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Research Article

Comparative Analysis of Upstream and Downstream Adaptations by Producers in the Extended Producer Responsibility Programme in Lagos State, Nigeria, From 2012-2021

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Abstract
The study did a comparative analysis of the upstream and downstream adaptations of the producers in the Extended Producer Responsibility programme in Lagos from 2012-2021. The upstream operations are the precautionary actions taken at the production stages against end-of-life impacts of products on the environment. The downstream aspect of the implementation of the Extended Producer Responsibility programme are taken at the end-of-life of products to avert adverse environmental effects. Data for the study was collected from both primary and secondary sources. Census approach was used because the producer population of 281 is rather small for sampling. Five-point Likert scale was used for the descriptive analysis which yielded a mean of 3.05 and 3.23 for upstream and downstream adaptations respectively. The qualitative content analysis showed that the producers adapted the reactive downstream operations more than the proactive upstream adaptations. Similarly, the hypothesis test resulted in significant difference between the upstream and downstream adaptations in favour of the downstream operations. The conclusion was that the producers yielded more to the downstream operations which is suggestive of the overburdened dumpsites in Lagos. The study recommended more regulatory efforts by the National Environmental Standards and Regulations Enforcement Agency to make producers tilt more towards the waste minimising upstream adaptations. The producers should invest more in Research and Development for innovative design for environment, green procurement and clean production which are elements of the upstream adaptations.
Keywords: Adaptations, Downstream, Extended Producer Responsibility Programme, End-of-Life, Environment, Producers, Upstream.

Introduction

The ever-increasing solid waste generation in Nigeria creates a lot of demand on the current infrastructure available to take care of the problem. In Lagos, only 2% of the State budget is allocated for waste management instead of the advised 5% minimum for countries in need of infrastructure improvement. This inadequacy of infrastructure is very evident in Lagos where drains often become clogged with plastic wastes causing frequent flooding and endangering the marine ecosystem (World Bank, 2024).

The improperly disposed waste also contaminates the environmental media made up of land, water and air. Toxic heavy metals from the waste leaches into the soil and the water bodies leading to contamination and sometimes emitted into the atmosphere thereby compromising the ambient air quality. Due to their large extent of toxicity, arsenic, cadmium, chromium, lead and mercury rank among topmost heavy metals emanating from wastes which are of public health concern. These metallic elements are recognised as systemic toxicants that cause multiple organ damage even at lower levels of exposure (Tchounwou *et al.,* 2012). Exposure to such contaminated media is the root cause of various serious health conditions such as cancers, infertility, mental retardation and so on. Furthermore, improper handling of dumpsites releases disturbing stench in the community and produce methane which is a greenhouse gas. There is also the problem of the non-degradable plastic waste that end up in the oceans, disintegrating into microplastics. The microplastics are ingested by aquatic life forms like fish which uploads it in the food chain and in turn consumed by man. This certainly exposes man to various forms of avoidable terminal ailments. According to Ikechukwu (2024), waste is a source of poisoning for the fish stock in the waters and humans end up ingesting them. Animals now eat plastic waste leading to the grooming and spread of cancer. The presentation further revealed that poor waste management exacerbates the destruction of the natural balance. Unsustainable consumption and production is the major cause of the problems arising from these waste streams. This ranges from designed product obsolescence to non-recyclability of products.

Figure 1. Refuse dumpsite at Ikotun, Lagos (Lat. 6° 34′ 16″ N / Long. 3° 15′ 9″ E). Source: Researcher's field work (20/07/2025).

Figure 1 shows the overburdened and unsustainable waste dumpsite that is commonplace in Lagos State fomenting various kinds of environmental issues. Extended Producer Responsibility is an environmental policy approach in which a producer's responsibility is extended to the post-consumer stage of product's life cycle (OECD, 2024). The Organisation for Economic Co-operation and Development (OECD) define the Extended Producer Responsibility (EPR) as "an environmental policy approach in which the producer's responsibility, physical and/or financial, for a product is extended to the post-consumer stage of the product's life cycle" (OECD, 2001, p. 18). It can be stated that the Extended Producer Responsibility is a scheme that requires manufacturers/brand owners to duly avoid negative impacts of their products on the environment after the goods' end of life.

There are the upstream and downstream levels of the implementation of the EPR programme. Design for environment (DfE), green procurement, clean production, eco-labeling are parts of the upstream activities (OECD, 2001). Similarly, Calcott and Walls (2000) averred that design for environment is the equivalent of the pollution policy that has advanced from the so-called end-of-pipe treatment of pollution-to-pollution prevention. The same way solid waste policy is shifting from waste disposal concerns to upstream product and process design issues. This is expatiated by McDonough and Braungart (2002) who noted that the new emphasis for sustainable design is to ensure that the process of product development should aim at limiting end-of-pipe externalities. Calcott and Walls (2005) added the example of how the design for environment works with electronic products that are designed for ease of disassembly or a suitable labelling of materials to make recycling easier and less costly. Design for environment takes place when firms deliberately incorporate environmental issues in their design and manufacturing (Calcott and Walls, 2005). The deposit refund system (DRS) and the upstream tax are among the sources of finance of the upstream sector. For the DRS, an initial deposit is made by the consumer at the point of purchase which are refunded upon return of end-of-life items to a collection center. On the other hand, the upstream tax is paid by producers which establishes a pool of fund to provide incentives for producers to alter their product design for ease of end-of-life management (Laubinger *et al.,* 2022).

