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Externality Effects of Sachet Water Consumption and the Choice of Policy Instruments in Nigeria: Evidence from Kwara State

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ABSTRACT The study examines the causes and negative externality effects of sachet water consumption in Nigeria. It traces the origin of sachet water production in Nigeria to 1990, and attributes the emergence and proliferation of sachet water production to the inability of the governments - federal, state and local - to provide their subjects with tap water supply that is adequate in terms of quantity and quality. The study adopts qualitative methodology, and makes use of questionnaire, structured interviews, informal personal interviews. Weather was found to be the most significant determinant of the demand for sachet water in Nigeria. Using judgemental convenience sampling, the deposit–refund system is considered the most applicable and appropriate instrument through which the externalities can be controlled. The applicability and appropriateness of the deposit–refund system is due to the nature of the externalities which is the recyclability of the packaging of the commodity.

I. INTRODUCTION

Almost every nook and cranny in Nigeria is littered with sachet water nylon, popularly called "pure water", the large volume of which in ordinary parlance, constitutes pollution and termed negative externality or economic 'bad' in economics. This is as a result of millions of used-sachets being thrown on daily basis onto the streets of virtually every city, town, and village in Nigeria. As noted by Edoga et al. (2008), about 70 percent of Nigerian adults drink at least a sachet of pure water per day resulting in about 50 to 60 million used water-sachets disposed daily across the country.

The packaging of this sachet water is made of non-biodegradable synthetic polyethylene (polythene), which does not decay, decompose or corrode, and which when burnt, produces oxides of carbon, nitrogen and sulphur which can harm man and the environment. The release of the oxides is due to the petrochemical composition of polythene, out of which the packaging is made. The harm it inflicts on the environment is called environmental degradation, which is a threat to the long-term development prospects of the country and world over. The resulting environmental ills from burning the disposed sachets pose extreme health hazards to people exposed to them. Such conditions, according to Adenuga et al. (2005) can precipitate epidemics and national heath crises. This is also noted by Akunyili (2003) that the disposal of waste generated from the production and consumption of packaged water, including sachet water, constitutes an aspect of health and environmental hazards.

Generally, pollution affects not only the polluters but also the non-polluters, that is, it has external effects (externality) on those who are not responsible for the pollution. Thus, in the case of sachet water, it is not only the litterbugs (or the pure water consumers) that are affected but also the non-consumers and the entire environment. This is because burning the packaging lowers the quality of the air that both the consumers and non-consumers breathe in, gives off stench, and causes harm through the release of toxic gases and smoke. The oxides of carbon, sulphur and nitrogen, methane, particulate matter and others, produced from burning of disposed water sachets cause various health problems such as cancer, carboxyhaemoglobin, brain damage, dizziness, headache, fatigue, lethargy, respiratory problem, and eye irritation. It also causes environmental problems such as acidification, eutrophication, the greenhouse effect (or global warning), smog, and ozone loss. Hence when the environment is damaged, both consumers and non-consumers of sachet water are affected since the environment is exhaustively composed of the two groups.

These insidious problems, though also caused by other plastic packaging other than sachets, have become more noticeable ever since the production of sachet water started in the country. Although, the exact date of introduction of the commodity was not known, it was introduced to

the Nigerian market around 1990, started attracting nationwide attention from 2000 when the National Agency for Food and Drug administration and Control (NAFDAC) registered 134 different packaged water producers (Onemano and Otun 2003). In the literature, there have been several ways of controlling pollution and/or internalizing externalities, but none of the control or internalizing options seems to be particular about the pollution/externality resulting from water sachets. Perhaps, this is because sachet water is relatively novel in the Nigerian economy and not because of the elusiveness of the phenomenon.

There have been general measures of pollution control such as legislation/regulation, awareness campaign about causes and dangers of pollution, the quest for alternatives to the extant pollutants, locating factories away from residential areas, research on pollution control devices, recycling, reclamation and reuse, the use of incinerators and burial method, the use of dumping site, awareness and anti-litter campaigns. As there are several control measures on pollution, so are the internalization measures of externalities – solutions to externalities. Solutions such as pigouvian taxes, integration, deposit-refund systems, pollution permits, negotiation and bargaining (Coasian rule), and direct government regulation, have been suggested in the literature – each best suited for a different set of circumstances. However, the basis for determining which of these options should be applied at any point depends on the nature or type, causes (consumers or producers), magnitude and the level of significance of the externality; and the type of economy – developed or developing (Egwaikhide and Aregbeyen 1999 and Adewuyi 2001).

