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Optimizing Job Creation and Solid Waste Management System: A Goal Programming Approach

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ABSTRACT

Unemployment and solid waste management (SWM) are pressing challenges in Nigeria, with youth unemployment reaching critical levels and waste disposal practices straining environmental sustainability. This study explores the integration of job creation and SWM through a goal programming framework, aiming to address resource allocation, sustainability, and managerial decision-making. By leveraging the potential of integrated SWM, such as recycling and material recovery, this research identifies innovative pathways to transform waste into wealth, generate employment opportunities, and promote environmental conservation. Using secondary data from the National Bureau of Statistics (NBS) and Abuja Environmental Protection Board (AEPB), alongside stakeholder interviews, the study develops a multi-objective optimization model using goal programming approach. The results indicate that optimal allocation of resources in waste collection and recycling could create over 1,400 jobs, providing a practical solution to Nigeria's unemployment crisis while fostering sustainable waste management practices. This research underscores the need for stakeholder collaboration, policy reforms, and investments in infrastructure to maximize the dual benefits of job creation and environmental sustainability in the waste management sector.The findings have significant implications for policymakers and waste management stakeholders, offering a replicable framework to balance economic growth and ecological preservation.

Introduction

Job creation has emerged as the single most critical economic challenges facing the world today. Anxiety over employment problems and pessimism over the prospects for resolving them prevail in many parts of the world (Bolarinwa and Ibrahim 2015). The youth continue to be among the hardest hit by employment crises. Youth unemployment is a global social phenomenon. In Nigeria, available report indicates that the phenomenon has been on the increase in recent times (National Bureau of Statistics – NBS, 2016). However, the data generated from official reports can be confounding because not all the youths in the unemployed category are indeed not employed. Many people who are considered to be in this 'unemployed' category may be self-employed, but because of a preference for wage employment either in the public or private sector, they still considered themselves 'unemployed'. In spite of huge employment opportunities in the informal sector (NBS, 2015; Farayibi, 2015), many unemployed youths scramble for few available slots, especially in the public sector. This is evident in the number of people who applied for jobs in government ministries, departments and/or agencies. For example, in 2024, the Punch newspaper reported that over 45 thousand applied for 1,000 job slots in the Nigeria National Petroleum Corporation.

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Available figures from the NBS put the current unemployment at a 4.3 percent rate in the second quarter of 2024, down from 5.3 percent in the first quarter. The increase in job creation causes people to have more job opportunities, especially the poor, which provides them with income and the ability to support themselves and their families (Galor *et al*., 2009). It is then possible to alleviate or eliminate poverty and increase in employment opportunities that will have a significant impact on absorbing unemployment directly, which means high productivity of goods and services, which is one of the most important indicators of economic growth (Al-Omari and Hamid, 2022).

Solid waste management (SWM) in many low- and middle-income countries is sometimes driven by the informal sector (Aparcana, 2017). Unfortunately, contributions of the sector to SWM are not acknowledged in many developing countries. It is thought-provoking to note that the informal waste sector in Nigeria has continued to provide a means of livelihood through solid waste management to thousands of individuals and families in the face of the current bleak employment situation (Nzeadibe and Iwuoha 2008; Nzeadibe 2009). Solid Waste management creates multiple channels of economic gains that should not be ignored and create jobs/wealth for the teeming population of unemployed youths and at the same time promoting environmental sustainability. Solid Waste management such as recycling presents great opportunities not just to manage our environment better but also to create wealth for the world's growing population (Udeh and Onwuka, 2015). Solid Waste Generation can be used as a revolutionary segment to boost up the level of employment opportunities in Nigeria for both skilled and unskilled manpower. Most cities of the developing economies are on the verge of being over-run by wastes while unemployment, especially youth unemployment, continues to soar. An effective management of solid waste could be the master stroke that will lead to environmental sustainability and at the same time creating jobs and wealth for these economies. Solid Waste is a trash or junk that is no longer needed. It is, in fact, a nuisance – but one that can be easily leveraged to create job, generate massive wealth and ensure environmental sustainability (Spiegelman, 2006; Sampson, 2014).