Downstream stage of the Extended Producer Responsibility Programme is concerned with waste treatment and disposal of end-of-life products. In the downstream stage, end-of-life products are either recycled or discarded (Calcott and Walls, 2005). At the downstream, producers are condemned to accept legal, socioeconomic or physical responsibility for environmental impacts that could not be taken care of by design (Swachhcoin, 2019). The advance deposit fees are used to finance post-consumer treatment of designated products. They are levied on products at purchase based on estimated costs of public collection and treatment. Additionally, combined upstream tax and downstream subsidy are paid by the producer to subsidise waste treatment and provide the financing mechanism to support public recycling and treatment (Laubinger *et al.,* 2022).

The producers are the providers of the goods that ultimately scale down to waste at end of life. This implies that wastes are generated from the point goods are placed in the market awaiting purchase and consumption. In the view of Lindhqvist (2000), all goods sooner or later become waste; (NESREA) apparently agrees by stating that the producer is the most responsible entity in the Extended Producer Responsibility programme. This is confirmed by Tojo (2001) who submitted that the producer has control over the fate of her discarded product with definite participation in the management of downstream operations. It further opines that the producer should have considerations for the properties and features of their products with respect to their end-of-life management. Lindhqvist (2000) concurs with the statement that producers should factor in solutions to unsatisfactory disposal of their products/materials after their lifetime from the planning and manufacturing stages of the products. Nnorom and Osibanjo (2008) affirm that producers are responsible for the environmental impact throughout the life cycle of their products. Field and Field (2009) were more emphatic to state that, producers need to achieve a series of demanding recycling and recovery targets for different categories of their appliances up to minimum rates of 70% to 80% of component materials. In Nigeria, producers are not only manufacturers but include brand owners, franchisees, assemblers, distributors or the importers who sell, offer for sale or distribute products (NESREA).

The objective of this study is to perform a comparative analysis of the upstream and downstream adaptations of producers of the Extended Producer Responsibility programme in Lagos.

Study Area

The study area, Lagos State is located in the south-western part of Nigeria. The State is bounded in the south by the Bight of Benin. To the west, it has international borders with the Republic of Benin. Lagos State shares borders with Ogun State, located to its north-west. The city is a low-lying coastal state in Nigeria. The coastal area commences from the Nigeria-Benin Republic border and continues up to 200 km to the east. Lagos is located within the geographical coordinates of latitudes 6^0 20'10"- 6^0 43'20" N and longitudes 2^0 41'15"-4^0 22'00"E (Nwilo *et al.,* 2020). Lagos covers a land area of 358,862 hectares or 3,577 sq. km. This represents 0.4% of the land mass of Nigeria which stands at 923.773 sq. km.

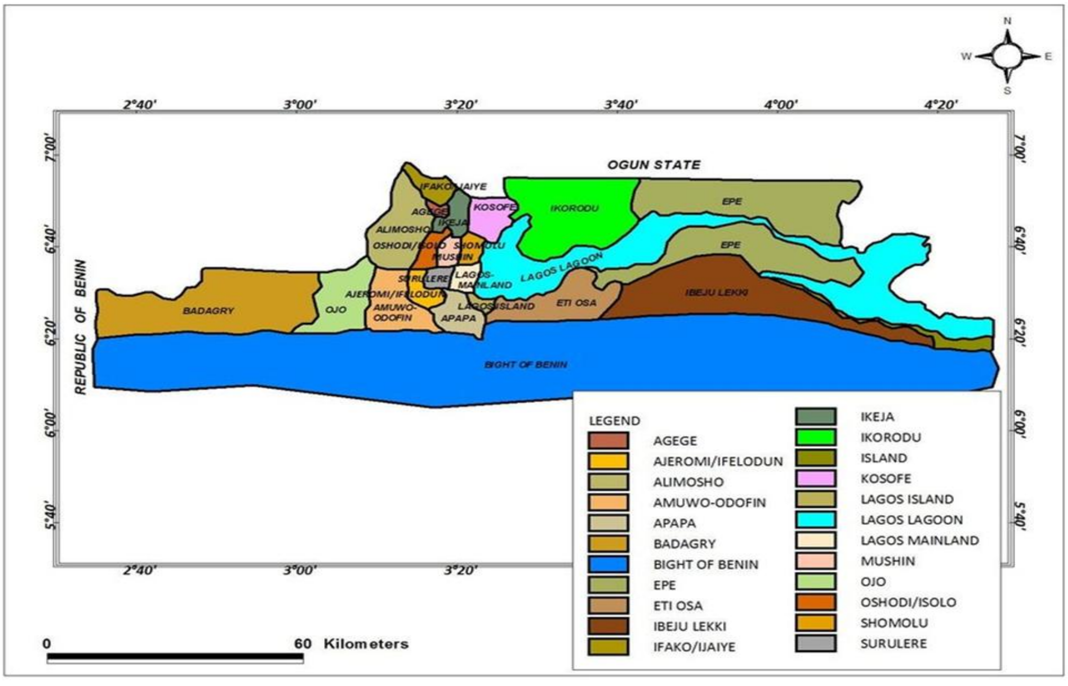

Figure 2. Lagos State showing the 20 local government areas (Source: Lagos State Ministry of Physical Planning).

