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Reverse logistics and environmental sustainability in selected manufacturing entities in Kampala district, Uganda

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ABSTRACT

The purpose of this study was to empirically establish the relationship between reverse logistics and environmental sustainability in Uganda, focusing on selected manufacturing entities in the Kampala district. The study employed a cross-sectional design. The study also used quantitative approaches in collecting and analysing the data both descriptively and inferentially. The study population was 675 manufacturing entities. Using the purposive sampling technique, the study took a sample of 248. Data were obtained from 186 usable questionnaires. The researcher applied Statistical Package for Social Scientists (SPSS) to test all four hypotheses. The results are presented in terms of descriptive statistics and inferential statistics in terms of correlation analysis, simple regression and multiple regression analysis models. Results indicate that Pearson's correlation results indicate a relatively moderate, positive and significant association between Green manufacturing and Environmental Sustainability in Kampala industries. The findings show that there was a low but positive correlation (r= 0.480, sig .000, p< .01) between Reverse Logistics and Environmental Sustainability. This implies that any improvements made in reverse logistics can be associated positively with environmental sustainability in Kampala. The study, therefore, concludes that findings are partially supportive of The National Environment Act, 2019; specifically concerning the prohibition of littering, Trans boundary movement of waste and classification and management of hazardous waste. It is therefore recommended that National Environment Management Authority and Uganda revenue Authority work out a rewards system for firms that actively practice Reverse Logistics as this undercuts pollution as reduces waste dumped in water bodies and the environment.

Keywords: *Reverse Logistics, Environmental Sustainability, Manufacturing Entities - Kampala district*

Introduction

Reverse logistics is the backward flow of goods, service delivery items and value from point of consumption to production. This helps in getting items for recycling, reuse, and remanufacturing. Organizations doing this, save a lot in costs of raw materials purchase and packaging costs among others (Jalil, *et al.*., 2016).

The final item is reverse logistics. After goods have been delivered to their final destination, some items are taken back to the manufacturing entities through the reverse logistics system, these are excess goods which shall be sold to other customers, broken goods which have to be mended and resold, empty containers like shipping containers, and other big containers that can be used to package goods and keep them in good condition during transportation for many more times, reusable goods like handling and fixing tools, these should be kept and used whenever they are needed. Fastening belts and tarpaulins, pallets and floorboards, and any more items are also returned for reuse. The other items that are returned by reverse logistics are waste that can be recycled low-cost raw materials are got for the production of industrial products, such items are plastic bottles and other non-biodegradable items. The items that aren't needed anymore but could jeopardize the environment if abandoned are brought back and disposed of professionally. These are called items that have reached the end of life e level. Reverse logistics is a very critical aspect of green supply chain practices, it helps in relieving the environment of dangerous items that would pollute it hence leaving the environment to thrive and be sustainable.

Reverse logistics also helps to generally enforce environmental sustainability, it can capture items that would have been disposed of poorly into wetlands and water bodies, hence ensuring better land use, availability of clean water sources and many more things. Reverse logistics is a critical function in helping to clean the environment, and not only that but improving environmental sustainability by relieving the environment of especially toxic waste.

Environmental sustainability is the process of human beings carrying out all activities they do in a manner that protects the natural environment and keeps it conducive for today and future generations (Zimon, Tyan, & Sroufe, 2020). The study decided to use this definition because it is precise and it grossly explains environmental sustainability. Such occurrences don't support environmental sustainability, which is a critical prerequisite to a life-supporting planet. Just like (Chathurani,2020), mentions the lack of environmental sustainability has over time become a critical concern in the manufacturing sector globally and an immediate remedy is required if the world is to survive the foreseen ramifications. Protecting the environment may be a costly venture but the dangers of not proactively protecting it are worse with situations like deaths occurring (Seyed, Ahmad, Mohammad, & Vahdat, 2018).

The world is under threat of being destroyed by poor environment-related disasters than ever before, and entities are compelled to align activities that promote green supply chain practices in order to reverse the situation (Tseng, Chiu, & Liang, 2017). This is due to the continued warming of the planet by carbon emissions, especially from manufacturing-based supply chains (Hendriks, *et al.*, 2017). In addition, for example, the wildfires that raved the Amazon rainforest in Brazil destroyed forestry and animal species (San-Miguel-Ayanz, Durrant, Boca, Maianti, Alberta, Artes, Jacome, Branco, De Rigo, Ferrari, Pfeiffer, Grecchi, Nuijten, Onida, & Loffler. 2020). The wildfires in California USA, South Wales and Victoria in Australia killed people and animal species, destroyed properties worth billions of dollars and many more storms in Asia and the USA (Food and Agricultural Organization & United Nations Environment Programme, 2020).