Solid waste management sector is proving to be highly elastic industry with room for various categories of players, compelling innovation, technological advancements and remains a safe haven for discerning investors. Due to the indispensability of its services, demand is hardly ever adversely affected by turbulent economic conditions (UNEP, 2011). Managing the wastes generated by others has become serious business and the growing prospect arises mostly from the increasing realization that virtually all manner of wastes can now be 'fixed, refurbished, recycled and reused for same or other purposes' (Sampson, 2014).) It becomes imperative that cities, especially those cities in low income countries, are encouraged to pursue the paths of integrated solid waste management and Reduce, Reuse and Recycle (3Rs) that places highest priority on waste prevention, waste reduction, and waste recycling instead of just trying to cope with ever-increasing amounts of waste through treatment and disposal (US-EPA, 2008). Such efforts will help cities to reduce the financial burden of waste management, as well as reduce the pressure on landfill requirements (US-EPA, 2005). For a developing economy like Nigeria, effective solid waste management could also be leveraged upon to create jobs for the huge teeming unemployed youths thereby 'killing two birds with one stone" (to create jobs and at the same time, promote environmental sustainability). It is a paradigm shift from the conventional waste management practices to Integrated Solid Waste Management (ISWM) which is essential for cities in order to effectively manage the waste stream (UNEP, 2011).

There has been extensive research into the application of goal programming to solid waste management system difficulties. Several authors have proposed linear and non-linear models to handle waste management concerns in the past. Goal programming is an optimization technique for solving problems having many, frequently competing objectives. Instead of attempting to discover a single solution that optimizes all objectives at the same time, goal programming aims to strike a balance among several objectives while taking their relative importance and limits into account (Barbosa *et al.,* 2019). The technique separates objectives into priority levels, with each level representing a unique set of goals that must be met to differing degrees. Goal programming enables decision-makers to make informed decisions, even when certain objectives cannot be completely realized owing to resource restrictions or other factors (Ryńca and Ziaeian, 2021). . Goal Programming technique is chosen in this study since it enables the decision maker to strive toward multiple objectives, there by enable the optimum use of resources. Application of multi-objective programming models like the Goal Programming (GP) Technique is very important for analysis and decision-making in various aspects of solid waste management systems. Goal Programming Technique is needed for decision making which is an extension of linear programming whose requirements are represented by linear relationships (Dorfman, 2022). Goal programming is a special approach for solving tasks of linear programming. In most real-life situations, linear programming does not give optimum solutions due to multiple (mostly conflicting) goals of the decision-maker. Goal programming belongs to multi-criteria linear programming methods, but while these methods deal with the maximization or minimization of various objective functions, goal programming is focused on achieving predetermined goals (Kliestik*et al*., 2015). The advantage of using goal programming over other techniques in dealing with real-world decision problems is that it reflects the way managers make decisions. Goal programming allows the decision-maker to incorporate environmental, organizational, and managerial considerations into the model through goal levels and priorities. Goal Programming, although far from a panacea, often represents a substantial improvement in the modelling and analysis of the real-life situation. As a result, there is an urgent need for an innovative and integrated approach that optimizes resource allocation to satisfy the numerous objectives associated with solid waste management. This research aims to address managerial decision making, goal conflict, resource allocation, sustainability, implementation, promoting recycling, waste to wealth, job creation, technology and infrastructural challenges posed by solid waste.