Figure 2 shows the twenty local governments namely: Agege, Alimosho, Apapa, Ifako-Ijaye, Ikeja, Kosofe, Mushin, Oshodi-Isolo, Shomolu, Eti-Osa, Lagos Island, Lagos Mainland, Surulere, Ojo, Ajeromi-Ifelodun, Amuwo-Odofin, Badagry, Ikorodu, Ibeju-Lekki and Epe. The figure also shows the Bight of Benin, Lagos lagoon and an unnamed island.

The first sixteen listed local government areas are the metropolitan part of Lagos making the State, the most urbanized in Nigeria (Lagos State Government, 2023). Lagos, with an estimated population of 21 million people is the largest city on the African continent. With the population continuing to grow, the population density is around 6,871 residents per square kilometer (World Population Review, 2024). Lagos is the commercial hub of Nigeria and indeed the West African sub region. Lagos accounts for over sixty (60) percent of the industrial and commercial ventures in Nigeria. A 2015 report by the Economist states that Lagos State generates $90 billion in goods and services annually. It further informed that if Lagos were a country, it would have been the 7th economy in Africa making it bigger than Kenya, Cote D'Ivoire and Ghana (CoolGeography, 2023).

Materials and Methods

A cross-sectional survey design was adopted in this study. The design embraced methods of data identification, collation and analysis. The methods were made up of features categorized into seven domains as follows: (i) types of data; (ii) sources of data; (iii) data collection tools; (iv) methods of data collection; (v) study population (respondents); (vi) method of data analysis; and (vii) results presentation and interpretation. These domains provided the logical approach needed to respond to achieve the objective of the study and test the hypothesis. Responses to key informant interviews were subjected to content analysis. The target population for this study are the registered producers in the food beverages, e-waste and battery waste stream who participated in the Extended Producer Responsibility programme in Lagos from 2012-2021. In the programme, the producers are not limited to manufacturers but include importers, wholesalers, brand owners, and franchise owners.

The primary sources were accessed from in-depth interviews with key informants such as the management and staff of the regulator. In addition to the key informant interviews, questionnaires were administered to the producers. The secondary sources of data were availed from published and unpublished literature materials in textbooks, journals, monographs, internet search, relevant data from NESREA, producers and collectors.

Table 1. Registered producers in the extended producer responsibility program in Lagos.

Waste stream	Producers
E-waste	249
F and B	29
Battery	3
Total	**281**
Source: National Environmental Standards and Regulations Enforcement Agency (NESREA, 2011).	

Table 1, shows that the total number of the producers in the Extended Producer Responsibility programme for the three streams of waste in the study area were only 281. The researcher therefore used the census approach and administered questionnaires on all of them as well as conducted in-depth interviews on some key managers and staff. This constitutes the study population which is not much as to be sampled. Out of the 281 questionnaires distributed, 270 were returned and found usable for analysis. Descriptive analysis of a five-point Likert scale questionnaire was applied.

The in-depth interview was equally analyzed in terms of environmental design, upstream taxation and responsibility at end-of-life. A qualitative content analysis was conducted to explore producers' perspectives on upstream and downstream adaptations within the Extended Producer Responsibility (EPR) programme in Lagos. The responses were analyzed using open coding, axial coding, and thematic abstraction to derive common patterns across three question domains. The data was also analysed with student t-test statistical tool and hypothesis testing.

Quantitative data provided objective and measurable information on the upstream and downstream aspects of the programme, while qualitative data offered insights into the underlying social, economic, and cultural factors that impact on the environment. Triangulating data from different sources helped validate the research findings. When quantitative results aligned with qualitative insights, it strengthened the credibility and reliability of the conclusions drawn from the study. Using qualitative methods like interviews and observations enabled the researcher capture diverse perspectives of the producers involved in the programme. To enhance the validity and reliability of the instrument, a pilot study was conducted with a small group of respondents to identify any issues with the survey questions or instructions. Based on the feedback received, necessary revisions were made before administering the survey to the entire registered producers in the Extended Producer Responsibility programme in the study area.

Result and Discussion

Table 2. Responses from producers on upstream adaptations.

Item	EPR operations	SA (5)	A (4)	N (3)	D (2)	SD (1)	n	Mean	Standard deviation
E1	Design for environment	58 (21.5%)	52 (19.3%)	54 (20%)	53 (19.6%)	53 (19.6%)	270	3.03	1.43
E2	Green procurement	60 (22.2%)	55 (20.4%)	54 (20%)	51 (18.9%)	50 (18.5%)	270	3.09	1.42
E3	Clean production	59 (21.9%)	53 (19.6%)	52 (19.3%)	54 (20%)	52 (19.3%)	270	3.05	1.43
E4	Eco-labeling	56 (20.7%)	54 (20%)	53 (19.6%)	55 (20.4%)	52 (19.3%)	270	3.03	1.42
E5	Pollution prevention	57 (21.1%)	56 (20.7%)	52 (19.3%)	53 (19.6%)	52 (19.3%)	270	3.05	1.42
E6	Upstream tax	58 (21.5%)	55 (20.4%)	54 (20%)	53 (19.6%)	50 (18.5%)	270	3.07	1.41
Section mean	-	-	-	-	-	-	-	**3.05**	-

Source: Researcher's field work (2024).
Abbreviations: SA = Strongly agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly disagree.

