daily PH values with national standards for effluent discharge showed that for all the three days, the factory discharged effluent from the effluent treatment plant with pH above the standard limit for acidity. However, the standard limit for alkalinity was slightly exceeded by <0.2 on all the days. Therefore, for all the days, the factory discharged effluent that met the standard limit for acidity but exceeded the standard limit for alkalinity.

TEMPERATURE

Comparison of the mean daily temperature values with national standards for effluent discharge showed that for all the three days, the factory discharged effluent from the effluent treatment plant with temperature above the lower discharge standard of 25^0C and below the higher permissible limit of 35^0C. Therefore, for all the days, the factory discharged effluent that met the national standards for effluent discharge with respect to temperature.

ELECTRICAL CONDUCTIVITY

Comparison of the mean daily EC values with national standards for effluent discharge showed that for all the three days, the factory discharged effluent from the effluent treatment plant with EC below the maximum permissible limit of 1500µS. Therefore, for all the days, the factory discharged effluent that met the national standards for effluent discharge with respect to electrical conductivity.

BIOLOGICAL OXYGEN DEMAND (BOD)

Comparison of the mean daily BOD values with national standards for effluent discharge showed that for all the three days, the factory discharged effluent from the effluent treatment plant with BOD below the maximum permissible limit of 50mg/l. Therefore, for all the days, the factory discharged effluent that met the national standard for effluent discharge with respect to BOD.

CHEMICAL OXYGEN DEMAND (COD)

Comparison of the mean daily COD values with national standards for effluent discharge showed that for all the three days, the factory discharged effluent from the effluent treatment plant with COD above the maximum permissible limit of 100mg/l. Therefore, for all the days, the factory discharged effluent that did not comply with the national standards for effluent discharge with respect to COD.

T-test results between the weekday and weekend results of the properties of the effluents discharged

PH: The results of the t-test between Saturday (weekend) and the week days (Monday and Thursday) showed that there was no significant difference between the PH values of the weekend and week days, at the significance level of 0.05. The P values of 0.76 and 0.31 for the Monday and Thursday tests respectively, both showed no significant difference between the days' sample data.

Temperature: The results of the t-test between Saturday (weekend) and the week days (Monday and Thursday) showed that there was no significant difference between the temperature values of the weekend and week days, at the significance level of 0.05. The P values of 0.378 and 0.386 for the Monday and Thursday tests respectively, both showed no significant difference between the days' sample data.

EC: The results of the t-test between Saturday (weekend) and the week days (Monday and Thursday) showed that there was no significant difference between the electrical conductivity values of the weekend and week days, at the significance level of 0.05. The P values of 0.918 and 0.779 for the Monday and Thursday tests respectively, both showed no significant difference between the days' sample data.

BOD: The results of the t-test between Saturday (weekend) and the week days (Monday and Thursday) showed that there was no significant difference between the BOD values of the weekend and week days, at the significance level of 0.05. The P values of 0.936 and 0.904 for the Monday and Thursday tests respectively, both showed no significant difference between the days' sample data.

COD: The results of the t-test between Saturday (weekend) and the week days (Monday and Thursday) showed that there was no significant difference between the COD values of the weekend and week days, at the significance level of 0.05. The P values of 0.871 and 0.584 for the Monday and Thursday tests respectively, both showed no significant difference between the days' sample data.

CHAPTER FIVE: DISCUSSION

5.1 Factors motivating SCOUL to implement self-regulation environmental interventions.

The data suggests that self-regulation is a desired compliance monitoring tool due to a variety of factors that may be local (both within and outside the factory), national and even international. Locally, the factors included occupational health and safety and pollution prevention while the national ones included requirements in national environmental regulations, competition with other sugar manufacturing companies as well as the need to prevent stricter regulation by the authorities. On the international basis, the factors included requirements in the ISO standards, competition on the world market as well as the reputational benefits that come with it.

These results are in agreement with findings from earlier researchers such as the argument on authority regulation by Stoeckl (2004) as well as the idea of economic and reputational benefits by Van-Driel (1989). However, besides pollution prevention as stated by Tietenberg and Wheeler (1998), the study identified that past experience from losses also plays a big role in the decision to implement self-regulation interventions. These losses could have resulted from fines or impacts of degradation of the surrounding environment as the case was with River Musamya pollution by effluents discharged from SCOUL, as reported by Turinayo (2013). This shows that there is need to take into account past experiences or lessons from other parties when deciding on the adoption of self-regulation in the manufacturing industry.

The results of the study fit the theory of Neil and Rees (1997) that indicated the potential for peer pressure and for successfully internalizing responsibility for compliance in motivating adoption of self-regulation by industries.

It cannot be concluded however that these are the only factors since only key informants from within the same department (Environment Health and Safety) of the factory were interviewed. However, the results are nonetheless valid since this department is the one responsible for formulating environmental policies and implementing self-regulation interventions.