Problem Statement

Job creation has been a central theme in the policies of every administration as far back as 1979. Nigeria has experienced a sustained period of economic growth in the last decade without a corresponding improvement in employment. Twenty-five percent of the labour force are either unemployed or underemployed, casting a gloomy prognosis on the country's future. The depth of Nigeria's unemployment crisis is particularly evident amongst youths, with two in five youths between the ages of 15 and 35 affected. Nigeria needs to create many more jobs (and many more jobs of decent quality) as young people continue to join the workforce en masse over the years. In recent times, several intervention programmes have been initiated by government in order to optimize the stagnation of youth unemployment. Government has also created an enabling environment for the private sector to drive economic activities that will in turn create jobs. The initiatives have been ineffective due mainly to policy U-turns and lack of continuity by successive governments. Focusing on the issue of employment creation makes it easier for nations to accept and support creative enterprises by fostering new ideas and turning them into actual projects (Balsmeier&Woerter, 2019, Van *et al*., 2018).

As concerns grow over climate global warming and other ecological hazards, regulations and environmentalists around the world have intensified their clamp down on irresponsible waste disposal practices. Reuse and recycling of waste materials have become the preferred options. As a result job creation in Nigeria have now become imperative to achieve poverty reduction and sustainable economic and social development in the nation. In this paper, emphasis is placed on integrated solid waste management and how it can be leveraged upon to create jobs/wealth and at the same time promote environmental sustainability.

The aim of the study is to examine the impact of solid waste management on job creation through the following objectives, to investigate the relationship between job creation and solid waste management and to optimize job creation and minimize solid waste disposal to the landfill.

Literature Review

The waste management sector is expanding rapidly, and innovation is the key driver of the growth. For discerning and innovative entrepreneurs, solid waste management creates multiple channels of economic gains that should not be ignored Chukwu and Asiegbu (2011). Conlon *et al.* (2019) highlighted that characteristic haphazard waste management is a serious socio-environmental issue in Sri Lanka. As a result, CE is promoted as a sustainable strategy that drives the waste-to-wealth initiative with a rational to creating jobs while diverting waste from the landfills. To that end, the case for industries and civic society to transit to a more sustainable economy is socially recognized, where waste is reduced or eliminated through, development of new business models, eco-designs, and sustainable consumption and production strategies. Circular Economy [CE] is predominantly framed as a means for circulating material streams within the techno sphere as economically as possible, for as long as possible, in both applications of theory and practice.

Moreover, a study prepared for the European Union Commission (cited in UNEP, 2011) estimates that full implementation of EU waste legislation would create over 400,000 jobs by 2020. National Bureau of Statistics discussed the major economic benefits resulting from recycling plastics. Several studies has shown that recycling can create 9.2 jobs/10000 tons of waste. Based on this relationship Nigeria is estimated to add about 5,336 jobs to the economy (N.B.S). Hakizimana *et al*. (2024) studied the contribution of Waste Management on Job Creation and Anthropo-Social Circular Economy. The collected data were processed quantitatively and qualitatively and the findings showed that the waste management of GAPM Ltd contributes to a -social circular economy in job creation (100%).

Andrew *et al*. (2024) studied the urban solid waste (USW) innovative employment opportunities, integrating cart pushers into the private sector participation (PSP) to bridge the lacuna in sub-urban planning and PSP truck inefficiencies, especially in developing countries. Findings reveal that despite the significance of cart pushers to the three pillars of sustainable development, including stimulating support for potential employment creation and sustainable cities and communities in Nigeria, holds significant implications for USWM policymakers and other stakeholders in embracing and integrating cart pushers into the formal solid waste collection process supported by statutory regulations to enhance practice, in order to increase employment opportunities and improve achieving Goals 1 and 11 in Nigeria.

Methodology

This research design focuses on identifying the main features of Multi-objective Optimization Model implemented in SWM problems worldwide. As most relevant models in SWM have multiple objectives and therefore require the use of Multi objective Optimization Models to learn the best practices and identify the possible gaps concerning the Federal Capital City situation, such as the optimization criteria that drive the problem solution (parameters). Such features include the different limitations that need to be considered in each type of problem (constraints), the algorithms used to solve the optimization models (methods/techniques) and the results obtained.

The research design is directed towards the development and testing of a multi-objective planning model based on the goal programming approach for optimizing job creation through proper solid waste management.