These therefore raise the question of what economic instruments or otherwise are available for controlling or internalizing the pollution/externalities. Which of these options or instruments would be most appropriate and effective for controlling or internalizing sachet-water consumption externality? Or put differently, how do make the sachet-water consumers and/or the producers internalize the associated social costs of their actions? What are the causes and externality effects of sachet-water consumption? What factors influence the consumption of sachet water and the resultant litter? What role does sachet-water production play in the Nigerian economy? Should sachet water be banned because of its consumption externality? These are questions the study intends to provide answers.

Consequently, the objective of this study is to analyze and recommend the most appropriate and potentially effective policy instrument(s) for the control of negative externality/pollution arising from the packaging of sachet water. In addition, the study attempt to investigate into factors that influence the consumption of sachet water and the attendant pollution so as to find out if the externalities could be controlled or internalized via those factors. The emphasis of this study is limited to externalities/pollution arising from the consumption of sachet water in Kwara State. The state is chosen as a case study because it was previously known (prior to the present administration) as one of the cesspits of used water-sachets and now acclaimed one of the cleanest states in the country. The scope of the study is also confined to the externalities resulting from sachet water consumption only due to the relatively high pollution-generating rate of the packing of sachet water as compares with other packaging.

The rest of the study is organized into five sections. Section two contains background to the study while section three reviews related studies. The theoretical framework and the methodology are discussed in section four. Section five discusses empirical results, while section six summarizes and concludes.

II. BACKGROUND TO THE STUDY

The Importance of water to man and his environment is very obvious. It is the duty of all governments to protect the health of the citizens, and in Nigeria it is the responsibility of the National Agency for Food and Drug administration and Control (NAFDAC), a parastatal of the Federal Ministry of Health. Government-owned public water utilities, such as Water Corporations, are statutorily charged with the responsibility of supplying water from conventional water treatment plants that use water from impounded reservoir (dams) flowing streams, lakes and deep boreholes. As the country population grew and industries increased, the supply of water by the public utilities became inadequate in quality and quantity. This led to the emergence, and proliferation of private water enterprises that operated side by side with the government-owned public water utilities.

Coincidentally, between 1992 and 1996, the years that sachet water production began to sprout, the rate of increase of the country's total water supply for industrial, agricultural and domestic uses was 1.0 percent while the population growth rate was 2.84 percent (Gbadegesin and Olorunfemi, 2007). The implication of this is that the population would be larger than the available water supply, the result of which is scarcity or inadequacy of water supply. Some recent studies, Aderibigbe et al. (2008); Adamu (2009), Maconachie (2008) and Gbadegesin and Olorunfemi (2007), have corroborated the inadequacy of the country's water supply. Machonachie and Adamu provide evidence of this shortage of water in Kano and Kaduna respectively through their state-specific evidence in terms of quality and/or quality. While quoting figures from National Millennium Developmental Goals Report (2005), Gbadegesin and Olorunfemi (2007) lamented that "after almost sixty years of water supply in Nigerian, it is regrettable that only 60 percent of the population has access to safe drinking water, and in rural area less than 50 percent of the households have access to good potable water".

According to Akunyili (2003), it is the inability of the Government to persistently provide adequate potable water for the growing population that has tremendously contributed to the proliferation of the so-called 'pure water' producers in Nigeria. Thus, the quest for solutions to the dearth of potable water led to the production of sachet water by some opportunistic private individuals who thought they could profit by packaging and selling water to the needy. The private water enterprises mainly collect their water as the end-product of initially treated water supplied by the government-owned public utilities and do little treatment such as the removal of the suspended solids to make the government-produced water more potable. They also do some minor treatment on water from natural springs, open wells and boreholes. In some cases, the private water enterprises only improved the supply from the government-owned public water utilities by use of booster pumps and erection of storage tanks to serve as private water kiosks. Some also collected water directly from the government- owned public water utilities kiosks and later resold them at a higher price. Some private water enterprises provide the cheapest and commonest source of drinking water, popularly known as 'pure water', packaged in sachets in most rural and urban areas of the country.

The services of the category of private water enterprises selling packaged water in bottles were initially adjudged satisfactory and reliable in the past years. They are however, more expensive when compared to that provided by the government and other category of private enterprises that sell theirs in sachets. Hence, bottled water producers are patronized by the few elite in the country. However, majority of the people (who are usually the low-income groups) in the country patronize and drink sachet water because of its cheaper price. This makes sachet water an inferior good. History reveals that sachet water was introduced to the Nigerian markets around 1990 but its regulation by the National Agency for Food and Drug Administration and Control started in 2001. It is relatively affordable and available even at the remote areas of the country. Increasing number of private companies registered and unregistered, are getting involved in the sachet water business in virtually every street. This recent involvement of all and sundry has brought a lot of concerns, especially health and externality concerns, and worry to the author of this study and most stakeholders in the water sector and some other quarters.