In Africa, a study on environmental sustainability focusing on health hazards espoused by poor environmental sustainability found that much as poor environmental sustainability and its effects were taking a toll on Zimbabweans, the local communities in the Mount Darwin district of Zimbabwe still believed that

environmental adverseness isn't real and simply not existing (Ncube & Tawodzera, 2019). Zimbabwe experienced a series of heat waves and storms which left a lot of devastation (Ncube *et al.*, 2019).

The study was carried out in Kampala Uganda specifically in the Kampala manufacturing industries. The impact of environmental management is still insignificant, in Uganda, there is evidence of poor environmental sustainability which manifests through droughts, floods and diseases like cholera that kill people especially, in Kampala, air and water and r pollution that is caused by the high concentration of manufacturing industries, reclamation of wetlands for construction the of manufacturing industries and harvest of raw materials which has led to the fast depletion of un renewable raw materials, congestion by the huge number of vehicles on the roads that also pollute the air and make it very unhealthy for human consumption. (Budget Monitoring and Accountability Unit, 2018). People move around littering everywhere with impunity, garbage hips and are seen in different spots within the city centre and which doesn't only keep the city untidy but also blocks drainage systems hence causing floods with sewage spilling on roads which causes disease and multiple other disease threats (National Environment Management Authority, 2018).

The issue of insufficient environmental management in Kampala has left manufacturing entities to continue operating inconsistent with environmental sustainability, for instance, wetlands have been claimed for the construction of factories, industrial packaging materials like polythene paper bags and bottles littered everywhere, poorly maintained vehicles polluting the environment with toxic smoke, uncontrolled mining of uncontrolled natural resources like stones while signs of air and water pollution amongst others are quite evident (BMAU, 2018). The continued practice has caused enormous challenges like serious, increased hot weather spells, inadequate waste management, continued flooding incidences in and around Kampala, depletion of raw materials, water and air pollution, wetland mismanagement, poor ecological balance, and not to mention the loss of human life due to disease outbreaks like cholera (National Environment Management Authority, 2018).

Environmental sustainability is very important, without sustainability, humankind, animals and humankind will be destroyed (Sarkis, 2017). Uganda is facing unprecedented environmental sustainability challenges caused by traditional supply chain practices which operate in total disregard to environmental protection (BMAUfor2018). Supply chains must continue to operate since they improve economic sustainability which is much needed, but the main challenge is that as they continue operating, they jeopardize environmental sustainability which threatens our existence and the existence of future generations (UGGDS, 2017/18). This is the main gap since without solving the current challenge, it would lead to a serious situation which threatens the extinction of all living things on the planet (Tesfaye & Kitaw, 2020). The state of affairs if not addressed expeditiously, it would also lead to adverse situations like raw materials depletion, which destroys lives and properties, wetland abuse, water and air pollution, and ecological challenges (National Environment Management Authority, 2018). Organizations like NEMA, KCCA, Ministry of water and environment, have educated the country on how to uphold environmental sustainability but all efforts haven't yielded enough (National Environment Management Authority, 2018). They have encouraged green sourcing, green manufacturing, green transportation, and reverse logistics among others (Ministerial Policy Statement, Ministry of Water and Environment; FY 2020-2021). Among all these efforts, environmental sustainability has continued to be a challenge in Kampala and this is due to supply chains not operating consistent with environmental sustainability (BMAU briefing paper, 2018).

If environmental sustainability in Kampala is to be improved, certain aspects that negatively impact it must be effectively identified and consequently addressed. Green supply chain practices in the manufacturing sector have been identified as a critical way of improving environmental sustainability Sarkis, (2017), and that is what compelled this study.

As such this study sets out to investigate the relationship between reverse logistics and wetland management. Since they are key to environmental sustainability, embracing green supply chain activities, and would allow sustainable solutions to environmental sustainability challenges.

Literature Review

A number of studies on reverse logistics and environmental sustainability have been published. For instance, Alhamzah & Bilal (2019) argue that reverse logistics is the process of moving goods and services to counter the forward supply chain. Wetland management means strictly avoiding activities that abuse wetlands. For instance, illegally building in them, disposing of waste items into them and reclaiming them in an unregulated manner. Reverse logistics is also defined as the effort made to collect all waste and other unrequired items from the trade back to the point of initiation for either proper disposal, recycling, or repair. Resale and general proper handling (Ahmed, Hui, Ahmed, Tarek & Mahmoud. 2020).

This research defines reverse logistics as the logistics flow of returning all that isn't required from the trade back to the manufacturers or to the supplier for professional handling. It involves activities of, identifying what needs to be returned, collecting the items, sorting and categorizing them, weighing, packing and transportation back to the manufacturers for recycling, reusing and any other necessary activities. The items sent back in the reverse system range from excess goods delivered, breakages, expired goods, packaging containers, i.e. shipping containers, waste like plastic bottles, obsoletes, and any other items not required in the trade (Alhamzah, *et al.*, 2019). These items are usually returned for better handling like remanufacturing, refurbishing, reusing, recycling, repairing, reconditioning, and renovating such that they are resold to the trade.