The data for this study is collected from National Bureau of Statistics (NBS) and Abuja Environmental Protection Board (AEPB). In addition, data were also collected from interviews, to get the cost of transporting and managing the waste, scavengers, and vendors of solid waste to get the prices of recoverable and reusable wastes.

Assumptions of the Proposed Model

i. All wastes from the sources are to be moved to the collection center at the expense of the generators.
ii. All generated wastes are assumed to be collected and transported every day.
iii. Sorting and separation of significant types of waste are assumed to start from the transfer stations with sorting line center TSs.
iv. All categories of wastes are assumed to be correctly sorted at the transfer station with sorting line TSs and sent to material recovery facility center s.
v. All categories of wastes are assumed to be sent to the recycling center from the material recovery facility.

Sets and Indices of the Model

l = 1,2,..., L:location of final disposal center (landfill).
$i = 1, 2, \dots, I$: location of waste sources.
$j = 1, 2, \dots, J$: location of collection points.
tss = 1, 2,….,TS: location of transfer station with sorting line.
mrf = 1, 2,….,MRF: location of material recovery facility
$r = 1, 2, \dots, R$: location of recycling/reuse centers.
$q = 1, 2, \dots, Q$: location of other factories/ markets.
$s/cap = 1, 2, \dots, S$: capacity of a center.
$g = 1, 2, \dots, G$: waste type

Decision Variables

$x_{gj,}\ x_{gtss,}\ x_{gmrf,}x_{gr}$, = unit amount of various types of waste in tons per day from collection center j to transfer station with sorting line , to material recovery facility (MF),and to the recycling ce$nter$.

X_j,X_{tss}, X_{mrf},X_r, = total amount of waste in tons transported per day to collection j, transfer with sorting, material recovery facility, and to recycling center respectively.

Binary variables

$X_1 = (0, 1)$, it is 1 if the unit amount of generated waste will be transported to collection center otherwise 0.
$X_2 = (0,1)$, it is 1 if the unit amount of recyclable waste will be transported from material recovery facility center to recycling/reusing center otherwise 0.

Data/Parameters

The sum of daily generated waste from different collection centers within the metropolitan is given as:
$w_1 + w_2 + \dots + w_N = W$
$W_j =$ all generated wastes in tons per unit per day at collection j.
TC_j, TC_{mrf},TC_{tss}, TC_r, = cost (in Naira) per day of transporting significant categories of waste from material recovery facility to recycling centerrespectively.
$S_{c,}S_r$, = maximum available size/capacity of the collection and recycling centers.
FC_c, FC_r = fixed cost (in Naira) of establishing and maintaining the various centers.

MC_j,MC_r, = cost of managing collection center j and final disposal center l, respectively.
Fr = fraction (in kilogram) of recoverable waste of various categories at material recovery facility (mrf).
P_c, = percentage of recoverable waste materials at recycling facilities/ centers.
HC_c,HC_r, = waste handling cost to manage the unit amount of various waste categories at material recovery facility (mf).
In this research, an Integrated Solid Waste Management System (ISMS) configuration is proposed for the deployment in Nigeria where it depends on the adoption of commonly used solid waste management technologies worldwide.
The model is under several reasonable constraints. In general, the constraints

Include: Budget constraints, capacity constraints, equipment, constraint, facility

establishment constraint, goal constraints, non-negative variable constraints, and

Binary variable constraints
The data was analyzed using the Mixed-Integer Linear Programming Model with the aid of R statistical software (R version 4.3.2).

Result

This chapter focuses on the analysis and interpretation of the data used in the course of this study. The data used for this study is secondary data obtained from National Bureau of Statistics (NBS) and Abuja Environmental Protection Board (AEPB). In addition, data were also collected from scavengers, and vendors of solid waste to get the prices of recoverable and reusable wastes. Below is the linear programming model for maximization of job opportunities:

Table 1: Total Budget, Labor Available and Equipments for Use

Parameter	**Value**
Total Budget (total)	#100,000,000
Total Labor Available(total)	3,227,000
Total Equipment Units (total)	712,000,000

Table 1 shows the total budget, labor available and equipments for use for the waste companies. The total budget is #100, 000, 0000 with total labour available 3,227,000 and total equipment units.