As seen from Table 2, it is established that 21.5% of producers strongly agreed with design-for-environment adoption of the EPR programme. 19.3% agreed, 20.0% were neutral, 19.6% disagreed, and 19.6% strongly disagreed. The mean is 3.03 with a standard deviation of 1.43. This shows a very balanced split between positive and negative responses, indicating moderate but inconsistent adaptation in eco-friendly product design.

Regarding green procurement, 22.2% strongly agreed, 20.4% agreed, 20.0% neutral, 18.9% disagreed, and 18.5% strongly disagreed. The mean compliance score is 3.09 with a standard deviation of 1.42. Producers moderately acknowledge sustainable procurement, but significant neutrality and disagreement suggest uninspiring adoption across industries.

Clean production initiatives saw 21.9% strongly agreeing, 19.6% agree, 19.3% neutral, 20.0% disagree, and 19.3% strongly disagree. The mean is 3.05 with a standard deviation of 1.43. Despite a slight lean towards agreement, adoption of clean production methods remains relatively modest and more needed among producers.

Eco-labeling practices had 20.7% strong agreement, 20.0% agreement, 19.6% neutrality, 20.4% disagreement, and 19.3% strong disagreement. The mean score is 3.03 with a standard deviation of 1.42. This evenly spread response shows limited integration of eco-labeling into product marketing strategies. More is required in the area of information dissemination to the consumers to ensure all-inclusive participation in the EPR programme.

Pollution prevention measures recorded 21.1% strong agreement, 20.7% agreement, 19.3% neutrality, 19.6% disagreement, and 19.3% strong disagreement. The mean score stands at 3.05 with a standard deviation of 1.42. Moderate adaptation is evident but is not dominant among producers, reflecting need for improved action to avert pollution.

For upstream tax considerations, 21.5% strongly agreed, 20.4% agreed, 20.0% were neutral, 19.6% disagreed, and 18.5% strongly disagreed. The mean compliance is 3.07 with a standard deviation of 1.41. Financial incentives and taxation measures are moderately adapted, but not yet a strong motivating force for many producers. With only 41.9% agreement to upstream tax, the source of funding design for environment is limited. The mean for upstream operations is 3.05, indicating moderate but not strong adaptation. The split between positive, neutral upstream tax, and negative, shows fragmented upstream environmental responsibility adoption across producers. A mean neutrality score of 19.7% indicates that more producers would tend to the more convenient negative downstream adaptation.

Table 3. Responses from producers on downstream adaptations.

Item	EPR operations	SA	A	N	D	SD	n	Mean	Standard deviation
F1	End-of-pipe treatment of pollution	70 (25.9%)	65 (24.1%)	53 (19.6%)	45 (16.7%)	37 (13.7%)	270	3.32	1.38
F2	Disposal of end-of-life products	72 (26.7%)	60 (22.2%)	50 (18.5%)	48 (17.8%)	40 (14.8%)	270	3.28	1.41
F3	Registration with relevant PROs	66 (24.4%)	54 (20%)	53 (19.6%)	50 (18.5%)	47 (17.4%)	270	3.16	1.43
F4	Collection of advance deposit fees	65 (24.1%)	58 (21.5%)	56 (20.7%)	48 (17.8%)	43 (15.9%)	270	3.20	1.40
F5	Payment of downstream subsidy	62 (23%)	60 (22.2%)	56 (20.7%)	49 (18.1%)	43 (15.9%)	270	3.18	1.39
F6	Acceptance of legal and socio-economic responsibility	68 (25.2%)	58 (21.5%)	55 (20.4%)	50 (18.5%)	39 (14.4%)	270	3.24	1.39
Section mean	-	-	-	-	-	-	-	**3.23**	-

Source: Researcher's field work (2024).
Abbreviations: SA = Strongly agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly disagree.

The presentation at Table 3 shows that end-of-pipe treatment of pollution recorded 25.9% strong agreement, 24.1% agreement, 19.6% neutrality, 16.7% disagreement, and 13.7% strong disagreement. The mean is 3.32 with a standard deviation of 1.38. The higher agreement rates suggest a relatively strong focus on managing pollution at the final disposal stages.

Disposal of end-of-life products had 26.7% strong agreement, 22.2% agreement, 18.5% neutrality, 17.8% disagreement, and 14.8% strong disagreement. The mean score is 3.28 with a standard deviation of 1.41. This shows preferable adaptation to managing product at end-of-life.

Regarding registration with Producer Responsibility Organizations (PROs), 24.4% strongly agreed, 20.0% agreed, 19.6% neutral, 18.5% disagreed, and 17.4% strongly disagreed. The mean score is 3.16 with a standard deviation of 1.43. Delegated responsibility of waste management is moderately well established but not universally adopted. A 44.4% agreement and 19.6% neutrality shows that producers largely find it more practicable to second the management of their end-of-life products to a third party.

Collection of advance deposit fees reported 24.1% strong agreement, 21.5% agreement, 20.7% neutrality, 17.8% disagreement, and 15.9% strong disagreement. The mean score is 3.20 with a standard deviation of 1.40. Financial models to support recycling costs are highly adopted among producers.