Reverse logistics is initially seen as a costly venture that drains the organization's resources but when implemented well, it reverses the initial stance tremendously, especially through availing of low-cost raw materials (Bashir, Aiman, Mohammed, Moath, Abdelatty, Ahmed, & Umar. 2021). In a study titled "drivers and barriers of reverse logistics practice: A study of large grocery retailers in South Africa" conducted by Arno Meyer, Wesley Niemann, Justin Mackenzie, & Jacques Lombaard (2017). It was found that reverse logistics optimizes profitability and reduces costs while also improving environmental sustainability. These findings indicate the criticality of practising reverse logistics as a measure of improving environmental sustainability. However, other authors negated the means of practising reverse logistics in a manner that would ensure environmental sustainability. This too needs to be addressed if positive results are to be obtained through reverse logistics globally. Most manufacturers especially in African countries are actually returning items they are going to reuse and or remanufacture living items like plastic waste which requires different sets of machines for recycling because they haven't mobilized that capacity. Some of the manufacturers haven't made a serious effort to venture into recycling because they lack the knowledge of how beneficial it is, leaving the few that have ventured into it to enjoy its proceeds although they also haven't succeeded in collecting most of the waste products so far.

Reverse logistics enables organizations to have full-time low-cost raw materials by enabling producers to collect the used items for the purpose of reuse, recycling and remanufacturing was that for the deplete able materials, it will take long for them to run out since the ones already in the market are being reused many more times (Sergio, Beatriz, Antonio, & Francisco, 2019). This should be encouraged by governments especially for nonrenewable resources and materials that if left in the environment unattended, will pollute wetlands, and other lands and adversely affect environmental sustainability (Jambeck,2018).

Reverse logistics facilitates sending back commercial value, end-of-use products and end-of-life products all to capture more value (Bashir, *et al.*, 2021). This prompts organizations to go green-of-reverse logistics being a critical operation in recovering waste and protecting the environment against pollution, there is strong evidence that reverse logistics can significantly protect wetlands, contribute to green supply chains/ environmental sustainability and reduce the overall cost of operations (Zhang, Zou, Feng, Wang & Yan. 2022).

Without a doubt, therefore, reverse logistics is of great importance globally in not only protecting wetlands but as well, improving social welfare through creating jobs for waste collectors and improving organizations' operational costs by providing low-cost raw materials (Al-Abrrow, Alnoor & Abdullah, 2018). This is a wake-up call for all of us. All leaders from the smallest unit of leadership which is a family setup should mobilize their people against disposing of especially non-biodegradable waste and keep it until they can sell it to those that can recycle it and have it reused for manufacturing different items. Many people's economic status can change through collecting waste and selling it to manufacturers for recycling, this has to be well communicated to the citizenry and people change from littering which kills them slowly to making money through collecting and selling the waste.

Although reverse logistics plays a significant role in environmental sustainability, many organizations aren't aware of it and most importantly, studies in Uganda don't really show how best it can be implemented in a manner that will harmonize manufacturing supply chains and environmental sustainability (National Environment Management Authority, 2018).

A similar study on reverse logistics found that it has a very significant relationship with both wetland management, environmental sustainability and sustainable manufacturing (Alhamzah *et al.*, 2019). Much as reverse logistics can be of great importance in the conservation of the environment, operating an efficient reverse logistics system requires serious systems development since the function requires funds to move around collecting waste. This can lead to high costs of operations if the process isn't well thought out and measures to make it financially viable put in place (Govindan *et al.*, 2015).

In the African context, a study was conducted to establish the feasibility of reverse logistics and it was concluded that some of the constraints faced in South Africa during reverse logistics operations are that, information systems to coordinate operations were found to be internal challenges whereas lack of supplier compliance was the external challenge (Meyer *et al.*, 2017).

In Uganda, coca cola limited is practising reverse logistics specifically collecting used plastic bottles for recycling.

They have established a large network of customers, private plastic waste collectors and administrative bodies like Kampala Capital City Authority to help gather plastic waste for recycling. In fact, to them, it is a successful business on its own making the recycling operations a dual benefit venture in which environmental protection and business avail income for society and the organization. The current reverse logistics operations in Uganda cannot significantly protect wetlands and avert environmental degradation in the country, which means that the gap between manufacturing systems and environmental sustainability will persevere unless most of the manufacturing entities take up reverse logistics. Government and other environment management bodies like NEMA should come up with more scientific and feasible ways of handling reverse logistics and educate and enforce green supply chain practices. According to Alkhatani *et al.*., (2021), the public doesn't easily comply with waste collection guidance like dumping their waste at collection points, this is a big challenge to the manufacturers because then they will have to go searching for the waste all over the environment and not collecting it from specific points if the public had put it in specific places. This makes it expensive for the manufacturers and that is probably the reason why Uganda is still grappling with the challenge of plastic collected from the environment. While the prior published works and studies enriched the available literature, they presented a number of gaps. Some of the studies used different variables to denote green supply chain practices creating a conceptual gap. A number of the studies took place in locations outside sub-Saharan creating geographical gaps. Another critical aspect that wasn't addressed by the studies is the issue of the provision of infrastructure and machinery necessary to implement reverse logistics, and this creates an empirical gap. This prompted the study to test the hypothesis that:

H1: There is a statistically significant relationship between reverse logistics and environmental sustainability in selected manufacturing entities in the Kampala district

Methodology

The study adopted Positivism Philosophical orientation and Positivism is mainly associated with the philosophical stance of the natural scientist, which entails working with an observable social reality to produce law-like generalizations (Saunders, 2019). This philosophy was found to be sufficient for the study because it establishes the truth about what's exactly happening in supply chains thereby helping to develop a scientific model to enforce green supply chain practices (Crowther & Lancaster, 2008).

The study employed both a survey and phenomenological design. The survey encompassed a cross-sectional approach whereby data was collected at a particular point in time. The study chose only a few illustrative sample essentials of a cross-section of manufacturing entities in Kampala. The researcher was not obliged to have further interactions with the study respondents.

In regard to the nature of the study objectives, a cross-sectional is the most suitable to gather quantitative data and make statistical predictions and correlations of factors associated with green supply chain practices and environmental sustainability.

The phenomenological approach was also adopted for this study, this was applied to establish inner most qualitative data using an open-ended question appended to the survey tool at the end of each objective, this open-ended question sought to establish the respondent's view on how green supply chain practices could be

improved in order to have them contribute to environmental sustainability. The use of two methodological designs aimed at detailed information gathering from respondents is highly recommended and supported due to its nature of helping the study to obtain more insight into what is happening in the area (Ntayi,2005; Mafabi; 2012).

The study area was environmental sustainability in selected manufacturing entities in the Kampala district. This geographical area has many high-scale manufacturing facilities, many of them being concentrated in close proximity, making accessibility easy (BMAU Briefing Paper 2018) the target population was all the manufacturing entities in the Kampala district. Kampala has 675 manufacturing entities (*www.uma.or.ug*).

The unit of analysis was the manufacturing entities and units of inquiry included top management like managing directors, general managers, operations managers, production managers, and procurement managers of these entities because they were well positioned to provide information on green supply chain practices and environmental sustainability in manufacturing entities in Kampala district.

Table 1 showing Sample size

Category of Population	Total Number (N)	Sample (S)	Sampling Technique
Top Managers	225	83	Purposive
Production and Operations	225	83	Purposive
Procurement Managers	225	82	Purposive
Total	675	248	

The sample size constituted 248 entities from a population of 675 entities; This was decided upon using Krejcie and Morgan's table of sample size determination. The research considered a more targeted way to select units of analysis and units of inquiry from whom to collect primary data. After determining the sample size of 248 manufacturing entities, they were categorized according to their level of activity and those with higher operations that were likely producing more waste were purposively selected. From these manufacturing entities and top management, production and operations managers, and procurement managers were selected. Purposive sampling from the categorized population was chosen as the method was fit for the purpose as only the managers of entities that produced a lot of waste were targeted as study participants. The study collected and analyzed primary data.

Data were collected at a single point in time since the study was a cross-sectional study. The cross-sectional kind of study was used due to its adequacy in fully exhausting the avenues of such a study and this method has been used in many more studies (Walugembe, 2018). Data was collected from one source and that is primary data which was collected through direct interviews with respondents.

Validity of Research Instrument

The researcher used the judgment of different experts to verify the content validity of the instruments. To assess this, judges were contacted to evaluate the relevance of each item in the instruments in relation to the objectives. The questionnaire was developed based on already used questionnaires which makes it appropriate enough for the exercise. Biases and inaccuracies were reduced through the creation of rapport between the

interviewer and interviewee, and explanations to make statements and questions well understood were also emphasized. Validity was determined using the Content Validity Index (C.V.I). C.V.I = Items rated relevant by both judges divided by the total number of items in the questionnaire.

$$CVI = \frac{\text{No. of items rated relevant}}{\text{Total no. of items}} \geq 0.5$$

In case less than the projected number of respondents had participated due to different reasons that caused failure to participate, a mathematical formula to establish a sufficient number like the one below was provided to ensure that the number of respondents is sufficient.

The CVI for the questionnaire was valid at above 0.5 because the least CVI recommended in a survey study should be 0.5 (Amin, 2005). CVI results were as presented in Table 2.

