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EXPLORING ENVIRONMENTAL IMPACTS AND RESPONSES IN THE CONDUIT TO SUSTAINABILITY ACCOUNTING IN AN AFRICAN COUNTRY

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ABSTRACT: *The purpose of this study is to explore environmental impacts and responses in Uganda, an African country where a sustainability accounting approach is of growing significance and relevance. This is still a relatively new field of practice as well as a new academic endeavor, and thus entails originality. Oil and petroleum and energy-sector activities are generally key ingredients in the fast-growing economy, and are in the categories of being high risk with immensely negative social and environmental impacts. Petroleum companies dominate the top taxpayers in the country, which justifies a focus on the oil industry sector. This study is conceived as an improvement on one of the objectives of a wider study by the first author that investigated the relations among legitimacy, marketing and environmental accounting practices, focusing on oil companies in Uganda. Data collection methods included analysis of the way in which environmental accounting is developed and assessment of the credibility of inputs at various levels. Other data collection methods included a review of companies' environmental reports/statements and ethnographic interviews at oil companies, formal and informal garages and filling stations. A questionnaire was also administered to 155 respondents drawn from 57 oil supply chains. Our major findings are that the main negative impacts on the environment in all oil marketing chains were soil and water pollution. There is an emphasis on profit margins at the expense of environmental factors in an equatorial country that induces climate change. The study results add to the body of knowledge on sustainability accounting to mitigate the environmental problems in place and minimize further occurrences. We suggest that future accountants need to understand and have knowledge of sustainability issues and how they can be captured in reports for a sustainable future.*

KEYWORDS: Africa, environment, impacts and resources, oil companies, sustainability accounting, Uganda

INTRODUCTION

The activities of petroleum companies and the energy sector generally are among those with the highest risk and greatest negative impacts on the environment (Sebastian and Hurting, 2005). They can be a resource curse and lead to patronage politics (McSherry, 2006), particularly in African countries. Nowadays environmental issues are more appreciated in our society and an

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increasing number of important stakeholders are concerned with them (Masanet-Llodra, 2006). Over the past 20 years, petroleum companies have continued to dominate the list of Uganda's top 20 taxpayers (Katusiime, 2008). Considering the current status of oil exploration in the country (Banfield, 2009), the gas and mineral exploration that has opened new horizons of growth, and recent developments in the sector that have important environmental implications, this study focuses on oil companies and their services. Indeed, the authors thought it would be gratifying to work towards eco-balancing (Burritt, 2005) for a sustainable future for the good of environmental progress. Economic results are not only a measure of the success of an organization but also have an impact on society; the environment could be detrimental to future prospects (Ashton, 2004) and this supports the development of more sustainable plans for oil exploration in the near future. As Manning (2013) argues, sustainability offers the potential to reduce the long-term risks associated with resource depletion, fluctuations in energy costs, product liabilities and pollution and waste management, and leads to organizations producing more and polluting less (Kritiporn, Panayotou and Charnprateep, 1990).

Thus, the principal objective of this study is to analyze the environmental impacts and mitigation measures of oil as a major industry in Uganda, a low-income country, in the conduit to sustainability accounting. According to Noordwijk *et al.* (2008), sustainability consists in finding ways to sustain the provision of goods and services. It is an effective means to prepare Africa's economies for the challenge of the detrimental effects of climate change, such as prolonged periods of drought and flooding, and to respond to barriers to trade. By negative impact on the environment we mean in this study the pollution of water, air and soils (Khan, 2008). In terms of the negative impacts, the research established that environmental problems are numerous and demonstrate significant differences. Examples of adverse environmental impacts are pollution and human loss (Boardman and Shaw, 1995); however, these are not new (Woodhouse, 2000). What probably are new are the mitigation measures, mechanisms and increased awareness. For instance, it is over 80 years since Mahatma Gandhi (1928) pointed out the environmental damage of industrialization, as cited by Chataway and Allen (2000). He stated:

God forbid that India should ever take to industrialization after the manner of the West. The economic imperialism of a single tiny island kingdom is today keeping the world in chains. If an entire nation of 300 million took to similar economic exploitation, it would strip the world base like locusts.

Thus, this investigation worked towards defining a well-informed baseline for providing oil services in an environmentally friendly fashion, particularly with respect to Uganda's oil industry as a major industry. According to KPMG's (1999) survey of environmental reporting, oil and gas were among the sectors that were the most high risk, heavy polluters and with high adverse environmental impact (Sebastian and Hurtig, 2005; Republic of Uganda, 2002). Oil and

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gas are also vital inputs into the productive and social sectors of Uganda's economy (National Environment Management Authority, 2004), spurring economic growth, creating employment, fostering technology transfer and generating revenue for investment (National Planning Authority, 2013). Dabbs (1996) states that one problem associated with oil lies in the damaging effects of production, distribution, transportation and use on the environment. The African Network for Environment and Economic Justice (2004) suggests that oil is one of the most sensitive commodities in the world in terms of dominating the economies of producing countries. Oil is a reason for civil conflicts and political instability in the case of Equatorial Guinea (McSherry, 2006). It brings in huge amounts of money, but the situation can also be catastrophic if an installation is sabotaged or burnt (Kato, 2007). The study by Aseto and Onga'ang'a (2003) found that garages, petrol stations and oil companies were the major sources of pollutants in the Lake Victoria Region. Uganda's oil sector has seen rapid growth since 1994 when the government adopted a policy of a free market economy, driven by the private sector. Aseto and Onga'ang'a point out that if you liberalize a market without control, adverse environmental impacts are the consequences. In addition, increased consumption led to licensing new oil companies involved in importing, retailing or both (Republic of Uganda, 2004).

Some of the newly established petroleum retail outlets and depots have been constructed within residential areas, commercial places and some water catchment areas vital for water filtering and purification, thus posing environmental problems and provoking public concern. Furthermore, consumption of petroleum products continues to increase, to counter the hydro-electricity deficit in Uganda (Tushabomwe-Kazooba and Kemeza, 2007), thus increasing imports and environmental problem areas. Despite this growing concern, very little systematic research focusing on oil companies in Uganda has been conducted to document the costs that oil developments are imposing on the environment. The supply industries are not being audited and the current exploitation of oil reserves in the country remains questionable.

As pointed out by Moyini, Muramira and Walaga (2003), while some progress has been made in environmental management in Uganda, significant challenges remain in some thematic areas, among which are environmental information systems. We point out that most of the previous research on environmental accounting practices has focused on the experience of companies in the developed world and the newly industrialized countries of the Asia-Pacific region, with limited studies carried out in African countries with the exception of South Africa (Villiers and Vorster, 1995; Tsang, 1998; Adams, Hill and Roberts, 1998; Kokubu and Nashioka, 2005; KPMG, 2005). A related study carried out in Uganda by Kisenyi and Gray (1998) was on a wide range of companies using reports from the Registrar of Companies. The present study concentrated on supply chains of oil and petroleum products, in addition to seeking views of those in the environmental accounting supply chain, especially environmental inspectors, auditors and District Environmental Officers.

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The findings indicate that the remarkable progress of the Ugandan economy since the mid-1990s accelerated the requirements for petroleum-related products and their associated damage to the environment. Furthermore, the country's recent discovery of petroleum resources in the Albertine Graben area will potentially have positive impacts on its development. Several studies, however, conclude that oil and gas exploration, development, production, transportation and processing activities carry with them a number of major adverse environmental impacts (Sebastian and Hurtig, 2005; Akeredolu and Sonibare, 2007; Ite, 2007; Olukoya, 2008; Banfield, 2009). It is also important that, like in other studies addressing roadblocks on the way to a green and pleasant land (Burritt, 2004), this study contributes to the search for an improved system for businesses to produce information on the social, environmental and sustainable aspects of their operations (ACCA, 2005; Moradi, Mehrabankhou and Shahrestani, 2013; Khozein *et al*., 2014).

RESEARCH QUESTION AND OVERVIEW OF METHOD

This section briefly notes the research question addressed. It also provides details on the way in which the data was gathered. The study is part of the Degree of Doctor of Philosophy in Management Sciences (awarded to the first author in January 2011) of Mbarara University of Science and Technology, entitled "Environmental Accounting of Uganda's Oil Companies: The Relationship between Legitimacy, Marketing and Accountability." Thus, the key research question addressed in this study is: "On what are the major environmental accounting reports of oil companies in Uganda based?" It was undertaken by analyzing key environmental impacts and mitigation measures of oil supply chains in the country.