Payment of downstream subsidies saw 23.0% strong agreement, 22.2% agreement, 20.7% neutrality, 18.1% disagreement, and 15.9% strong disagreement. The mean score is 3.18 with a standard deviation of 1.39. This reflects high support for cost-sharing initiatives and preference to the downstream EPR framework.

Acceptance of broader legal and socio-economic responsibilities recorded 25.2% strong agreement, 21.5% agreement, 20.4% neutrality, 18.5% disagreement, and 14.4% strong disagreement. The mean score is 3.24 with a standard deviation of 1.39. This suggests that more producers have preference for the backlash arising from the post-consumer management of their products rather than waste preventive actions. The mean for downstream operations (3.23), is higher than upstream (3.05). Downstream adaptations such as legal liabilities and pollution treatment are more strongly implemented compared to upstream practices like eco-design and green procurement. Producers perform better in final-stage responsibilities like pollution control, disposal of waste, and legal actions. Upstream practices like design for environment, green procurement, and eco-labeling are less consistently integrated, suggesting producers focus more on end-of-life waste management than on preventive eco-friendly product design.

Table 4. Upstream and downstream adaptations to extended producer responsibility.

S/N	EPR operations	SA	A	N	D	SD	n	Mean	Standard deviation
1	Design for environment	28 (10.4%)	32 (11.9%)	35 (13.0%)	57 (21.1%)	118 (43.7%)	270	2.241	1.384
2	Green procurement	29 (10.7%)	30 (11.1%)	38 (14.1%)	52 (19.3%)	121 (44.8%)	270	2.237	1.394
3	Clean production	42 (15.6%)	29 (10.7%)	49 (18.1%)	48 (17.8%)	102 (37.8%)	270	2.485	1.467
4	Eco-labeling	16 (5.9%)	15 (5.6%)	30 (11.1%)	68 (25.2%)	141 (52.2%)	270	1.878	1.172
5	Pollution prevention	56 (20.7%)	58 (21.5%)	23 (8.5%)	65 (24.1%)	68 (25.2%)	270	2.885	1.510
6	Upstream tax	21 (7.8%)	27 (10.0%)	29 (10.7%)	80 (29.6%)	113 (41.9%)	270	2.122	1.269
7	Registration with relevant PROs	110 (40.7%)	80 (29.6%)	41 (15.2%)	12 (4.4%)	27 (10.0%)	270	3.867	1.273
8	End-of-pipe treatment of pollution	120 (44.4%)	47 (17.4%)	23 (8.5%)	32 (11.9%)	48 (17.8%)	270	3.589	1.560
9	Disposal of end-of-life products	117 (43.3%)	68 (25.2%)	27 (10.0%)	18 (6.7%)	40 (14.8%)	270	3.756	1.440
10	Advance deposit fees	134 (49.6%)	51 (18.9%)	43 (15.9%)	19 (7.0%)	23 (8.5%)	270	3.941	1.304
11	Downstream subsidy	127 (47.0%)	80 (29.6%)	13 (4.8%)	26 (9.6%)	24 (8.9%)	270	3.963	1.305
12	Engineered landfill sites	132 (48.9%)	78 (28.9%)	23 (8.5%)	17 (6.3%)	20 (7.4%)	270	4.056	1.220

Source: Researcher's field work (2024).
Abbreviations: SA = Strongly agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly disagree.

Table 4 was obtained when data from the upstream and downstream were analysed by averaging upstream and downstream adaptation items measured on 5-point Likert scale. As observed in Table 4, only 10.4% of producers strongly agreed to design for environment, 11.9% agreed, 13.0% were neutral, 21.1% disagreed, and 43.7% strongly disagreed. The mean score is 2.24, with a standard deviation of 1.38. These results reveal very weak adoption of eco-design principles, with more than 64.8% expressing negative perceptions.

For green procurement, 10.7% strongly agreed, 11.1% agreed, 14.1% neutral, 19.3% disagreed, and 44.8% strongly disagreed. The mean score is 2.24, and the standard deviation is 1.39. Similar to eco-design, green procurement practices are poorly integrated, with more than 64.1% recording disagreement or strong disagreement.

Regarding clean production, 15.6% strongly agreed, 10.7% agreed, 18.1% neutral, 17.8% disagreed, and 37.8% strongly disagreed. The mean is 2.49, and the standard deviation is 1.47. Although slightly better than eco-design and procurement, adoption of cleaner production methods still remains low among producers.

For eco-labeling, 5.9% strongly agreed, 5.6% agreed, 11.1% neutral, 25.2% disagreed, and 52.2% strongly disagreed. The mean score is 1.88, with a standard deviation of 1.17. This indicates extremely weak adoption of eco-labeling practices, with 77.4% negative responses, the highest negativity across all items. Pollution prevention efforts recorded 20.7% strong agreement, 21.5% agreement, 8.5% neutrality, 24.1% disagreement, and 25.2% strong disagreement. The mean is 2.89, and the standard deviation is 1.51. While slightly better, opinions remain split, with a substantial portion still not adopting proactive pollution prevention measures.

In relation to upstream taxation, 7.8% strongly agreed, 10.0% agreed, 10.7% neutral, 29.6% disagreed, and 41.9% strongly disagreed. The mean is 2.12, and the standard deviation is 1.27. There is strong opposition to upstream tax adaptations among producers, reflecting concerns about cost of design for environment.