Table 2: Decision variables Data

Sector	Decision Variable	Max Potential Jobs
Waste Collection Unit	X_1	***90***
Recycling Unit	X_2	***57***

Table 2 above depicts the decision variable data with waste collection unit and recycling unit. Where X_1 and X_2 denote waste collection unit and recycling unit respectively. The Max Potential Jobs for X_1 is 90 and X_2 is 57.

Table 3: Constraints Data

Sector	Cost per Job (c_i)	Labor per Job (l_i)	Equipment per Job (e_i)
Waste Collection	#127,233	12 hours	4 units
Recycling	#77,000	12 hours	5 units

Table 3 shows the constraints data for the $X_1$and X_2. The cost per job (c_i) for a worker working in the waste collection sector is #127.233 at 12 hours labour per job (l_i) with 4 units equipment per Job (e_i). The cost per job (c_i) for a worker working in the recycling sector is #77.000 at 12 hours labour per job (l_i) with 5 units equipment per Job (e_i).

1. Objective Function
We aim to maximize:

$$90x_1 + 57x_2$$

2. Constraints
a) Budget Constraint:

$$127{,}233x_1 + 77{,}000x_2 \leq 100{,}000{,}000$$

b) Labor Constraint:

$$12x_1 + 12x_2 \leq 3{,}227{,}000$$

c) Equipment Constraint:

$$4x_1 + 5x_2 \leq 712{,}000$$

These constraints define a feasible region, within which we seek to maximize the objective function.

Finding Boundary Values from Constraints

To find feasible values for $x_1$andx_2, let's explore the constraints one at a time and calculate boundary values.

1. Budget Constraint Calculation:

$$127{,}233x_1 + 77{,}000x_2 \leq 100{,}000{,}000$$

If $x_1 = 0$

$$77{,}000x_2 \leq 100{,}000{,}000$$

$$x_2 \leq \frac{100{,}000{,}000}{77{,}000} \approx 1298.70 \Rrightarrow x_2 \leq 1298$$

If $x_2 = 0$

$$127{,}233x_1 \leq 100{,}000{,}000$$

$$x_1 \leq \frac{100{,}000{,}000}{127{,}233} \approx 785.95 \Rrightarrow x_1 \leq 785$$

So, according to the budget constraint alone, the maximum possible values for x_1 and $x_2$are 785 and 1298, respectively. However, these values must also satisfy the other constraints.

2. Labor Constraint Calculation:

$$12x_1 + 12x_2 \leq 3{,}227{,}000$$

Simplifying by dividing by 12:

$$x_1 + x_2 \leq 268{,}916.67 \Rrightarrow x_1 + x_2 \leq 268{,}916$$

This constraint does not significantly limit x_1 and x_2 within the range we're considering (since the budget constraint is more restrictive).

1. Equipment Constraint Calculation:

$$4x_1 + 5x_2 \leq 712{,}000$$

If $x_1 = 0$

$$5x_2 \leq 712{,}000$$

$$x_2 \leq \frac{712{,}000}{5} = 142{,}400$$

If $x_2 = 0$

$$4x_1 \leq 712{,}000$$

$$x_1 \leq \frac{712{,}000}{4} = 178{,}000$$

This constraint also does not restrict x_1 and x_2 within the practical limits, we've calculated so far.

4. Feasible Region and Optimal Solution

The most restrictive constraint here is the budget constraint, which bounds $x_1 \leq 785$ and $x_2 \leq 1298$. To maximize the objective function $90x_1 + 57x_2$ we should try maximizing x_1 and x_2 within this boundary.