It can be observed that one of the issues in understanding sustainability accounting is first of all to explore environmental impacts and responses. Information contained in this study was collected through interviews with key management and staff of organizations in the oil supply chain, experts and community consultations; an assessment of mitigation measures at supply points; and the observation method (Kothari, 2004). A literature review of documentation, especially environmental impact assessments, environmental audit reports and experiences of other countries, helped to sharpen this understanding. This same method was used by Hopkins and Purnell (1996) when studying internal audit – perceptions of quality and the expectations gap within a competitive environment. Furthermore, a literature search was carried out to establish the key words that were used for the pollution issues of petroleum and the energy sector generally (Heller, Shields and Beloff, 1995; Sebastian and Hurtig, 2005). These appeared to fall into four categories, namely: (WP) Water pollution (spills and solid wastes, from disposal of oils); (SP) Soil pollution (spills and solid wastes, from service bays); (HL) Human life (on transportation, includes accidents); and (SW) Solid wastes (from service bay, inappropriate disposal). Table 3 uses the abbreviations WP, SP, HL and SW to represent these four categories.

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The biggest part of the data was collected from filling stations and garages. This is where oil and petroleum products end up in their journey to the final user. Additionally, Uganda as a country currently does not produce oil of its own and all its consumption is imported as a refined product. The study points out that licensed oil companies in the country are only marketing channels. They import and market products, operate service stations and wholesale products. We may add that information was collected from Environmental Impact Assessors, District Environment Officers and Environmental Audits. Information provided through the questionnaire helped to cross-check the data received at the sites. In order to preserve the anonymity of the organizations because of the sensitivity of the study, oil companies are denoted as C_n, filling stations as F_n and garages as G_n. Respondents are categorized according to their perspectives: environmental practitioner, preparer, independent auditor, environmental officer, regulatory agency personnel, academic/educator, attorney and planner.

RESULTS AND DISCUSSIONS

Uganda and Study Sites Situational Analysis

Uganda is a land-locked country occupying 241,551 sq. km., 18% of which consists of open inland waters and permanent wetlands (United Nations Development Programme, 2008). As in the case of many other developing countries, a key strategy for achieving faster economic and financial development of the country is one of rapid industrialization (Sahay, 2004; Rugumayo, 2004; Belal and Owen, 2007). Industrialization leads to the creation of jobs and has a direct impact on improving the economy (Republic of Uganda, 2008, 2014). With that strategy in mind, a private sector–led industrial development policy is being aggressively pursued with the aim of attracting as much foreign investment as possible (Uganda, Ministry of Agriculture Animal Industry and Fisheries, 2000). This has been accompanied by the increase in demand for certain services and products. Petroleum-related products are in noticeable areas where growth is taking place. There has been an increase in the total sales of petroleum products. On the other hand, the oil discovery and the proposed refinery to meet the needs of Uganda and the region will to some extent lead to environmental damage (Banfield, 2009). An approximately 10.2% (24,562.1 km^2) exploration area of the total surface area of Uganda has been defined in the Albertine Graben (Uganda, Petroleum Exploration and Production Department, 2009), with oil and gas deposits estimated at 3.5 billion barrels of oil equivalent (Uganda Bureau of Statistics (UBoS), 2014).

The road transport sector has also registered tremendous growth, as depicted by the number of both passenger and cargo vehicles over the years. To illustrate, the number of motor vehicles on the roads increased by 144.3% in 2009, compared to an increase of 108% in 2008. Newly registered vehicles increased by 38.7% in 2013 compared to 2012. The share of newly registered vehicles to the estimated total vehicles on the road in 2009 was 18.5%. Commercial traffic at Entebbe, the only international airport in the country, also registered increases in passengers

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from 1,342,112 in 2012 to 1,464,004 in 2013; an increase of 9.1%. The amount of freight increased by 0.3% in the same period (UBoS, 2014). A combination of growth in the transport sector and commercial traffic at Entebbe has led to increases in the number of registered petroleum companies involved in importing, retailing or both.

Other economic and financial measures introduced in the 1990s included macro-economic and development reforms (Republic of Uganda, 2004). Consequently, in recent years economic growth has averaged 6% while the monetary sector grew by 9% during the 1990s, and the index of production for manufacturing stood at 199.5 in the year 2013, indicating a 3.2% rise from the year 2012. Annual inflation, which averaged over 100% between 1982 and 1990, was brought under control by tight fiscal management and has remained stable at around 6%.

As the economy grew at an average of 5.6%, so did population growth (3.2%), which is expected to double every 20 years (United Nations Development Programme, 2008). Consequently, the demand for and consumption of petroleum products increased. This study indicates that the transport sector accounts for approximately 76% of all petroleum product consumption in the Kampala study site. Indeed, oil companies contribute approximately 25% to the country's economy and directly employ thousands of people (Nkurunziza, 2007; UBoS, 2014). The increase in demand for oil and petroleum products become a precursor for increased businesses dealing in these products in both the formal and informal supply chains of the sector. Moreover, the urban population continues to increase and the challenge is how to harness this urban potential.

It is estimated that there are over 660 filling stations in the country, with the Kampala study site alone accounting for approximately a fifth (22.8%). The findings of this study reveal that the majority of filling stations in the Kampala study site, 136 (90.7%), were approved within a period of ten years. This is in an area of 197 km^2, of which 31 km^2 or approximately 15.7% is covered by wetlands. That is a ratio of 1:1.12 of filling station to a square kilometer (excluding wetlands). Furthermore, approval and establishment of filling stations are increasing rapidly. To illustrate this scenario, the cumulative figures of fuel service stations approved from 1998 to 2008 increased from 2 to 596, representing an increase of 29700%. On the other hand, this study indicates that the number of formal garages is 15 who are UMA members (Uganda Manufacturers Association, 2004), with numerous informal ones spread throughout the study sites. The study also found that 100% of the informal garages studied at the Kampala study site have no proper means for disposal of waste oil products. As a result, waste oil products are directed to drainage channels meant for storm water, which flow to Lubigi, Nakivubo, Kawagga and Kansanga swamps. Figure 1 illustrates the main water channels. Nakivubo passes through the city and ends up in Nakivubo and Kansanga swamps, the main Kampala city water catchments. Consequently, the pollution flows to Lake Victoria, where Kampala City draws the water supply from the Gaba waterworks.

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Insert Figure 1 about here

We would point out that environmental systems must not be polluted. It is therefore imperative that any business, especially an oil business, ought to minimize pollutants. Failure to do this will result in algae blooms, anoxic conditions and loss of phyto/zoo plankton, distorting the food and web chains of the water body. A second study site is Mbarara Town. The town has 23 filling stations that are very close to one another. On a stretch of approximately 1 kilometer, this study reveals 10 filling stations. The study also found 31 informal garages, the majority (58.6%) of which were established in the last ten years. There are only two (6.5%) garages operating in planned premises, although recently the premises degazzeted. Even these were found to lack oil interceptors, waste tanks for used oils and oil filters. Of the remaining (93.5%) informal garages studied at the Mbarara study site, none was operating in an area that minimizes damage to the environment and is designated for garages. Moreover, the garages are close to each other, within the busiest areas, near drainage channels and operating on undeveloped commercial plots. Without proper disposal facilities for solid wastes and wastewater, water channels were found to be the only alternative.

The water drainage channels lead to the River Rwizi catchment zone, which is used by downstream communities for water supply, is the main source of water for the town and is important to the Lake Victoria Basin (Figure 2). Moreover, it is the main water supply to Lake Mburo, the most important water point in the Lake Mburo National Park, known as the "Home for Zebras," which together attract hippos, crocodiles and a variety of water birds, while the swamps hide sitatunga antelopes. Additionally, this study has established that over four-fifths (84.2%) of filling stations are on the same stretch of road of less than 4 kilometers. In the opinion of a respondent who is a Senior Environmental Officer at Mbarara District Environment office (pers. com., March 2009), concerning the closeness of informal garages and filling stations within the busiest areas, he indicated that Mbarara Municipal Council (MMC) refused to allow zoning of the area. Garage and filling station zoning may be seen to be anti-development.