5.2 Self-regulation environmental interventions implemented by SCOUL

The results indicate that the interventions implemented are in response to requirements in national environmental regulations as well as the ISO standards. These regulations and standards include air quality standards, water quality standards, standards for discharge of effluent into water, standards for the control of noxious smells, standards for the control of noise and vibration pollution, soil quality standards, solid waste management, as well as requirements in the ISO 14000 for Environmental Management Systems as well as the Occupational Health and Safety Assessment Series. The interventions implemented include effluent treatment plant (ETP), hourly effluent sampling and analysis, self-inspections, daily housekeeping, staff training, noise level monitoring, equipment maintenance, spray pond, biogas compost pant, record keeping as well as report making.

In line with OECD (2007), the factory emphasizes record keeping and report making for continuous review and ensuring that the self-regulation programme objectives are being met. The reports are made daily, weekly, monthly in preparation for the quarterly reports to be presented to the National Environment Management Authority, as required by the regulations. However, in addition to record keeping, the study identified that the industry also employs cleaner production practices as part of the self-regulation interventions. For instance, daily housekeeping, installation of mechanical dust collectors and use of a spray pond, aid in preventing pollution through minimizing waste and promoting efficiency. Basing on the case study approach employed in the research, there could be more possible interventions, other than those identified by the study, employed by the various industries that have adopted self-regulation. For example The Coca-Cola Company in Brazil (TCCC) started commissioning its own audits on its sugar suppliers. A Supplier's Guiding Principles was instituted and it requires that its first and second-tier suppliers adopt responsible workplace practices, comply with local labor and environmental laws, and respect international human rights standards. With this, farms provide workers with personal safety equipment and the employees in sugar mills operate in shifts. The personal safety equipment reduces accidents and absenteeism while better-trained employees can acquire necessary skills such as monitoring quality levels, keeping production logs, and implementing statistical process controls (Coslovsky and Locke, 2013).

However, the results of this research remain appropriate as the study is specific to a given case, that is, SCOUL.

5.3 Effluent water quality at SCOUL plant

The analysis confirms that the self-regulation interventions implemented by SCOUL are effective basing on the results from the sample data collected.

The comparison of the studied parameters with the permissible limits according to national standards indicated that the standards for effluent discharge were met on all the days except for the standard limit for alkalinity. The comparison of the weekdays and weekend also showed that there was no significant difference between the days' sample data.

The non-conformity with the standard limit for alkalinity was suspected to be due to excessive amounts of lime ($Ca(OH)_2$) added to the effluent while in the neutralization pond. The impact of this was however not significant as the error was less than +0.2. This could also be attributed to possible leakages but since there were none identified at the time, then the lime proves a better explanation.

The results contradict the claims of some critics like Neil and Rees (1997) and Braithwaite (1993). Neil and Rees claim that self-regulation often fails to fulfill its theoretical promise, serving the industry rather than the public interest. But considering the compliance to effluent discharge standards, the public equally benefits. On the other hand, Braithwaite's claims that self-regulation is an attempt to deceive the public into believing in the responsibility of an irresponsible industry are equally invalid since the presence of the effluent treatment plant also gives better quality of the effluent discharged from the factory into the river. These results should therefore be taken into account when considering the effectiveness of self-regulation interventions with regards to the environment.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS.

6.1 CONCLUSION

From this study, the following conclusions can be made:

i. Adoption of self-regulation as a compliance monitoring tool by the sugar manufacturing industries is largely driven by requirements in national and international regulations and standards, reputational benefits as well as the desire to prevent economic and environmental losses.
ii. Lessons from past experience, especially in the case of violation of environmental rights of the surrounding communities as well as employees were also a driving factor in the adoption of self-regulation in SCOUL.
iii. The self-regulation environmental interventions implemented at SCOUL were in response to national and international requirements in regulations and standards for example air quality regulations, water quality regulations, and solid waste management regulations, EMS, OHSAS, among others.
iv. The interventions included ETPs with periodic analysis of the effluents discharged, noise level measurement and use of MDCs to prevent air pollution, use of a biogas digester and compost plant for zero solid waste, and finally adoption of PPE use and staff trainings to ensure safety of employees.
v. With respect to the quality of the effluent discharged, the self-regulation environmental interventions employed are effective in ensuring compliance to the national standards for effluent discharge on all days throughout the week. However, some deviations were identified with respect to the standard limit for alkalinity and this was attributed to irregularities in the management of the ETP.
vi. Comparison of the samples collected on weekdays and weekend also showed no significant difference between the effluent water parameters analyzed thus suggesting that SCOUL maintains similar standards in ensuring self-regulation in both weekdays and weekends.