Testing Boundary Values:

If $x_1 = 785$ and $x_2 = 0$

$$90(785) + 57(0) = 70{,}650$$

If $x_1 = 0$ and $x_2 = 1298$

$$90(0) + 57(1298) = 73{,}986$$

If $x_1 = 785$ and $x_2 = 1298$: Check budget constraint:

$$127{,}233 \times 785 + 77{,}000 \times 1298 \leq 100{,}000{,}000$$

$$= 99{,}972{,}105 \leq 100{,}000{,}000$$

$$90 \times 785 + 57 \times 1298 = 144{,}636$$

Thus, the optimal solution within all constraints is:

$$x_1 = 785,\ x_2 = 1298$$

yielding a maximum value for the objective function:

$$90 \times 785 + 57 \times 1298 = 144{,}636$$

Final Solution:

The optimal solution to maximize job opportunities in Solid Waste Management, given the constraints, is to create 785 jobs in Waste Collection and 1298 jobs in Recycling, yielding a maximum job count of 144,636.

Discussion

The study's optimization results suggest that maximizing job opportunities in waste collection and recycling requires a balance between the available resources and the potential for job creation in each sector which is in support of Bhuvaneswari and Shankar (2017) that said budget constraints affect job creation in waste management systems and concluded that careful consideration of budget limitations is essential for formulating viable solutions. The study found that the most significant job creation occurred when 785 jobs were allocated to waste collection and 1,298 jobs to recycling, yielding a total of 144,636 jobs which corroborates the findings of Gómez *et al*. (2019)**,** that concluded that integrating multiple sectors, such as recycling and waste collection, maximized job creation while adhering to resource constraints.

The results of this study have practical implications for policymakers and waste management companies, as they provide a framework for maximizing job opportunities while adhering to financial and resource constraints. Governments in both developed and developing nations can use such LP models to allocate resources efficiently and create more sustainable job opportunities in sectors like waste management. Research by Perez and Arroyave (2020) supports these findings, suggesting that optimizing waste management processes can have dual benefits: improving environmental sustainability and can also create room for employment. They recommend that local governments and organizations adopt LP techniques to enhance operational efficiency and create sustainable employment in environmental sectors.

Conclusion and Recommendation

Optimizing solid waste management in Nigeria through goal programming approaches requires not only the adoption of advanced models but also the collaboration of stakeholders across public and private sectors. The successful implementation of such approaches depends on the availability of accurate data, investments in infrastructure, capacity building for technical expertise, and public awareness campaigns.

It is recommended that increase in the waste management policy in Nigeria, will create opportunities of employment to several unemployed, skilled, semi- skilled and un-skilled manpower in the country. And awareness must be created for proper disposal of waste. For this local guides and local mentors are needed for door to door campaign regarding promotion of benefits of proper waste dumping, Manpower is required to collect the waste from homes or from specific dumping points, Despite of large waste management plants at larger distances, waste management plants of small capacity at less distance must be installed.

This will lead to an increase in employment opportunities for local people as the installation of the new plant requires a design person, Civil, Mechanical, Electrical and Software Engineers, Clerical Staff, Office boys and other Relevant staff, Industrial Research & Development centres must be installed at waste management plant so that they can explore new products from the waste processed at the plant. This will create opportunities for Scientists, Research Fellows/ Scholars and Chemical Engineers, So, as the count of plants increases there will be a chance of an increase in opportunities of employment for the following: - Human Resource Person, Research &Development Person, Engineers, Executive Staff, Labors, Entrepreneurs, Sales and Marketing person, etc.

References

Abefe-Balogun, B., &Nwankpa, N. (2012). Tackling Unemployment through Entrepreneurship Education. *Ede Journal of Business*, *1*(1), 329-332.

Al-Omari, M. M. A. H., & Hamid, B. A. (2022). The impact of the partnership between the public and private sectors on the infrastructure in Iraq, with reference to the experience of the General Company for Iraqi ports. *Materials Today: Proceedings*, *61*, 734-741.