Insert Figure 2 about here

Besides filling stations and garages being concentrated in small and unplanned spaces, there is a high illiteracy rate among 15–25-year-olds, currently at 23.9% (UBoS, 2014), an indication that the majority actors in the oil supply chain may not be environmentally sensitive. They do not understand what environmental damage is and what should be done. As an example, what does "ecological sustainable industrialization" mean, or "green accounting"? According to the respondents (100%), the number one objective for oil and petroleum suppliers setting up in business is profit, in spite of the sector naturally being concerned with social issues (Steger, 2006), and there is substantial evidence of a business case in the social areas in Africa (Thorpe

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and Prakash-Mani, 2006). This is the most objective reason for people living in such a business environment. This argument is similar to the comments by a respondent who is an environmental practitioner and attorney (pers. com., March 2009). She indicated that the continuity and sustainability of the environment are seriously at stake considering the way in which informal garages conduct their business. There is a need to have the laws and guidelines known to all stakeholders in order to reduce degradation of environment by using the oil business.

In addition to the way in which informal garage owners conduct their businesses, the informal mechanics' low level of understanding and discernment is not likely to improve very soon for us to be able to say that this problem could be addressed by concepts such as environmental accounting. A comment from a respondent who is a top Local Authority Administrator was interesting (pers. com., February 2008). He indicated that the problem is that both the government and the private sector are looking at revenue and profits while disregarding environmental damage.

The study indicates that the marketing chains for oil and petroleum products in Uganda comprise oil companies (57), filling stations (approximately 660), and formal (15) and numerous informal garages. The study indicates that over the past ten years the increasing rate of urbanization of Kampala City and Mbarara Town, the study sites, has also created a growing number of marketing chains for oil and petroleum products. The researchers also wanted to find out the educational level of service bay lubricants technicians. This is because service bays are where most of the oil processing marketing takes place. The study indicates that over two-fifths (42%) of those who work at filling station service bays had not received any formal education, while 38% (17) had attained only primary education. Only a small proportion, a fifth (9), had gone beyond primary education.

Oil Companies' Environmental Impacts

Using various assets oil companies add value, produce products or services and generate returns to owners. Some of the outputs render the environment unacceptable for its best usage and thus polluted (Tushabomwe-Kazooba and Kemeza, 2008). For instance, this finding supports the work in an earlier paper by McChlery (2000) which stated that companies produce unacceptable outputs, which are solid wastes, waste water, waste air and other pollutants. Consequently, oil and petroleum suppliers incur both financial and non-financial costs to rectify these unacceptable outputs. This survey requested respondents to highlight environmental impacts. Answers from 72 respondents including District Environmental Officers (36%), Environmental Practitioners (36%), Environmental Auditors (15%), Regulatory Agency personnel (10%) and planners (3%) helped in the rating of impacts. Information obtained from interviewing those who work in oil chains and observations enriched this understanding, as presented in Tables 2 and 3. The responses (multiple) to the question "What in your opinion are the environmental impacts of oil

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companies in Uganda?" are the ones that were analyzed and rated. Positive impacts are disregarded in this analysis. Responses have been categorized according to quantifiable and non-quantifiable. Each of these impacts is presented and discussed below.

First, environmental damage happens during transportation of both crude and refined products to various upcountry stations. Secondly, the study findings indicate air and water pollution, lithosphere waste, and biodiversity loss to flora and fauna through fire. Thirdly, used oils from service bays, which are usually mishandled, also end up in drainage systems and along streetside drains. A common feature of informal garages is that waste oil filters are dumped along with other wastes. These wastes are later disposed of with other solid wastes and end up at garbage dumping sites. This was supported by the revelations at Kiteezi Landfill located on the western outskirts of Kampala, the official disposal site for all sorts of refuse gathered from all corners of the city, and at Kenkombe, the Mbarara dumping site. In agreement with Mwiganga and Kansiime (2005), at Kiteezi the findings show huge mounds of assorted wastes. Some of these wastes were from marketing chains for oil and petroleum products without pre-treatment. The landfill for Mbarara Town located at Kenkombe also shows a similar situation of solid wastes from oil and petroleum chains, some soaked with oil, and continued burning that pollutes the atmosphere.

A remark from a respondent (pers. com., January 2008) who is a service bay attendant at F_5, on the Entebbe road in the Kampala research area, with over 20 years' experience, supports this: "used oils are wastes, we do not mind who collects them and how it is disposed of." Comparatively, the information obtained at F_6, one of the five filling stations that were in operation in the 1980s in the Mbarara study site, was the same on oil waste dumping. A response by another senior service bay attendant (pers. com., January 2008) with 27 years' experience regarding records of used oils and filters, and frequency of collection by the tenderer, remarked that what they find is what they take and filters are taken by other people. The study reveals that at this station 14,400 liters (39.3%) of used oil is collected by the tenderer annually, while approximately 36,600 liters is generated. We conclude that 60.7% of used oils end up polluting soil and water. In contrast, when compared with analysis of records available to this study at another filling station, this seemed to be an exaggeration. At the latter filling station, the findings indicate a much smaller (16.8%) amount of used oils not collected by the tenderer, as outlined in Figure 3. The limited statistical scope of the study means that it cannot be regarded as all-inclusive of environmental accounting, either in terms of its quantity or quality. It does, however, offer a useful introductory insight into accounting for the environment by oil companies in Uganda.

Insert Figure 3 about here

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Further evidence from an academic/educator (pers. com., January 2009) who is a planner suggests that oil tins and plastics are not properly disposed of by buyers and garages, and thus constitute a big threat alongside used oils that are disposed of anyhow. Despite these remarks by service bay attendants of filling stations, the biggest polluters were found to be informal garages. The conclusion can be drawn that oil and petroleum product operations have negative environmental impacts that include pollution of water, air and soils and littering of solid wastes.
A documented case of water and soil pollution, and the subsequent cleaning exercise, is the oil spill at Lake Nkugute and surrounding communities because of frequent accidents at the Rubare–Rutoto ridge as the trailers descend the slope. Exhibit 1 shows key highlights of the case. The case highlights of the oil spill and pollution of Lake Nkugute are further analyzed to prepare an environmental report and accounting for the environmental issues presented in Table 1.

Insert Exhibit 1 about here

To relate the above case study of water and soil pollution, and the subsequent cleaning exercise of the oil spill at Lake Nkugute and surrounding communities, the suggested accounting for the environmental issues and environmental report is tabulated in Table 1. The list of environmental issues provided is not exhaustive, but is meant to demonstrate how environmental damage can be accounted for and consequently reported, considering the requirements of sustainable reporting. Additionally, the environmental accounting information and the cleaning exercise preserve the natural environment. For instance, Deo Odota's remark demonstrates the preservation of the natural environment after cleaning was successfully done. He stated in one of the technical assessment reports that snakes, scorpions and other aquatic animals that had left the lake during pollution had started coming back (Water Analyst, Directorate of Water Resources Management, January 2008). Like Helland-Hansen, Holtedahhl and Arnstein (1995), various valuation techniques were used in this case study to suggest the accounting information by major reporting entities, which are replacement cost, relocation cost, opportunity cost, direct costs, preventive expenditure and changes in productivity.

Insert Table 1 about here

Oil companies and their associated supply chains have a negative impact not only on ecology, but also on human nature. Accidents and deaths involving fuel tankers are common occurrences in Uganda. The first such accident was in 2002 and involved a fuel tanker with 1,500 20-liter cans of kerosene, which occurred about 382 kilometers (239 miles) west of Kampala City, killing more than 70 people and spilling all the products into the nearby water body. In another accident, 38 people were burnt to death and 79 others injured when they were trying to collect fuel that had spilled from a broken-down fuel tanker in the eastern Ugandan District of Iganga (Odeke, 2001). Another accident happened on 14 February 2004 about 45 kilometers east of the capital, Kampala, when a fuel tanker hit a minibus. It was reported that 40 people died in that collision.