Table 2: Content Validity Index

Items	Number of Items	Items Deleted	Items Retained	Content Validity Index
Green Sourcing	12	2	10	0.833
Green Manufacturing	7	1	6	0.857
Green Transportation	6	2	4	0.667
Reverse logistics	6	1	5	0.833
Resource use efficiency	7	2	5	0.714
Ecological balance	8	3	5	0.625
Clean air and water	6	1	5	0.833
Wetland Management	7	2	5	0.714
Total Items	59	14	45	0.76 (AVG CVI)

Instrument Reliability

Reliability is the extent to which a research instrument yields consistent results across the various items when it is administered again at a different point in time (Sekaran, 2016). To establish reliability, the instruments were pilot tested in areas with designated industrial parks in Namanve, Jinja and Gulu industries. Reliability was assessed using an intra-class reliability measure. The intra-class correlation coefficient is computed to measure agreement between two or more raters.

Table 3: Intra-class Correlation Coefficient

	Intraclass Correlation	95% Confidence Interval		F Test with True Value 0		
		Lower Bound	Upper Bound	Value	df1	df2
Single Measures	.703[b]	.622	.769	5.728	185	185
Average Measures	.825[c]	.767	.869	5.728	185	185

Source: Primary Data

The intra-class correlation coefficient values less than 0.5 are indicative of poor reliability. Values between 0.5 and 0.75 indicate moderate reliability; values between 0.75 and 0.9 indicate good reliability and values greater than 0.9 indicate excellent reliability (Sekaran, 2011). This study scored an intra-class correlation coefficient of 0.825 which is indicative of a tool with good reliability.

Data Analysis and Presentation

The data collected was analyzed using a computerized analysis application called Statistical Package for Social Scientists (SPSS). This included descriptive and inferential analysis. The descriptive analysis gives data structures in form of frequency tables, standard deviation, and percentages. The inferential analysis gives correlations, Regression, and ANOVA tables. These were used to determine the relationship between the independent variables and the dependent variable. The results from the statistical analysis were presented in tables. This kind of analysis was done for each objective in the study.

Ethical Consideration

The ethics were handled with utmost care since any divergence or neglect of the ethical considerations would lead to a dispute regarding the study outcomes. In this regard, all necessary ethical guidelines were considered. Ethical approval was sought from Mengo Hospital Research Ethics Committee (MHREC) and Uganda National Council for Science and Technology (UNCST) was consulted for guidance on the ethical aspect of the study. prior consent from the respondents was sought and all data collected from respondents was handled in a way prior agreed upon between the researcher and respondent. Exposing the respondent's identity and publishing sensitive material without permission wasn't and won't be done too. Environmental sustainability is quite a sensitive area that is fast affecting the world and we all have to participate in countering the trajectory. In doing so, all of us who decide to make an input in the quest to find a solution should do it with the best of ethics and integrity. Things like reporting falsehoods must at all times be avoided.

Results

Response rate

This study involved 248 respondents to enable the researcher to come up with conclusive results about the relationship between reserve logistics and environmental sustainability in the Kampala district. Only 186 of the respondents that were set for the study or research were able to respond to the study. This reflected a per cent response rate

Table 4 showing a response rate.

Instrument	Distributed	Per cent	Response Rate
Questionnaire	248	186	75%

Source: Primary Data (2021)

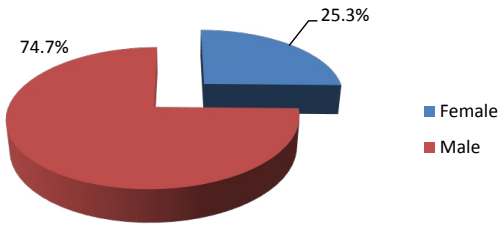
Background of the Respondents

This theme handles the background information on the respondents that participated in the study. The study identifies characteristics of the respondents that help judge their aptitude in expressing views about the relationship between supply chain practices and invites the entire environmental sustainability in Kampala district. These characteristics include gender, age, the highest level of education, job description and tenure in the current docket.

Gender of the respondents

To take into consideration the gender of the respondents, the researcher recorded the results in figure 1.

Figure 1: Gender of the respondents.



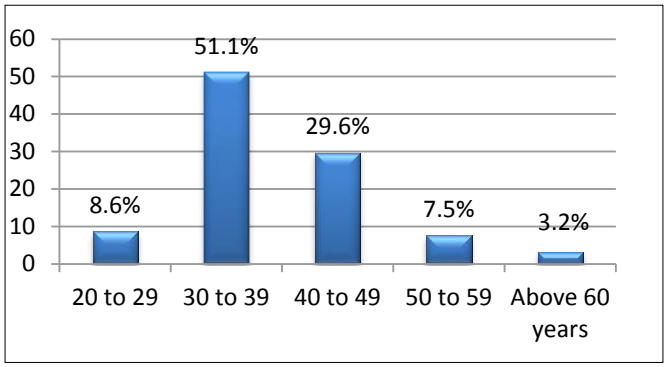
Primary Data 2022

From *Figure 1* above, the study was conducted with mainly male respondents who constituted 74.7%. Female respondents, on the other hand, were 25.3%. The implication of such gender percentages in the study was that all genders were reproduce gender percentages in the study implied between green supply chain practices and environmental sustainability in the Kampala district were captured in the study in a legitimate manner. The responses were however male dominated.