Registration producer responsibility organisation (PRO) recorded 40.7% strongly agreed, 29.6% agreed, 15.2% neutral, 4.4% disagreed, and 10.0% strongly disagreed. The mean score is 3.87, with a standard deviation of 1.27. This is a strong positive result, showing reliance on third-party for compliance to waste management through.

End-of-pipe pollution treatment had 44.4% strong agreement, 17.4% agreement, 8.5% neutrality, 11.9% disagreement, and 17.8% strong disagreement. The mean is 3.59, and the standard deviation is 1.56. Producers demonstrate moderate to high commitment to pollution treatment at end-of-life stages, although some resistance persists.

Disposal compliance showed 43.3% strong agreement, 25.2% agreement, 10.0% neutrality, 6.7% disagreement, and 14.8% strong disagreement. The mean is 3.76, with a standard deviation of 1.44. Disposal practices are relatively well adapted among producers, reflecting successful final-stage responsibility adoption.

For collection of advance deposit fees, 49.6% strongly agreed, 18.9% agreed, 15.9% neutral, 7.0% disagreed, and 8.5% strongly disagreed. The mean is 3.94, and the standard deviation is 1.30. Producers are increasingly comfortable with deposit fee models, supporting financial mechanisms that underpin recycling operations.

Regarding downstream subsidy payment, 47.0% strongly agreed, 29.6% agreed, 4.8% neutral, 9.6% disagreed, and 8.9% strongly disagreed. The mean is 3.96, and the standard deviation is 1.31. Financial contributions towards downstream recycling costs are largely supported among producers.

Maintenance of engineered landfill sites recorded 48.9% strong agreement, 28.9% agreement, 8.5% neutrality, 6.3% disagreement, and 7.4% strong disagreement. The mean score is 4.06, with a standard deviation of 1.22. This is the strongest adaptation area overall, showing high acceptance of structured waste disposal practices.

Comparatively, weak upstream adaptations were observed in eco-labeling (item 4; mean = 1.88), design-for-environment (item 1), and green procurement (item 2). Stronger adaptations occurred in registration with PROs (item 7), advance deposit fee collection (item 10), subsidy payment (item 11), and landfill maintenance (item 12).

Thus, producers show a pattern of stronger end-of-life (downstream) adaptations but weaker early-stage (upstream) waste management practices. This portends more waste accumulation leading to overburdened dumpsites with the resultant problems.

Table 5. Themes on environmental design, upstream tax, and end-of-life responsibility.

Theme	Category (Code)	Example quotation	Freq.
Environmental design (Q1)			
Lack of integration in R&D	Environmental design rarely implemented	"Environmental considerations are part of R&D discussions but rarely implemented.''; "Compliance-focused, not proactive."; Downstream phase prioritized over eco-design."; "We emphasize compliance at the downstream phase."	3
Limited capacity	Machinery upgrades unaffordable	"The environmental design requires machinery upgrades we cannot yet afford."; "Gradual explorations." "Starting to explore eco-friendly designs."; "Our company is just beginning to explore eco-friendly designs."	3
Upstream tax (Q2)			
Non-strategic priority	Focus on growth over eco-design	"It is not a strategic priority right now, given our market expansion goals."; "Opinions on upstream tax	3

		skepticism toward upstream tax."; "Prefer downstream subsidies/schemes."; "We're skeptical of how upstream taxes are used, prefer controlled downstream schemes."	
Need for financial support	Producers need incentives, not taxes	"Producers like us need financial incentives, not taxes."; "Administrative practicality and downstream easier to implement."; "It's easier to administer downstream subsidies than enforce upstream taxes fairly."	4
Policy uncertainty	Lack of clarity on upstream tax modalities	"We lack sufficient clarity on upstream tax modalities, prefer known downstream methods."; "Circular economy alignment and deposit systems preferred."; "Deposit systems align better with circular economy principles in our view."	3
Responsibility for end-of-life issues (Q3)			
Acknowledgement of responsibility	Producers accept responsibility under law	"We acknowledge producer responsibility, though enforcement still needs improvement."; "Corporate governance influence."; "Responsibility is part of governance discussion."; "Responsibility is part of our corporate governance discussion."	2
Reactive to regulation	Anticipate legal liability	"We anticipate liability under new regulations and are adjusting production processes." "Compliance-oriented planning and preparing for legal obligations."; "We're currently drafting policies to align with end-of-life legal obligations."	1
Shared responsibility model	Prefer shared burden across value chain	"We would prefer shared responsibility across the value chain, but accept our role." "Minimal stakeholder feedback was reported, although disposal practices are occasionally questioned by stakeholders."	4
Source: Researcher's field work (2024).			