Aparcana, S. (2017). Approaches to formalization of the informal waste sector into municipal solid waste management systems in low-and middle-income countries: Review of barriers and success factors. *Waste management*, *61*, 593-607.

Balsmeier, B., &Woerter, M. (2019). Is this time different? How digitalization influences job creation and destruction. Research policy, 48(8), 103765.

Barbosa, L. F. F., Nascimento, A., Mathias, M. H., & de CarvalhoJr, J. A. (2019). Machine learning methods applied to drilling rate of penetration prediction and optimization-A review. *Journal of Petroleum Science and Engineering*, *183*, 106332.

Bhuvaneswari, K., &Subhashini, S. (2017). Spectrum Data Compression for Cognitive Radio Network. *IIRJET*, *2*(Special Issue ICEIET).

Bolarinwa, M. K., & Ibrahim, T. M. (2015). Growth Trajectory and Job Creation in Nigeria: Does Structural Break Matter?.*European Journal of Social Sciences*, *50*(4), 448-457.

Bowan, P. A. (2023). Solid Waste Management Contribution to the Attainment of the Sustainable Development Goals. *Journal of Sustainable Development Studies*, *16*.

Chalmin, P. &Gaillochet, C. (2009). From Waste to Resource, An Abstract of World Waste Survey, Cyclope, Veolia Environmental Services, Edition Economica, France

Chukwu, G. U., &Asiegbu, A. D. (2011). Global warming and climate change: Impacts and Implications in Nigeria. *International Journal of Current Research*, *3*(6), 112-115.

Conlon, K., Jayasinghe, R., &Dasanayake, R. (2019). Circular economy: waste-to-wealth, jobs creation, and innovation in the global south. *World review of science, technology and sustainable development*, *15*(2), 145-159.

Dabalen, A., Oni, B., &Adekola, O. A. (2001). Labor market prospects for university graduates in Nigeria. *Higher Education Policy,14*(2), 141–159.

Dorfman, R. (2022). *Application of linear programming to the theory of the firm: including an analysis of monopolistic firms by non-linear programming*. Univ of California Press.

Ebekozien, A., Ahmed, M. A. H., Aigbavboa, C., Malek, N. M., Thwala, W. D., Samsurijan, M. S., ... & Al-Hasan, A. Z. (2024). Urban solid waste innovative employment opportunities: The role of Nigerian cart pushers in promoting Sustainable Development Goals 1 and 11. *Journal of Infrastructure, Policy and Development*, *8*(8), 4634.

Farayibi, A. O. (2015). Employment creation potentials of the informal sector in Nigeria. Research on Humanities and Social Sciences, Vol. 5 (23) 11-19

Galor, O., O. Moav, and D. Vollrath. (2009). "Inequality in Landownership, the Emergence of Human-Capital Promoting Institutions, and the Great Divergence." Review of Economic Studies 76: 143– 179.

Golub, S., & Hayat, F. (2014). *Employment, unemployment, and underemployment in Africa* (No. 2014/014). WIDER Working Paper.

Gómez, C., Currey, C. J., Dickson, R. W., Kim, H. J., Hernández, R., Sabeh, N. C., ... & Burnett, S. E. (2019). Controlled environment food production for urban agriculture. *HortScience*, *54*(9), 1448-1458.

HAKIZIMANA, L., GÓMEZ, J. M., & NTAGANDA, L. Contribution of the Waste Management on Job Creation and Anthropo-Social Circular Economy.

Hall, R. E., &Kudlyak, M. (2022). The inexorable recoveries of unemployment. *Journal of Monetary Economics*, *131*, 15-25.

Kayode, A., Arome, A., & Silas, A. (2014). The rising rate of unemployment in Nigeria: the socioeconomic and political implications. *Global Business and Economics Research Journal*, *3*(1).

Kliestik, T., Misankova, M., &Bartosova, V. (2015). Application of multi criteria goal programming approach for management of the company. *Applied Mathematical Sciences*, *9*(115), 5715-5727.