Age of the Respondents

To ascertain their respective age distribution, the respondents were asked to provide the study with their ages. Information presented in figure 2 below:

Figure 2: Age of the Respondents



Primary Data 2022

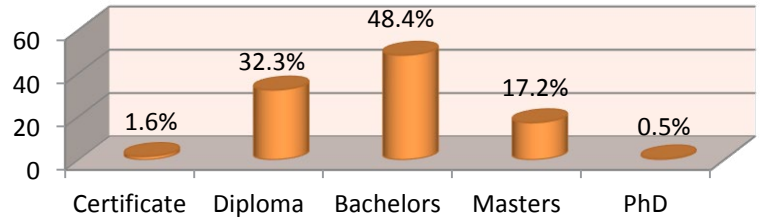
Figure 2 above indicated that of the respondents who participated in the study, 8.6%, were in the range of 20 to 29, 51.1% were in the range of 30 to 39, 29.6%, were in the range of 40 to 49 years, 7.5% were in the range of 50 to 59 and 3.2% were Above 60 Years of age respectively.

The above statistics imply that all respondents (100 %) covered by the study were above ≥20 years of age and considered mature enough to give responses that were consistent and legitimate. The statistics also imply that there was fair distribution in terms of respondents' ages, which provided the study with views of respondents from all ranges in terms of age, without bias.

Highest Level of Education of the Respondents

Respondents were also asked to state their level of education and most of them indicated that they had a bachelor's degree as shown in figure 3 in detail below.

Figure 3: Level of education of the respondents



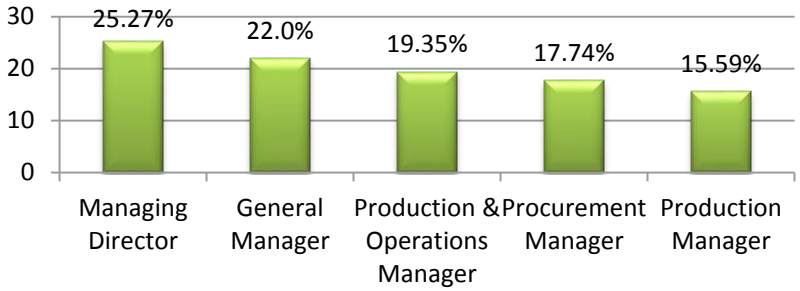
Primary Data 2022

Figure 3 depicts the fact that the largest part of the respondents had attained a bachelor's degree which stood at 48.4%. Only 1.6% held certificates. Those who had attained a Diploma constituted 32.3% of the respondents and Master's Degree holders were 17.2% of the respondents. One PhD holder participated in the study. This implied that the respondents who took part in the study were adequately educated and could provide information that was pertinent to the study.

Job description held in Industry.

The research also sought to know the job description of the respondents. The findings are shown in figure below.

Figure 4: Showing Job description held in Industry



Prominent from figure 4 above it is clear that 25.27% of respondents were managing directors, 22.04% were general managers, 19.35% were production and operation managers, 17.74% were procurement managers, and 15.59% were production managers. The implication was that the majority of respondents involved in the running of factories were the right people to give their opinion on the relationship between reverse logistics and environmental sustainability in the Kampala district and their responses would be considered consistent and legitimate.

Correlation Results

This section delivers a detailed description of the inferential statistics obtained from the field of study based on the specific objective of the study. It goes on to present and answer to the research question. These findings were thus obtained on the relationship between Reverse Logistics and Environmental Sustainability in Kampala industries in terms of reverse logistics and how it relates to environmental sustainability in Kampala industries.

Objective four of the study was to establish the relationship between Reverse Logistics and Environmental Sustainability in Kampala industries.

In order to assess the association and direction between Reverse Logistics and Environmental Sustainability in Kampala industries, the study computed Pearson's product-moment Correlation (PPMC) between Reverse Logistics and Environmental Sustainability in Kampala industries. The bivariate Pearson Correlation produced a sample correlation coefficient, r, which measured the strength, association and direction of linear relationships between pairs of the two continuous variables. The weights of the correlation were interpreted on the following basis: 1.00 perfect relationship; 0.90 – 0.99 very high; 0.70 to 0.89 high; 0.50 to 0.69 moderate; 0.30 to 0.49 low; 0.01 to 0.29 very low and 0.00 translates to a non-existent relationship. Results can be seen in Table below:

Table 5: Correlations between Reverse Logistics and Environmental Sustainability in Kampala industries.