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This study shows that in a period of less than four years, four accidents occurred, in one of which 198 people were killed. This number excludes those who were injured and taken to the hospital and eventually died.

Respondents were asked an open-ended question to indicate the adverse environmental impacts of oil companies in Uganda. From the responses received, a number of adverse environmental impacts of oil companies were identified. The most significant types of negative environmental impacts are tabulated in Table 2, categorized as long, short and medium term. The number of differences was interesting. Some were certainly to be expected, but the responses revealed that there are in fact a considerable number of significant differences between oil companies' impacts.

Insert Table 2 about here

Therefore, based on the above results, three types of adverse impacts for each supply chain frequently disclosed by respondents were included in an environmental matrix, shown in Table 3. Here, types of environmental damage that were common in the responses are ranked.

Insert Table 3 about here

The interpretation is that environmental damage is different for each oil chain. A three-point modified Likert scale ranging from "high" to "low," where high denotes major impact, followed by medium and low, was used for measurement. The rating of formal and informal garages and filling stations is based on the researchers' own observation and assessment.

On the whole, the majority of respondents plus the first author's own observation and assessment found water pollution to be the major environmental damage in all oil chains. This is followed by soil pollution caused by oil spills and from solid wastes because of the nature of informal operating areas. This finding tallies with an earlier survey by Moyini, Muramira and Walaga (2003), who estimated the total potential loss from water contamination as between US $22 million and 35 million per year. Although their findings neither denied this loss nor apportioned it to the polluting sectors, oil chains in Uganda are among the major polluters. The other reason advanced with respect to poor solid waste management and the link to floods in the study sites (Tushabomwe-Kazooba and Kemeza, 2008) is the general apathy on the part of urban communities (Kabumbuli and Kirumira, 2006). These results suggest that the population regards waste management as the responsibility of urban authorities. On the other hand, a sizeable proportion of the urban population is poor, illiterate and weak economically, coupled with poor record keeping. To compound this problem, the management of oil wastes is expensive, particularly in an environment where culture and norms do not discourage littering and do not encourage sorting wastes at the supply chain level.

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Oil Companies' Environmental Mitigation Measures

As Slater (1996) points out, the problems of improving the environment without crippling industry are common to most if not all countries. Regardless of the perspective from which the respondents were completing the questionnaire, they were asked to indicate oil companies' environmental mitigation measures. Despite the drawbacks of open-ended questions where respondents will not be willing to respond in writing (Fray, 1996), an open-ended question was used in order to get satisfactory and meaningful responses.

In answer to the question "What in your opinion are oil companies' environmental mitigation measures?" this study has identified a number of mitigation measures to offset the expected environmental damage. All the filling stations (100%) sampled carry out regular pressure tests and daily monitoring of fuel levels so as to detect any leakages. The tanks are provided with breathers so that build-up of internal pressure is prevented. Also the tanks are 10 meters apart and have a protective wall around them. Fire hydrant pipes are installed on each tank at the depot. These measures were found in the environmental impact assessment reports. Used oil is supposed to be collected in a drum and clearly labeled "Used Oil Only." Systematic disposal of used oil was found at all the five formal garages and 9 (33%) of the filling stations. At the rest of the filling stations, 18 (67%), although a drum existed, the staff at the service bays were putting most of the oil in jerricans or other containers and selling it. In interactions with service bay attendants, they indicated that they use it for timber preservation, for control of mosquitoes by pouring it on stagnant water and for marking out football field boundaries.

The study reveals that this is used as a side income for service bay employees. The study findings also indicate that the management of filling stations tends to agree with this arrangement. Whatever remained unsold was being put in a drum. Interestingly, there was no record of what was collected by the contractor authorized by NEMA or of the quantities collected. Additionally, no date was indicated when it was collected. One respondent at filling station F_{14} in the Mbarara study site indicated that in a year the contractor collects used oils approximately three times and takes them to their point of origin to recycle them an environmentally friendly manner. This was surprising, as this study found that it is one of the busiest service bays in the Mbarara study site. The same situation was found among filling stations in the Kampala study site. This was seen as a weakness and likely to contaminate the environment.

What is surprising is that management of these facilities are aware of the guidelines issued by NEMA, that a competent contractor is the only one authorized to collect the used oils. This study has also identified that for the year 2008, NEMA awarded and licensed two contractors to collect used oils throughout the country. These are still not enough; they are only based in Kampala with

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no offices in other towns. There are obvious savings associated with avoiding collection of all the used oils.

What was of interest was that at F_1, Kampala Study Site, staff at the service bay were trained and informed to guard against giving used oil to unauthorized people. At this service station, there was a record indicating the amounts generated and dates collected by the contractor, which the researcher considered excellent. At this filling station, the owner was able to take the researcher through the processes of generating used oils. This was compared with another station that was considered average in terms of management procedures for used oils.

As an example, for the year 2008, at F_1 used oil generated was collected by the tenderer in eight loads. It is interesting to note that this service bay is modern and was very busy. Although the researcher could not find a relationship between environmental performance and financial performance, the station tends to enjoy enhanced consumer relations because of this approach. When the researcher asked whether the name of the filling station should be disclosed, the proprietor gladly and naturally accepted. It is CityOil on Bombo Road, Kampala City. One may conclude that environmental performance is becoming an important component of a company's reputation. On the other hand at F_5, although they responded that used oil is collected, the researcher was not provided with such records. Using the practices at F_1, the researcher came up with an accounting best practice, especially for used oils.

The study was also interested in finding out the environmental management procedures at the garages, both formal and informal. Of the five formal garages studied, garage G_1 was considered excellent as far as environmental procedures are concerned. The first author was taken around the service bay and given details of the entire process of disposal of used oil. At this same garage, oil interceptors were installed and properly maintained so as to clean runoff of any oil before discharge into the storm water drainage channel. Proper waste disposal cans were installed at the salesroom and at the service bay. Such a good management system of environmental mitigation measures was not available at the other formal garages. Therefore, G_1 was considered as an exemplar, whereas G_3 was considered the least environmentally managed. Despite the willingness of the General Manager of G_3 to take the researcher around their service bay, he indicated that I should not mention his name in this study nor disclose the name of this garage.

This study, plus a review of the literature (Ditz, Rangnathan and Banks, 1995), came up with ten key assessment issues and criteria for environmental mitigation measures for filling stations, formal and informal garages. These were rated using a modified Likert scale as very useful – the oil chain addressed the criterion for the key issue in a meaningful or detailed way – useful, somewhat useful and not useful – the chain did not address the key issue or provide information

ISSN 2056-7537(print), ISSN 2056-7545(online)

to demonstrate that the issue had been considered. Table 4 tabulates the assessment. Oil companies were disregarded in this analysis, as information obtained from reports and their websites was sketchy, hence this study could not come up with meaningful analysis. It is interesting to note the importance of spacious filling stations to avoid congestion; an environmental problem, however, that is not stressed in developing countries, as this study has revealed.

Insert Table 4 about here

The majority of filling stations (75.9%) and formal garages (70%) were assessed as very useful and useful on issues and criteria for environmental mitigation measures. The exception is the lack of environmental audit reports, which was common across all oil supply chains. The performance of informal garages in all the key environmental performance areas was either somewhat useful or not useful. Therefore, this analysis reveals that with the exception of formal garages, the other supply chains need improvement in some areas of environment management. Even formal garages ought to address the issues of conducting and using audit reports, and the regulatory agencies need to improve on their monitoring. Lack of records, however, is an African way of doing business.

Other Environmental Impacts, Mitigation Measures and Archival Records

In agreement with the Energy Policy for Uganda (Republic of Uganda, 2002), the petroleum sector has bigger environmental impacts than most other economic sectors (Kritiporn, Panayotou and Charnparateep, 1990). This means, in one way or another, that there will be a negative environmental impact on the areas in the supply chain.

Apart from all formal garages and two informal garages from the Mbarara Study Site, the rest of the garages studied operate in dilapidated places, do not have cement floors, operate in the open air on permeable soil and some of them are near water channels. This state of affairs indicates a less sustainable development trail. Used oils are sometimes dumped on the floor, in water channels, in waterways and on the soil in large quantities, an indicative aspect of less environmental consideration. Because of high poverty levels in the country and economic, social and cultural limitations, consideration for the environment is still remote. As an example, drums provided at service bays were not being used and instead garage owners opt to sell used oil without questioning what it was going to be used for. Provision of drums and labeling them "used oil" is the first step at the filling stations (100.0%) and is a good sign. A record of used oil generated and collected was available at three filling stations (11.1%). This study has also shown that at the informal garages there is still a lot to be done.