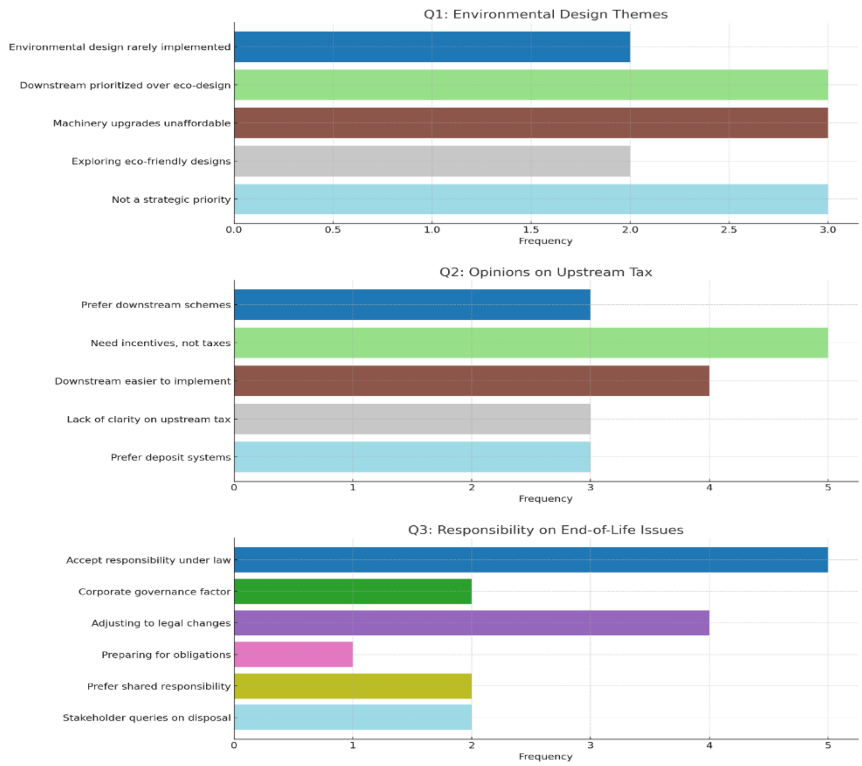

Figure 3. Themes of qualitative content analysis.

Figure 3 shows that for environmental design, most producers acknowledged that environmental considerations are discussed but not yet fully implemented due to financial, strategic, or technical constraints.

A few are beginning to explore eco-design, but upstream innovation remains marginal. The majority of respondents expressed a clear preference for downstream regulatory instruments, citing cost, clarity, and administrative ease. Some support market-aligned deposit systems, but skepticism about upstream tax utility remains high for upstream taxation and for end-of-life responsibility, there is widespread recognition of the producer's role in managing product lifecycle impacts. However, responses indicate a largely reactive posture, with adjustments made primarily in response to evolving legal liabilities.

The qualitative evidence suggests that producers are more reactive than proactive in implementing upstream adaptations. Financial constraints, policy ambiguity, and limited enforcement dilute eco-design incentives. Regulatory clarity and economic instruments aligned with business realities could enhance adoption of sustainable practices.

Hypothesis

H_0: There is no significant difference between upstream and downstream adaptations of producers in the Extended Producer Responsibility (EPR) programme.

Table 6. Test of normality.

Variable	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Level on streams from producers	.193	12	.200*	.902	12	.168
*. This is a lower bound of the true significance.						
a. Lilliefors significance correction.						

Before conducting comparative analyses between upstream and downstream adaptations of producers under the Extended Producer Responsibility (EPR) programme, it was necessary to assess the normality of the data distribution. As presented in Table 6 tests of normality, the Kolmogorov-Smirnov statistic for the level on streams from producers was 0.193 with a significance value of 0.200, while the Shapiro-Wilk statistic was 0.902 with a significance value of 0.168. Both p-values are greater than the 0.05 threshold, indicating that the data are approximately normally distributed. This validation allowed for the use of a parametric test—the independent samples t-test—to compare the upstream and downstream adaptations reliably. Thus, the assumption of normality was satisfied, ensuring the robustness of the subsequent inferential analysis.

Table 7. Group statistics.

Variable	Group	N	Mean	Std. deviation	Std. error mean
Level on streams from producers	Downstream operations	6	3.2300	.02338	.00955
	Upstream operations	6	3.0533	.06164	.02517

The comparison between upstream and downstream adaptations is initially illustrated in Table 7 group statistics. The upstream operations recorded a mean compliance score of 3.0533 with a standard deviation of 0.06164, while downstream operations recorded a slightly higher mean of 3.2300 with a standard deviation of 0.02338. The standard error of the mean was 0.00955 for downstream and 0.02517 for upstream operations, suggesting a relatively higher variability in the downstream operations. The descriptive statistics already hint at a noticeable difference in the levels of adaptation between the two operational streams, with downstream adaptations appearing stronger than upstream practices. However, formal statistical testing was necessary to confirm whether this observed difference was statistically significant.

Table 8. Independent samples test.

Variable		t-test for equality of means						
		t	**df**	**Sig. (2-tailed)**	**Mean difference**	**Std. error difference**	**95% confidence interval of the difference**	
							Lower	**Upper**
Level on streams from producers	Equal variances assumed	-6.564	10	.000	-.17667	.02692	-.23664	-.11670
	Equal variances not assumed	-6.564	6.409	.000	-.17667	.02692	-.24152	-.11181

The results of the independent samples t-test, presented in Table 8, independent samples test, provide strong evidence regarding the difference in adaptation levels between upstream and downstream adaptations. When equal variances were assumed, the t-statistic was -6.564 with 10 degrees of freedom, and the two-tailed significance value was 0.000. The mean difference was -0.17667, with a standard error difference of 0.02692. The 95% confidence interval for the difference ranged from -0.23664 to -0.11670, not containing zero. Even when equal variances were not assumed, the t-statistic and p-value remained exactly the same. These results indicate that the difference between upstream and downstream adaptations is statistically significant at the 0.01 level. Specifically, downstream adaptations have a significantly higher level of adaptation compared to upstream adaptations among producers participating in the EPR programme.