		Reverse Logistics	Environmental Sustainability
Reverse Logistics	Pearson Correlation	1	.480**
	Sig. (2-tailed)		.000
	N	186	186
Environmental Sustainability	Pearson Correlation	.480**	1
	Sig. (2-tailed)	.000	
	N	186	186

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Primary Data 2021

The results in table above show the results from the correlations computed. The findings show that there was a low but positive correlation (r= 0.480, sig .000, p< .01) between Reverse Logistics and Environmental Sustainability. This implies that any improvements made in reverse logistics can be associated positively with environmental sustainability in Kampala.

Regression results of Reverse Logistics on Environmental Sustainability in Kampala industries.

In order to derive the coefficient of determination and to also appreciate the predictive power of the Reverse Logistics on Environmental Sustainability in Kampala, a Linear Regression Analysis (LRA) was adopted. The findings are presented below.

Table 6: Model Summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.480a	.231	.227	.31733
a. Predictors: (Constant), Reverse Logistics				

Source: Primary Data 2021

Results in Table 5 above reveal an Adjusted R Square which indicates the variance in Environmental Sustainability due to changes in Reverse Logistics and Environmental Sustainability. The Adjusted R square value of 0.227 accounts for the variations noted in Environmental Sustainability in Kampala by 22.7% (at 100% test level). The remaining variations (77.3%) in Environmental Sustainability in Kampala are accounted for by other factors.

Table 6: Analysis of Variance

ANOVA						
Model	Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	5.556	1	5.556	55.177	.000[a]
	Residual	18.529	184	.101		
	Total	24.085	185			
a. Predictors: (Constant), Reverse Logistics						
b. Dependent Variable: Environmental Sustainability						

Source Primary Data 2022

F-statistic measures the statistical significance of each of the regression coefficients. Reverse Logistics reflects a moderate F-statistic of 55.177 indicating a moderate variation between sample means relative to the variation within the samples. This means that an F-Factor of 55.177 provides evidence that despite the difference between the group coefficients, they still reflect statistically significant coefficients.

Table 7 showing Regression Coefficients analysis.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.800	.126		22.292	.000
	Reverse Logistics	.237	.032	.480	7.428	.000
a. Dependent Variable: Environmental Sustainability						

Source Primary Data 2022

The Standardized Beta value of .480 (sig. 000, p<.05); means Reverse Logistics explains 48.0 % of the variance in the dependent variable, the remaining 52.0% explained by other factors. Therefore, to improve environmental sustainability, manufacturing organizations can achieve it by improving reverse logistics activities

Testing the Hypothesis H1

The hypothesis states that;

> *H1: "There is a statistically significant relationship between Reverse Logistics and Environmental Sustainability in selected manufacturing entities in Kampala district"*

A statistically significant positive relationship between "reverse logistics" and "Environmental sustainability" The Standardized Coefficient (0.203) was positive (p = 0.010); (p<.05). H1 is accepted. Therefore, the null hypothesis is rejected. There is thus sufficient evidence at the 99 percent level of significance to support the alternative (directional) hypothesis.

Green transportation and Green manufacturing did not significantly predict variations in environmental sustainability. They are necessary factors but do not significantly predict environmental sustainability as they may have limited contributions to environmental sustainability when applied by manufacturing industries in Kampala district.

Discussions

This study analyzed reverse logistics along with the following domains: whether organizations return items that are unwanted by the consumers to the factory; whether organizations return waste from the trade for recycling; whether organizations dump waste in landfill stations; whether organizations repair and re-sale broken items and whether organizations collect, repair and replace spoilt items from the trade.

Findings on Reverse Logistics and Environmental Sustainability in Kampala revealed that organizations receive items that are unwanted by the consumers through the reverse logistics process to the factory. This statement can be supported by numerous submissions from other scholars. This is supported by Tesfaye *et al.* (2020), who assert that conceptualizing the reverse logistics of the plastics recycling system involves complete comprehension of how the whole system works from the initial phase to its logical conclusion when items are duly returned; while Jalil *et al.* (2016) asserted that deep understanding of the process of reverse logistics generally leads to the successful implementation of the process. Meyer *et al.* (2017), while examining drivers and barriers of reverse logistics practices while studying large grocery retailers in South Africa, concluded that a clear appreciation of the entire process explains its success in the South African country. The study results obtained reveal the adherence to reverse logistics standards as specified in the general obligation to prevent and mitigate pollution in the National Environment (Waste Management) Regulations, 2020 Part II (Standards for effluent) regarding criteria for documentation, handling, storage, recycling and reuse of plastics and plastic product. The study finding partly conforms to the Institutional Theory which specifies regulation based on governance institutions regarding laid down procedures.