ISSN 2056-7537(print), ISSN 2056-7545(online)

What is common through the supply chain is the absence of useable and meaningful environmental records, represented by 25 filling stations (92.6%), 1 formal garage (20%) and 15 informal garages (100%). Even for bigger oil companies, namely Shell, Chevron and Total, in their respective files at the companies' registry there was scanty information about environmental issues. This is in contrast to the requirement of company law in Uganda (Bakibinga, 2001). An example is that company law S.119 (2) clearly stipulates that companies are to make a return to the registrar of companies at least once a year. On this question the Registrar General of Companies indicated that oil and petroleum supply chains are private companies that issue no shares, hence they are not required to make returns. He hastened to add, however, that there are organizational inadequacies and weaknesses in monitoring and enforcement of the existing law as far as environmental issues are concerned. This study had assumed that it was the smaller companies that would normally present a problem in this area.

Another challenge as revealed by this study is that the environmental impacts are generally not immediately visible or even quantifiable. If that is the case, this may be the reason for poor records, especially by informal garages and filling stations regarding used oil. A country that has no recycling facilities, say of waste oil, oil and diesel filters and batteries, views such byproducts as wastes or of no value. Consequently, incurring costs to keep records of such wastes is of no value to the organizations, therefore avoiding it is the best option.

One fact worth mentioning is that garages, especially informal ones, are scattered all over the country and are sometimes difficult to locate. The fact that informal garages are scattered, small and with no permanent address presents a problem in monitoring and enforcement. In addition, by virtue of informal garages being small, they are usually unable to afford the costs of measures to prevent damage to the environment as a result of their actions.The respondents were also asked the areas that need more or less reporting by oil companies to further improve environmental issues, using a scale of much more, more, stay the same, less and much less. Arising from the literature review, this study had come up with only two areas, namely compliance and environmental issues. This question was put to the staff of NEMA and MoEMD, DEO, EImAs and Eats. The reason for doing this is that they are the ones who are involved in auditing and monitoring oil companies, hence they are considered to have knowledge of the current gaps in environmental and compliance performance. On compliance issues, the majority of respondents (65%) indicated much more accounting to improve the usefulness of environmental issues by oil companies. Approximately a third (35%) indicated more. There was no respondent who indicated that it should stay the same or have less or much less. The results of accounting for environmental issues, however, were the reverse. Based on the results for this question, there is overwhelming support by the respondents to account for and report on environmental and compliance issues by oil companies, which would require changes in

ISSN 2056-7537(print), ISSN 2056-7545(online)

accounting standards and reporting requirements to consider the requirements of sustainability reporting (Khozein *et al.*, 2014).

Environmental Accounting Elements

As a starting point, not all of the issues can be reported on in the same way by everyone in the supply chains because of the complexities involved and the lack of staff with knowledge of environmental accounting. The way to get around this dilemma is to highlight the major impact areas that can be accounted for along each supply chain. These are the ones that we should come up with benchmarks for and report on. This is because there is a likelihood of their not being reported on and it is difficult to set benchmarks to measure their progress. The study has come up with a maximum of five accounting elements/environmental issues per value chain that can be accounted for and disclosed.

The list of accounting elements was developed from the responses received from environmental practitioners, environmental auditors, environmental impact assessors and district environmental officers, shown in Table 5. The ranking was done using a Likert scale, with 5 denoting elements that need much more while 1 denotes much less accounted for and disclosed.

Insert Table 5 about here

Challenges to Environmental Responses

In Figure 4 we summarize possible high-risk sources, outcomes and accounting associated with responses to environmental damage by oil companies.

Insert Figure 4 about here

The study reveals that beneficiaries of environmental damage continue to resist and sabotage all plans. What emerged strongly from the study is traditional stakeholders' selfish motives and lack of interest in environmental response efforts in the country. Also, there has been a limited professional capacity among the agencies involved.

Conclusion: Widening All Bottlenecks in the Conduit to Sustainability Accounting

Environmental management and the requirements of sustainability accounting for oil companies in Uganda are very complex. They involve oil companies, central government and local governments. Other agencies such as NEMA, environmental groups, entrepreneurs and environmental practitioners are also involved. Because of the complex nature of this area, it is difficult to effect change rapidly, which in turn influences the outcomes of environmental

ISSN 2056-7537(print), ISSN 2056-7545(online)

management. Our findings indicate that environmental management is changing very slowly. We point out that when dealing with organizations, one is dealing with systems, procedures and structures. The major problem is failing to get the systems, structures and institutions' different roles harmonized. On the whole, the study findings indicate that the main causes of oil companies' environmental impacts are soil, air and water pollution. These impacts were found to be common to all the marketing chains. Another finding is the loss of human life caused by accidents during transportation of oil and petroleum products. Interestingly, the findings indicate that people collect used oil from service bays, waste oil filters are dumped along with other wastes and vehicle repairs are done in the open air on permeable soil, an aspect of indiscipline and later disposal in ways that have real or potential effects on the environment. The study shows that this is exactly what is happening at the service bays of filling stations and informal garages. Thus, we will never be able to control environmental impacts unless we have a highly sensitive and disciplined public. Among other suggestions, we propose the use of collecting pans or rags under the vehicle to keep the surface clean and draining oil filters into an oil can.

The explanation for this problem is poverty and lack of information on the effect on the environment. Consumer ignorance is also to blame. Otherwise, those involved would know the potential effects on future sustainability of poor disposal of the used oil or dumping filters along with other waste. We suggest that this needs to be addressed by a joint NEMA and local government campaign. For instance, a fee could be levied on those supply chains that mismanage their wastes. Overall, those monitoring and enforcing environmental governance should tighten their systems and come up with specific targets that are measurable, easy to implement and coupled with minimal costs. In addition, changing work ethics, attitude and motivation are essential. The fact that accountants are relied on for facts is an important bridge between society, the economy and the environment, and helps to develop sustainable business practices. They need to be seen to be hungriest for sufficient information on social and environmental accounting and reporting knowledge.

The conclusion of this study can perhaps be best summarized using a Tonga proverb from Zambia: "Where two buttocks are together there is always friction" (Long, 2000). This study shows that one of the buttocks is oil and petroleum companies and their services. The other buttock is the environment, seen as air (including air within buildings and structures above and below ground), water and land. The frictions, on the other hand, are accidents, water, soil and air pollution. However, "There is weeping when separated, quarrelling when together" (a Tanzanian proverb, as cited by Long (2000) quoting The African Proverbs project CD-ROM from Global Mapping International). In the context of this study, these proverbs' main message is that oil supply chains need to recognize their adverse impacts on the environment by coming up with mitigation measures for producing more and polluting less, thereby improving both economic aspects and society. In fact, the responses revealed by this study are daily monitoring of fuel

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levels to detect any leakages, the procedure of putting used oil in drums for it to be collected by an authorized contractor and training of staff in environmental management procedures. Other responses are to sort non-biodegradable wastes, and to produce and display health, safety and environmental (HSE) guidelines. Therefore, oil chains should not disregard their adverse environmental impacts. The best way of considering them is to provide information that reflects their magnitude, costs and the actions being taken to minimize them. Doing this will facilitate informed decisions about investments, purchases and partnerships.

Perhaps most importantly of all, if stakeholder groups are provided with rich information that is relevant to their issues, further stakeholder dialogue and inquiry are invited (Adams, 2001). Such accounting elements could be the number of programs for managing impacts, the total amount of waste, the percentage of materials used that is recycled and total environmental expenditure. Moreover, achieving such clarity in accounting holds the promise of delivering value to both businesses and non-traditional stakeholder groups, who have become more powerful and reliable for working towards a sustainable future.