6.2 RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

i. Regulatory authorities should strengthen enforcement of the regulations and policies in place especially through regular and thorough inspections to ensure validity of the reports submitted by the industries.
ii. Sugar manufacturing industries that have not yet adopted self-regulation should take it on so as to realize the associated economic and environmental benefits as well as contribute towards the sustainable development of Uganda and the globe at large.
iii. Further research should also be conducted in other sugar manufacturing industries to improve on the information available about self-regulation in this industry. During the research, considerations should be put on collecting samples at night for those industries that operate at night.

ANNEX

Annex 1: Student T-test for the weekday and weekend results of the properties of the effluents discharged using a 5% level of significance.

	SATURDAY - MONDAY		SATURDAY - THURSDAY	
PH	t Stat	-0.341159125	t Stat	-1.209415796
	P(T<=t) two-tail	0.755480196	P(T<=t) two-tail	0.313118187
	t Critical two-tail	3.182446305	t Critical two-tail	3.182446305
TEMPERATURE	t Stat	-1.121908808	t Stat	1.098700531
	P(T<=t) two-tail	0.378506284	P(T<=t) two-tail	0.386492068
	t Critical two-tail	4.30265273	t Critical two-tail	4.30265273
EC	t Stat	-0.108871833	t Stat	0.299616859
	P(T<=t) two-tail	0.918547135	P(T<=t) two-tail	0.779393255
	t Critical two-tail	2.776445105	t Critical two-tail	2.776445105
BOD	t Stat	0.085552935	t Stat	-0.12803688
	P(T<=t) two-tail	0.935932953	P(T<=t) two-tail	0.904298898
	t Critical two-tail	2.776445105	t Critical two-tail	2.776445105
COD	t Stat	0.172380332	t Stat	0.647292045
	P(T<=t) two-tail	0.871508913	P(T<=t) two-tail	0.583817798
	t Critical two-tail	2.776445105	t Critical two-tail	4.30265273

Annex 2: Standards for discharge of effluent or waste water

Maximum Permissible Limits

1. 1,1,1, -trichloroethane ------------- 3.0 mg/1

2. 1,1,2.- dichloroethyelene ---------- 0.2 mg/1

3. 1,1, 2, -Trichloroethne ------------ 1.06 mg/1

4. 1,2- Dichloroethane --------------- 0.04 mg/1

5. 1,3- dichloropropene -------------- 0.2 mg/1

6. Aluminum -------------------------- 0.5 mg/1

7. Ammonia Nitrogen ---------------- 10 mg/1

8. Arsenic ----------------------------- 0.2 mg/1

9. Barium ----------------------------- 10 mg/1

10. Benzene -------------------------- 0.2 mg/1

11. BOD5 ----------------------------- 50 mg/1

12. Boron ----------------------------- 5 mg/1

13. Cadmium ------------------------- 0.1 mg/1

14. Calcium -------------------------- 100 mg/1

15. Chloride ------------------------- 500 mg/11

16. Chlorine --------------------------- 1 mg/1

17. Chromium (total) ---------------- 1.0 mg/1

18. Chromium (VI) ------------------ 0.05 mg/1

19. Cirrus- 1,2 - dichloroethylene -- mg/1

20. Cobalt ------------------------------ mg/1

21. COD -------------------------------- 100

22. Clifford Organisms---------------- 10,000 counts/100 ml

23. Color ------------------------------ 300 TCU

24. Copper --------------------------- 1.0 mg/1

25. Cyanide -------------------------- 0.1 mg/1

26. Detergents ----------------------- 10 mg/1

27. Dichloromethane ---------------- 0.2 mg/1

28. Iron ------------------------------ 10 mg/1

29. Lead ----------------------------- 0.1 mg/1

30. Magnesium --------------------- 100mg/1

31. Manganese --------------------- 1.0 mg/1

32. Mercury ------------------------- 0.01 mg/1

33. Nickel ---------------------------- 1.0 mg/1

34. Nitrite - N ----------------------- 20 mg/1

35. Nitrite - N ------------------------2.0 mg/1

36. Nitrogen total ------------------ 10 mg/1

37. Oil and Grease ---------------- 10 mg/1

38. pH -------------------------------- 6.0-8.0

39. Phenols ------------------------- 0.2 mg/1

40. Phosphate (total) -------------- 10 mg/1

41. Phosphate (soluble) ----------- 5.0 mg/1

42. Selenium ------------------------1.0 mg/1

43. Silver ----------------------------0.5 mg/1

44. Sulfate ---------------------------500 mg/1

45. Sulfide -------------------------- 1.0 mg/1

46. TDS ---------------------------- 1200 mg/1

47. Temperature -------------------- 20-350C

48. Tetra Cholera ethylene -------- 0.1 mg/1

49. Tetrachloromethananc --------- 0.02 mg/1

50. Tin ------------------------------ 5 mg/1

51. Total Suspended Solids ------- 100 mg/1

52. Tricholoroethylene ------------- 0.3 mg/1

53. Turbidity ------------------------ 300 NTU

54. Zinc ----------------------------- 5 mg/1

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