The study established that organizations practice reverse logistics. These findings are supported by Alnoor, *et al.* (2019), who discussed the effect of Reverse Logistics on Sustainable Manufacturing and established that organizations practising reverse logistics will themselves be able to professionally handle the waste materials that they produce. Other scholars like Aslam, *et al.* (2019), conducting an environmental sustainability study in Pakistan hold the view that reverse logistics has cut demand for raw materials and cut solid waste materials substantially. De Carvalho *et al.* (2020), argue that promoting the practice of reverse logistics is a legitimate attempt to alleviate environmental degradation. However, the study results indicate that reverse logistics by the manufacturing sector as specified in the National Environment (Waste Management) Regulations, 2020 Part II (Standards for effluent) of regarding extended producer responsibility and product stewardship regarding accepting back goods that are deemed as damaged for recycling isn't sufficient. The study finding partly conforms to the Institutional Theory which requires that stakeholders to make social claims of their environment through practices like reverse logistics.

The study established that organizations don't dump waste in landfill stations. This finding is not in line with Chan, *et al.* (2015), who hold the view that manufacturing entities being the biggest active polluters should engage in responsible dumping like in landfills; while Zhang *et al.* (2018), argue strongly that just a fraction of manufacturers desisting from dumping untreated waste materials in the wetlands and instead utilize landfills. Diabat, *et al.* (2013) put forward the view that the Automotive Industry could greatly contribute to environmental sustainability by responsible disposal of waste; this incudes landfills. However, the study results are not in agreement to part II of general provisions relating to waste management contained in the National Environment (Waste Management) Regulations, 2020 regarding responsibility for waste management.

The study findings partly conform to the Institutional Theory which specifies that organizations have to make efforts to conform to the legislative powers and social claims of their environment. Manufacturing units desisting from dumping untreated waste into water bodies and utilizing designated landfills is in conformity with the legislative framework and feeds into environmental sustainability.

The study clarified that organizations repair and resale broken items. This finding is partly in line with Jambeck *et al.* (2018) who while conducting a study on plastic waste inputs from land into the ocean argued that more factories switching to reverse logistics involving repair of products regarded as damaged in support of environmental sustainability. Other scholars such as Govindan *et al.*. (2014) largely concur. They hypothesize that given the environmental degradation situation; only a decisive switch to reverse logistics will remedy the situation. However, the fact that the study was unable to identify a critical mass to form a firm foundation of firms that use renewable energy as a form of reduction in carbon emissions is a cause of concern. This is partly contrary to Part IV article 110 of domestic waste, municipal waste and industrial waste management contained in the National Environment (Waste Management) Regulations, 2020 concerning Waste generated at commercial premises or establishments. The study outcome is somewhat corresponding with the Institutional Theory which advocates for legislative powers and social rights involving recommended techniques like reverse logistics.

The study results established that organizations collect, repair and replace spoilt items from the trade. This finding is supported by Maleki, *et al.* (2019), who conducted a study on the eco-capability role and argue that manufacturing units reduce waste during manufacturing by assembling, refurbishing and swapping damaged items. Congruently, Choudhary *et al.*. (2019), specified that in Bangladesh and Pakistan, gradual reduction in their respective carbon emissions through the implementation of reverse logistics. Although the results reveal a positive association between Reverse Logistics and Environmental Sustainability, it also revealed evidence that many manufacturers are yet to buy fully into reverse logistics operations. The study finding partly conforms to the management of industrial waste contained in Part IV of domestic waste, municipal waste and industrial waste of the National Environment (Waste Management) Regulations, 2020 regarding the duty to manage industrial waste. The study results did not wholly conform to the Institutional Theory which urges that practitioners need to make efforts to conform to the legislative powers; some of which support reverse logistics as measures that can enhance environmental sustainability.

Conclusion and Recommendations

Conclusion

On objective four of the study: "To evaluate the relationship between Reverse Logistics and Environmental Sustainability in Kampala district". The positive hypothesis that there is a significant positive relationship between Reverse Logistics and Environmental Sustainability was not rejected, thus confirming its predictive power of Environmental Sustainability.

The study results concluded that the amount of unique variance Green Sourcing accounts for is statistically significant.

The study, therefore, concludes that findings are partially supportive of The National Environment Act, 2019;

specifically concerning the prohibition of littering, Transboundary movement of waste and classification and management of hazardous waste.

Recommendations

Considering the finding which revealed that Reverse Logistics accounted for some small variations in Environmental Sustainability in Kampala led to the conclusion that Reverse Logistics when put under consideration by National Environment Management Authority, has had a small effect on Environmental Sustainability in Kampala.

It is therefore recommended that National Environment Management Authority and Uganda revenue Authority work out a rewards system for firms that actively practice Reverse Logistics as this undercuts pollution as reduces waste dumped in water bodies and the environment. This is because Reverse Logistics employed on a large scale can eventually contribute to Environmental Sustainability in Kampala.

The findings illustrate the fact that Reverse Logistics can be used to enhance Environmental Sustainability and should be highly considered amongst supply chain operators.

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