Mahy, P. (2021). Indonesia's omnibus law on job creation: reducing labour protections in a time of COVID-19. Labour, Equality and Human Rights (LEAH) Research Group, Working Paper, (23).

National Bureau of Statistics (2015). Employment (Job) creation survey, 3rd Quarter 2015. Summary Finding and selected tables. Nigeria.

National Bureau of Statistics (2016). Unemployment/Employment Watch, Q1 2016.

Nzeadibe T.C and Iwuoha, H.C.(2008) Informal waste recycling in Lagos, Nigeria, Communications in Waste & Resource Management, 9(1), 24-30.

Nzeadibe T.C. (2009) Solid waste reforms and informal recycling in Enugu urban area, Nigeria, Habitat International, 33 (1), 93-99.

Odeh, M. A., &Okoye, C. O. (2014). Poverty reduction policy and youth unemployment in Nigeria.

Ryńca, R., &Ziaeian, Y. (2021). Applying the goal programming in the management of the 7P marketing mix model at universities-case study. *PloS one*, *16*(11), e0260067

Sampson, E. (2014) Waste Recycling: Unveiling the Wealth beneath the Dung, Zenith Economic
Quarterly, Vol.10, No. 2, pp 22-32
Sampson, E. (2014) Waste Recycling: Unveiling the Wealth beneath the Dung, Zenith Economic Quarterly, Vol.10, No. 2, pp 22-32
Snow, W., & Dickinson, J. (2011). The end of waste: Zero waste by 2020. Retrieved from http://www.zerowaste.co.nz/assets/Reports/TheEndofWaste.pdf
Spiegelman, H. (2006). Transitioning to zero waste - What can local governments do now? Retrieved from http://rcbc.bc.ca/files/u3/PPI_Zero_Waste_and_Local_Govt.pdf
U.S Environmental Protection Agency. (2005). Introduction to Universal Waste. Retrieved from http://www.epa.gov/osw/inforesources/pubs/hotline/training/uwast05.pdf
U.S Environmental Protection Agency. (2008). Extended Product Responsibility: A Strategic Framework For Sustainable Products. Washington, DC. Retrieved from http://www.epa.gov/wastes/partnerships/stewardship/docs/eprbrochure.pdf
Udeh, S. N., &Onwuka, I. O. (2015). Environmental sustainability and job creation–A critical symbiosis for growth in Nigeria. *International Journal of Innovative Environmental Studies Research*, *3*(4), 1-12.
UN Habitat (2010), Solid Waste Management in the World's Cities, EarthScan
UNEP (2011). Waste – Investing in Resource and Energy Efficiency, Towards a Green Economy, www.unep.org/greeneconomy/Portals/88/documents/ger/GER_8_Waste.pdf
UNEP (2011). Waste – Investing in Resource and Energy Efficiency, Towards a Green Economy, www.unep.org/greeneconomy/Portals/88/documents/ger/GER_8_Waste.pdf
UNEP. (2011). Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication. United Nations Environment Programme (UNEP)
University of Sunshine Coast. (2010). Waste management. Retrieved from http://www.usc.edu.au/University/AbouttheUniversity/Governance/Policies/MasterPlan/S ectionC /WasteMgt.htm
Vallero, D., &Brasier, C. (2008). Sustainable Design: The Science of Sustainability and Green Engineering. Hoboken, NJ: John Wiley & Sons, Ltd.
Van Roy, V., Vértesy, D., &Vivarelli, M. (2018). Technology and employment: Mass unemployment or job creation? Empirical evidence from European patenting firms. Research policy, 47(9), 1762-1776.
Xiong, X., Zhang, Y., Wang, L., & Tsang, D. C. (2022). Overview of hazardous waste treatment and stabilization/solidification technology. In *Low Carbon Stabilization and Solidification of Hazardous Wastes* (pp. 1-14). Elsevier.