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ISSN 2056-7537(print), ISSN 2056-7545(online)

Table 1: Suggested Accounting for Environmental Issues according to Major Reporting Entities

Environmental Issues	Major Reporting Entities				
	Total (U) Ltd	**BDLG**	**DWRM**	**MoWE**	**NEMA**
Spilled HFO products Communities affected Water analysis Contaminated water & soil Clean-up Health-related issues Restoration costs Fishery – fish migration, death and spawning	Amount spilled & revenue loss Expenditure legally obliged to pay to communities as fines, penalties and compensation Amount paid to Epsilon (U) Ltd to clean up lake and surroundings Expenditure for restoration – fish, flora and fauna Expenditure related to mitigation of future accidents Cost of materials used	Number of people affected Health-related issues in oil spill (humans and animals), cost of treatment Loss of income by communities due to closure of lake Expenditure incurred during meetings Change in time by community to get other sources of water supply Loss of labor	Costs incurred during exercise to verify clean-up operations Expenditure related to analysis of water quality Opportunity cost of staff involved	Expenditure incurred during monitoring of clean-up exercise Opportunity cost of staff involved	Expenditure incurred during monitoring of clean-up exercise Costs of loss of flora and fauna Costs of loss of fishing activity Costs of loss of species Opportunity cost of staff involved

MoWE – Ministry of Water and Environment; NEMA – National Environment Management Authority; DWRM – Directorate of Water Resource Management; BDLG – Bushenyi District Local Government

Source: Analysis of the case summarized in Exhibit 1.

ISSN 2056-7537(print), ISSN 2056-7545(online)

Table 2: Consolidated List and Spread of Adverse Environmental Impacts (Multiple Responses)

Most Significant Types of Negative Environmental Impacts Being Produced by Oil Companies in Uganda		
Temporal Spread	**Quantifiable**	**Non-quantifiable**
Short- and medium-term environmental impacts	Noise pollution Accidents associated with oil operations CO_2 emissions Spillage Air quality deterioration especially from low-quality fuels, surface water contamination Open-air spraying pollutes air, damages health of workers	Soil contamination – blocking of access routes in case of drilling companies Aesthetic impacts such as distortion of landscape during construction phase Impacts resulting in non-point pollution that cannot be attributed to a specific oil company or fuel station Use up space that could be used for other more profitable activities Oil waste disposal especially from numerous points (almost non-point)
Long-term environmental impacts	Generation of hazardous waste Occupational, health and safety impacts on staff Fuel stations licensed to operate in very crowded areas – high business centers, which poses a future danger in case of fire outbreaks Pollution and associated risks Global warming and climate change Groundwater contamination	Biodiversity loss and fauna displacement Possibility of both groundwater pollution and surface water contamination, which in turn have impact on human health and other organisms Air pollution from emissions Pollution effects on soil and groundwater by oil products, and air pollution Impact of petroleum leakages and waste oil disposal on water cycle Health effects from waste oils – skin problems

Source: Field data 2008–2010.

ISSN 2056-7537(print), ISSN 2056-7545(online)

Table 3: High-Ranking Matrix of Negative Environmental Impacts of Oil Companies' Supply Chain

Oil Supply Chain	Frequently Disclosed Form of Impacts	Measurement
Oil companies	WP	High
	SP	Medium
	HL	Low
Filling stations	WP	High
	SP	Medium
	SW	Low
Formal garages	WP	High
	SP	Medium
	SW	Low
Informal garages	SP	High
	WP	Medium
	SW	Low

Source: Field data 2008–2010.

ISSN 2056-7537(print), ISSN 2056-7545(online)

Table 4: Assessment of Mitigation Measures at Supply Points

Key Assessment Issue and Criteria	Filling stations number = 27 - %					Formal garages number = 5 - %					Informal garages number = 15 - %				
	1	**2**	**3**	**4**	**A**	**1**	**2**	**3**	**4**	**A**	**1**	**2**	**3**	**4**	**A**
HSE manual available and displayed	85	15	0	0	1.2	100	0	0	0	1.0	0	0	0	100	4.0
Staff at service bay trained	11	89	0	0	1.9	80	20	0	0	1.2	0	0	0	100	4.0
Drums labeled "Used oils only," waste disposal cans	100	0	0	0	1.0	100	0	0	0	1.0	0	0	0	100	4.0
Availability of records of used oils	11	4	19	66	3.4	80	20	0	0	1.2	0	0	0	100	4.0
Sorting non-biodegradable wastes	56	44	0	0	1.4	80	20	0	0	1.2	0	0	0	100	4.0
Record of date of testing underground tanks and pipelines; revamping	33	67	0	0	1.7	-	-	-	-	-	-	-	-	-	-
Incineration of sawdust	93	7	0	0	1.1	100	0	0	0	1.0	0	0	0	100	4.0
Record of inspection of site facility by NEMA or DEO	0	44	26	30	2.9	0	0	40	60	3.6	0	0	0	100	4.0
Existence of labels of not smoking, employees wearing protective clothing, availability of fire-fighting equipment – serviced and tested	100	0	0	0	1.0	100	0	0	0	1.0	0	0	13	87	3.9
Environmental audit reports	0	0	0	100	4.0	0	0	40	60	3.6	0	0	0	100	4.0
Total observed frequency (f_o)	132	73	12	53		32	3	4	6		0	0	2	148	
Expected frequencies (f_e)	67.5	67.5	67.5	67.5		11.3	11.3	11.3	11.3		37.5	37.5	37.5	37.5	
P = 0.05	df = 27; χ^2_{obs} = 390.5 ; χ^2_{cv} = 40.11; Yates' corrected chi-square = 345.739					df = 24; χ^2_{obs} = 50.6 , χ^2_{cv} = 36.42; Yates' corrected chi-square =22.445					df = 8; χ^2_{obs} = 16.2; χ^2_{cv} = 15.51; Yates' corrected chi-square = 10.277				

All results (filling stations, formal garages and informal garages) are statistically significant because x^2_{obs} is greater than x^2_{cv}.

Key: 1– very useful; 2 – useful; 3 – somewhat useful; 4 – not useful; A – average

Source: Field data 2008–2010.

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Table 5: Accounting Elements for Oil Supply Chains of Environmental Impacts

Supply Chain	Accounting Elements and Ranking				
	5	**4**	**3**	**2**	**1**
Oil production	People affected who directly or indirectly depend on Lake Albert and surrounding areas for survival	Spills into nearby water body (Lake Albert); soil pollution	Water and energy usages	Destroyed flora and fauna species; noise pollution	CO_2 emissions; global warming; climate change; generation of wastes
Oil companies depot	Groundwater contamination and soil pollution; associated risks	Collected used oils	Loss of life; water and energy usages	Fire	Air quality pollution; occupational exposures to petroleum fumes
Filling stations	Generated used oils	Solid wastes	Water and energy usages	Noise pollution from generators	Fire
Formal garages	Generated used oils	Water and energy usages	Solid wastes	–	–
Informal garages	Generated used oils	Generated solid wastes	Fires	–	–

Note: Currently the country does not produce oil, but oil and gas deposits have recently been discovered in Albertine Rift Valley, Western Uganda.

Source: Field data and document review 2008–2010.

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Exhibit 1: Case Highlights: Oil Spill and Pollution of Lake Nkugute and Subsequent Cleaning Exercise

On February 13, 2008, a Total (U) Ltd truck carrying HFO overturned and spilled some of its products in Lake Nkugute, Bushenyi District. Not only is the lake a source of domestic water use for Bunyaruguru Gravity Flow, which serves over 20,000 people in the communities of Nyakasalu, Chambura, Kicwamba and Musumba, but it is also a source of fishing activity. As a result, the lake was closed awaiting an assessment report from the Directorate of Water Resources Management, Ministry of Water and Environment.

Following the spill and closure, major stakeholders, namely Bushenyi District Local Government, Ministry of Water and Environment, National Environment Management Authority, Total (U) Ltd and Epsilon (U) Ltd, started the exercise of a massive clean-up that took three months. Total (U) Ltd, the polluter, employed physical means of oil removal from the water column and removal of soil sediment. It also used foam mattresses, which have a good affinity with oil and soil sediment.