Based on the evidence provided by the tests of normality and the independent samples t-test, it can be concluded that the null hypothesis (H_0)—which states that there is no significant difference between upstream and downstream adaptations—should be rejected. The alternative hypothesis is accepted, affirming that there is a significant difference between the two types of adaptations. Producers demonstrate stronger compliance and integration with downstream EPR requirements such as pollution control, registration with PROs, and end-of-pipe product management, compared to upstream activities like design-for-environment, green procurement, and clean production. This pattern highlights a potential flaw in EPR implementation efforts, emphasizing the need for greater attention to upstream innovation and environmental responsibility at the production and design phases.

Conclusion

Resulting from the analysis of the 5-point Likert-scale analysis, the section mean for upstream operations (design for environment, green procurement, clean production) was 3.05, indicating moderate adaptation. In contrast, the mean for downstream operations (pollution control, product end-of-life management, registration with PROs) was higher at 3.23, suggesting that producers are more strongly aligned with final-stage environmental responsibilities than with early-stage preventive strategies. Downstream operations were significantly better implemented compared to upstream operations. This was corroborated by the outcome of the qualitative content analysis which indicated the respondents' preference to downstream operations.

Similarly, the hypothesis test showed a significant difference between the upstream and downstream operations with the downstream having an edge. This indicates producers' preference to the management of generated waste rather than its post-consumer prevention. The preferred practice is highly suggestive of the cause of large volumes of waste that are common sight in various parts of Lagos State constituting health and environmental issues. It is recommended that the National Environmental Standards and Regulations Enforcement Agency should aggressively encourage the producers to tilt much more to the upstream adaptations of the EPR programme. There should be continuous research and development (R&D) towards design for environment and clean production. The producers should consistently pursue technological advancement that is geared towards waste minimization and recyclability. The producers should de-emphasize end-of-pipe treatment of waste including high tendency for waste disposal.

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References

1. Calcott, P. and Walls, M. 2000. Can downstream waste disposal policies encourage upstream "design for environment"? American Economic Review, 90(2): 33-237.
2. Calcott, P. and Walls, M. 2005. Waste, recycling, and "design for environment": Roles for markets and policy instruments. Resource and Energy Economics, 27(4): 287-305.
3. CoolGeography. 2023. UIC-location and importance of Lagos. Retrieved from https://www.coolgeography.co.uk/gcsen/Location_Importance_Lagos.php
4. Field, B.C. and Field, M.K. 2009. Environmental economics: An introduction (5th ed., pp. 373–374). New York, NY: McGraw-Hill/Irwin.
5. Ikechukwu, E. 2024, July 21. Alarm over groundwater pollution. BusinessDay Nigeria.
6. Lagos State Government. 2023. Lagos State Government official website. https://www.lagosstate.gov.ng
7. Laubinger, F., Brown, A., Borkey, P. and Dubois, M. 2022. Deposit-refund systems and the interplay with additional mandatory extended producer responsibility policies (OECD Environment Working Papers No. 208). OECD Publishing.
8. Lindhqvist, T. 2000. Extended producer responsibility in cleaner production: Policy principle to promote environmental improvements of product systems. Lund University, International Institute for Industrial Environmental Economics (IIIEE).
9. McDonough, W. and Braungart, M. 2002. Cradle to cradle: Remaking the way we make things. North Point Press.
10. National Environmental Standards and Regulations Enforcement Agency (NESREA). 2011. National environmental (electrical/electronic sector) regulations. NESREA.
11. Nnorom, I.C. and Osibanjo, O. 2008. Overview of electronic waste (e-waste) management practices and legislations, and their poor applications in the developing countries. Resources, Conservation and Recycling, 52(6): 843-858.
12. Nwilo, P.C., Ibe, C.A., Adegoke, J.O., Obiefuna, J., et al. 2020. Long-term determination of shoreline changes along the coast of Lagos. Journal of Geomatics, 14(1): 72–83.
13. Organisation for Economic Co-operation and Development (OECD). 2024. Extended producer responsibility: Basic facts and key principles. OECD Publishing.
14. Organisation for Economic Co-operation and Development (OECD). 2001. Extended producer responsibility: A guidance manual for governments. OECD Publishing.
15. Swachhcoin. 2019. Role of extended producer responsibility in effective smart waste management. Medium. https://medium.com/@swachhcoin
16. Tchounwou, P.B., Yedjou, C.G., Patlolla, A.K. and Sutton, D.J. 2012. Heavy metal toxicity and the environment. In: Luch, A., (Ed.), Molecular, clinical and environmental toxicology (pp. 133–164). Springer.
17. Tojo, N. 2001. Effectiveness of EPR programmes in design change: Study of the factors that affect the Swedish and Japanese EEE and automobile manufacturers (IIIEE Report No. 19). Lund University, International Institute for Industrial Environmental Economics.
18. World Bank. 2024. Improving solid waste and plastics management in Lagos State: A way forward. (p. 2).
19. World Population Review. 2024. United Nations population estimates and projections. United Nations Department of Economic and Social Affairs, Population Division. https://worldpopulationreview.com

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