The first water samples taken from the lake in a bid to determine the quantity of oil in the water were collected on February 28, 2008. This was after weeks of vigorous cleaning spearheaded by Total (U) Ltd's Health-Safety-Environment and Quality Coordinator, assisted by the Engineering Manager, the Depot and Distribution Manager. The cleaning exercise was witnessed by Bunyaruguru Gravity Flow Scheme Chairperson, Assistant CAO (Bushenyi District Local Government), Water Officers, Environmental Officer and Local Councillors from the area.

The Ministry of Water and Environment also sent a team of water quality analysts from the Directorate of Water Resources Management during the period April 9–11, 2008 to verify the effectiveness of the clean-up operations. The team undertook comprehensive water quality analyses on the lake. The laboratory analysis showed improvement in the water quality with respect to oil and grease and the physical chemical parameters – turbidity, pH, electrical conductivity, nitrates, phosphates and nitrates. The community also reported that the snakes, scorpions and other aquatic animals that had left the lake during pollution had started re-occupying the lake.

Three samples earlier drawn on the water surface from three different areas by Total (U) Ltd and taken to the National Water and Sewerage Corporation's central laboratory in Bugolobi for analysis of oil and grease had revealed that the level of oil in the three water samples was 0.33 mg/l intake pipe longer, 0.28 intake pipe shorter and 0.47 mg/l lakeside accident scene. This is below the environmentally accepted limit of 10 milligrams of oil per liter of water: an indication of low concentrations of oil and grease in the water, which was in compliance with national environmental standards.

After water quality analysis by a team from the Ministry of Water and Environment, oil concentrations were found to be 2.6mg/L and 0.1mg/L at the accident scene and water intake respectively. The team recommended precautionary measures to be undertaken by Total (U) Ltd.

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The recommended measures were lining up foam mattress strips along the entire length of the intake point at a distance of 5 meters. The same foam mattress strips were to be lined up along the entire length up to the point where the lake is accessed by the community. This was to remain for a period of six months, but be monitored. Opening up of the water supply system was to be after a period of five days after the alignment of the foam mattress, and a satisfactory result that the foam traps oil at the water supply intake pipe.
Source: District Water Department, Bushenyi District Local Government, 2009.

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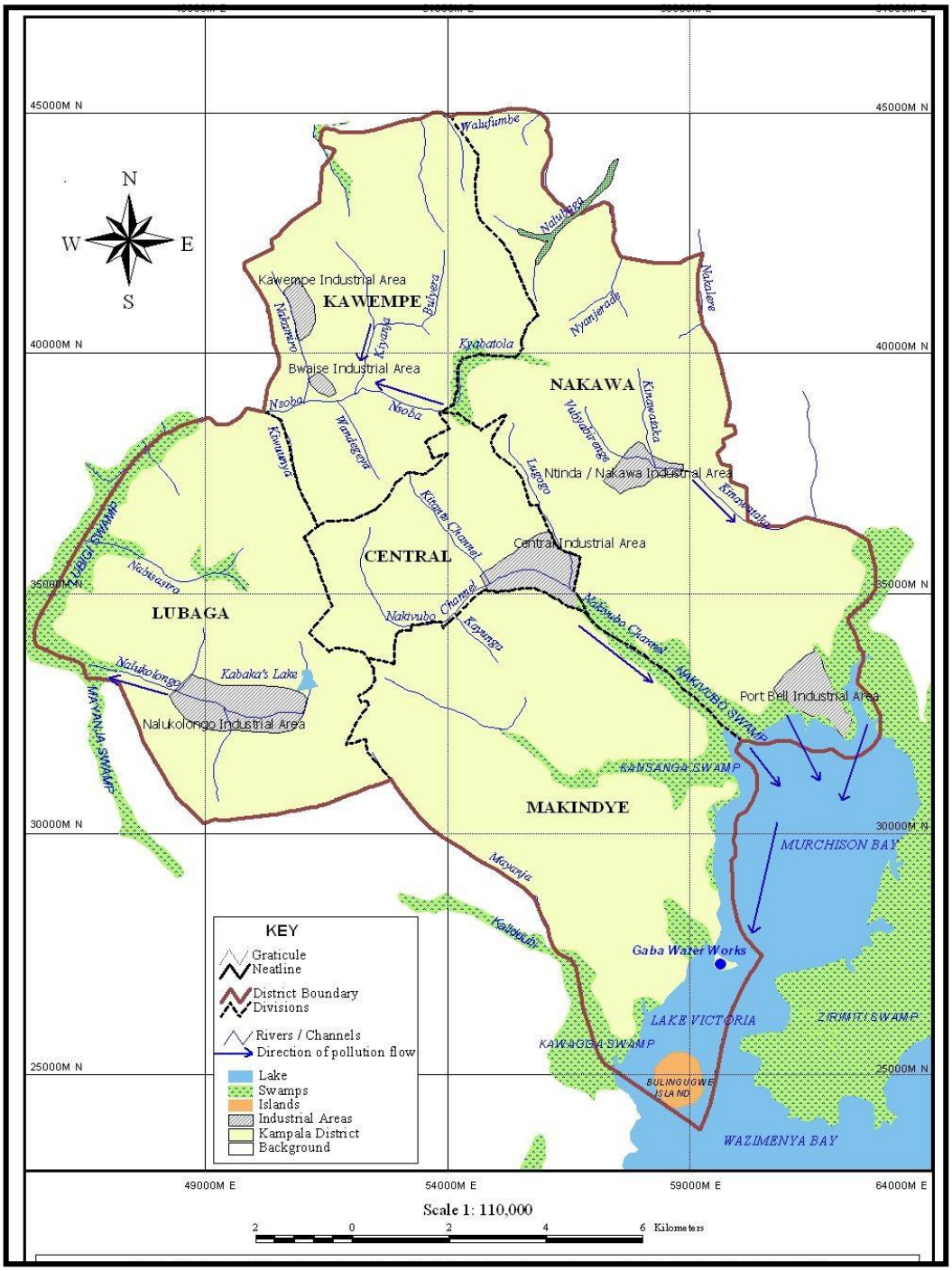

Figure 1: Kampala City Water Catchments and Industrial Zones

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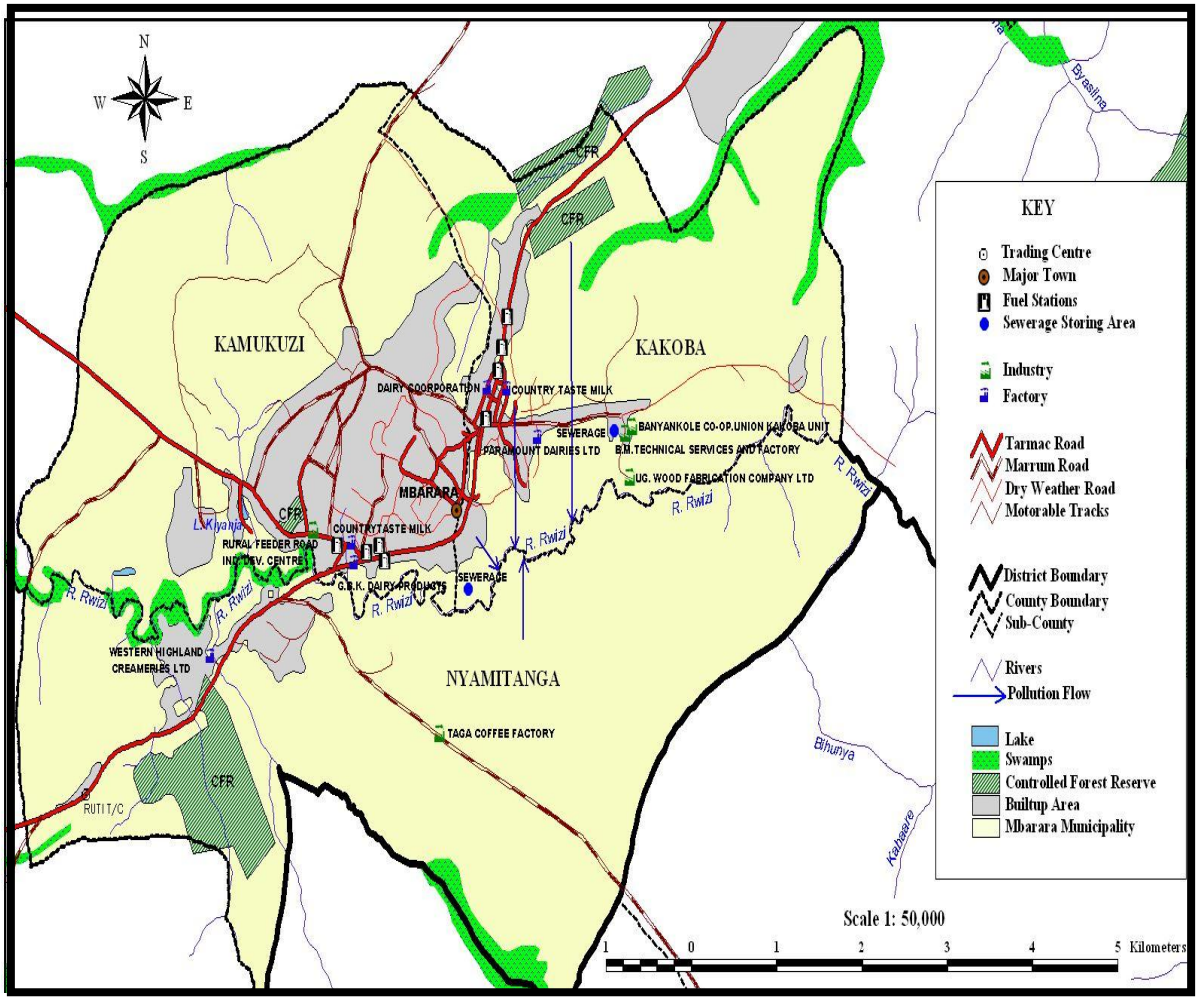

Figure 2: Mbarara Town Water Catchments and Pollution Flow

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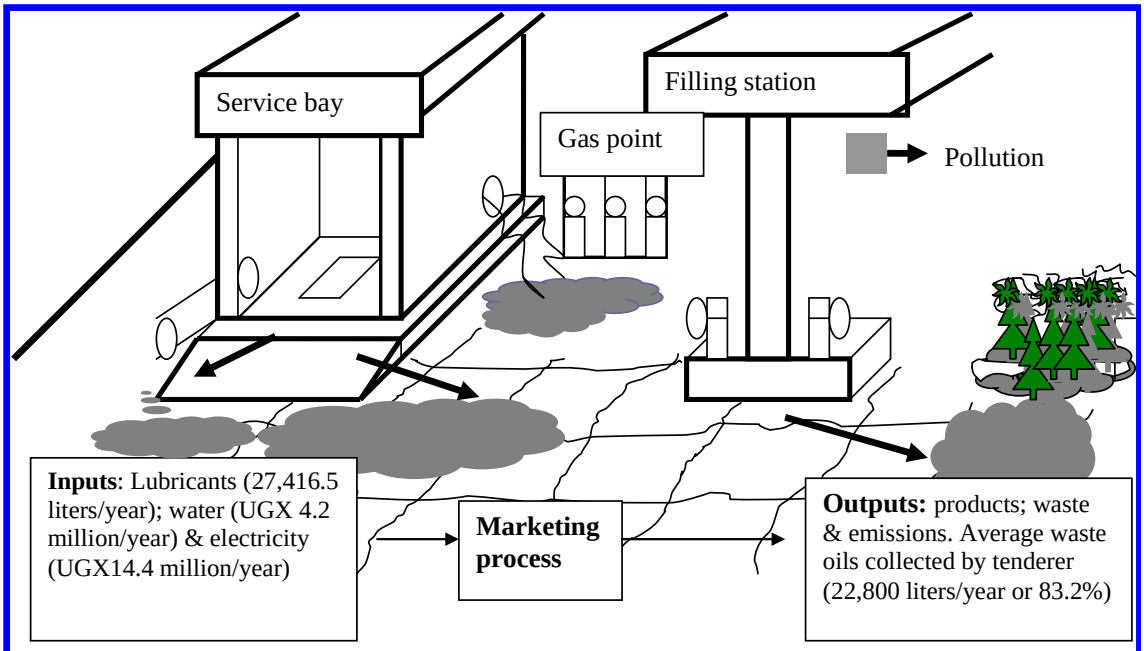

Figure 3: Material and Money Flows in a Filling Station, Mbarara Study Site

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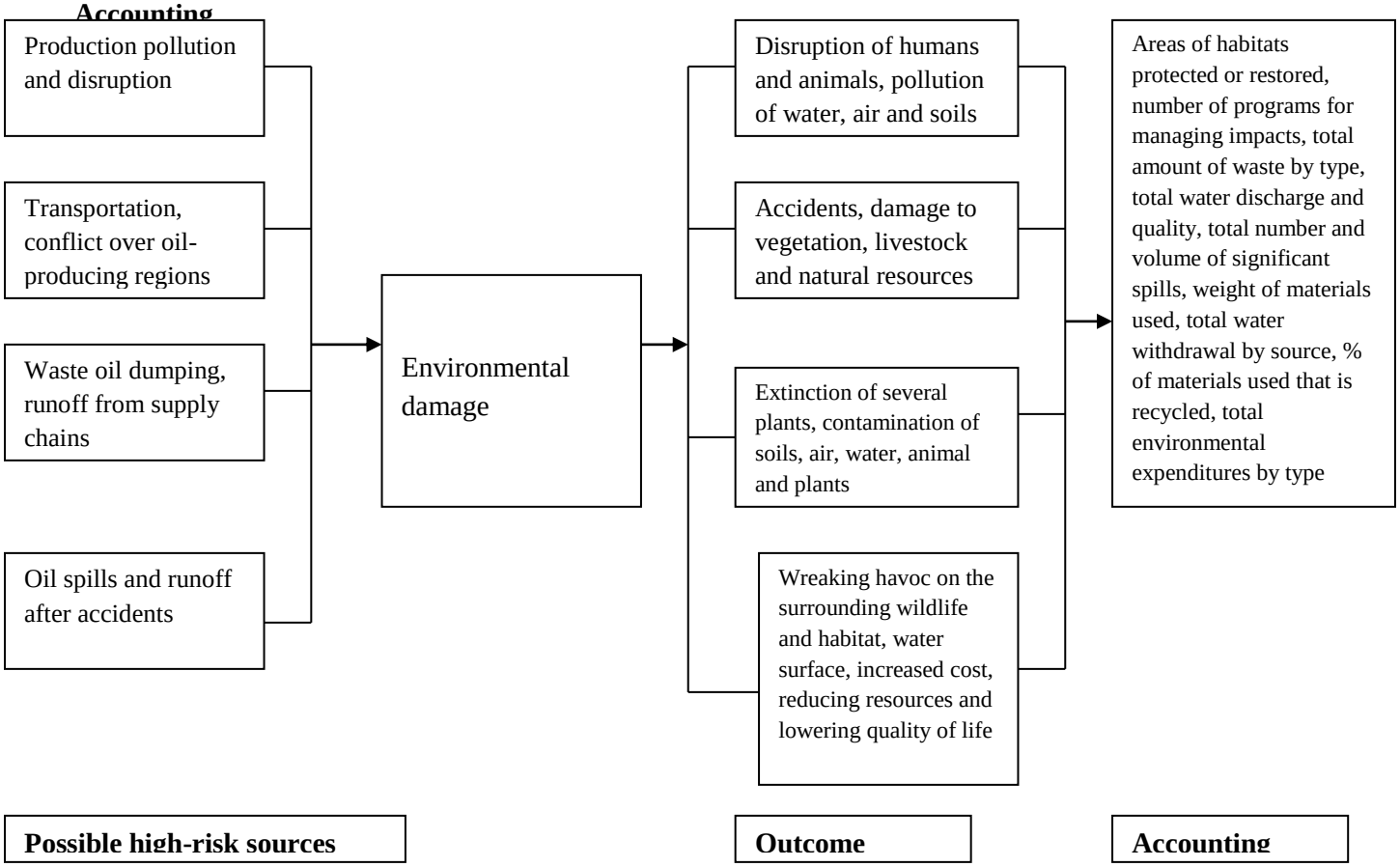
Figure 4: Environmental Damage of Oil Companies: Possible High-Risk Sources, Outcomes and Accounting



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