The provision of water that is not only safe, but tasteless, odourless and clean in appearance is top priority in any country that cares for good health, and poverty alleviation towards sustainable development (Akunyili 2003). The private individuals purportedly treat not-fit-for-drinking water, like well, borehole, and make them fit for drinking while consumers cannot by themselves ascertain the quality of drinking water. Naturally, water that appears murky, discoloured, smelly or with unpleasant taste would be treated by these opportunists but not with grave suspicion from the consumers. Regulation of packaged water is therefore a government intervention in the private water sector for the sake of public health as it assures quality in the production and packaging of water. This is where National Agency for Food and Drug administration and Control comes in to safeguard the health of the nation by ensuring access to only safe and good quality packaged water to the public.

Sachet Water Externalities

Our physical environment is made up of air, water, and land (soil). Humans, plants, and ani-

mals require each of these for survival and growth. Air, water, and soil each possess physical and chemical properties which make them suitable for life processes. In particular, the composition of each by nature, volume, and mass is supposed to be fixed or reasonably constant. However, if the composition of any of these is altered by the presence of some other material in the mixture, it could become unsuitable for life processes. Such substances, as enter air, water, or soil and render them unsuitable for life processes are called pollutants, and the phenomenon is known as pollution. Besides the stench that these air pollutants generate, they also cause serious harms to human life and the environment.

The externalities caused by the disposal of used water-sachets are, therefore, of three dimensions namely, air pollution, land pollution and water pollution. The litter resulting immediately a sachet of water is drunk constitutes land pollution which later translates to water pollution, while the burning of the disposed sachets creates air pollution. These three dimensions and their respective externality effects are discussed one after another in this section, starting from air pollution to land pollution.

The air pollution from sachet water consumption stems from the burning of the disposed water-sachets. There are two main methods of refuse disposal in Nigeria. These are burial (land filling) and burning methods. Reference could be made to the Kwara State Environmental Protection Agency (KWEPA) and Kwara State Waste Management Company (KWMC) which are responsible for proper disposal of household and industrial waste, especially refuse, in Kwara State. The agencies use the two methods though the burning method is mostly used. This is probably because of the observation by Nürnberger (1999) that sinks[1] are limited and/or watertight, or because much of the household refuse is made up of non-biodegradable waste materials, which can make landfills quickly, saturated, and thus impose constraints on land filling method.

The problems with this method are that one, if the waste is buried at the dumping sites or landfills, there are tendencies that it could affect the ground water. Two, if eventually burnt, it creates air pollution by releasing the toxic gaseous pollutants into the atmosphere. Hence, the method does not even control pollution but instead, creates more pollution. The method simply transfers pollution from one place to another. To borrow from Nürnberger (1999), "cleaning up often simply means toxic materials are transferred from one sink to another, say from water to air", which in this study's case, is from land to air or water (ground water).

Since the sachet externalities also constitute a kind of atmospheric pollution, it affects not only the area where the pollution is generated but also the adjacent non-pollution-generating areas, where it is air-borne. Its effects are perceivable when harmful chemical compounds are released into the atmosphere during the combustion of emptied sachets. These insidious effects on humans and the environment are well documented in the science literature (Ababio, 2005; and Adesina 2008).

Welfare Distributional Effects/Justification of Pollution and the Control Measures

The welfare justification concerns the need to correct for externalities. Equity argument for the need to control externalities is well established in the literature (e.g., the polluter-pays-principle). The existence of externalities increases the welfare of some people and decreases the welfare of others, and since changes in both directions are unlikely to be absolutely equal, externalities cause changes in general welfare. There are two types of changes in social welfare (Jhingan 2003) namely:

i. Those, which benefit all or at least one person through trading
ii. Those, which benefit at least one person at the expense of the others through conflict.

The latter change can be attributed externalities. For instance, the consumption of sachets improves the welfare of the consumers and reduces the welfare of the non-consumers through damage done to their health and environment by disposed sachets. Sachet water consumption improves the welfare of the consumers because, according to Bergson (1938), social welfare is a function of the quantities of products consumed by each member of society. So the consumers' welfare increases while the non-consumers' welfare decreases because of the disutility brought about by sachet pollution. Therefore, the change in welfare brought about by the consumption of sachet water benefits the consumers at the expense of the non-consumers. In Pareto's words, the consumers are made better off while the non-consumers are made worse off. The Pareto crite-

rion relates to the former change where all or at least one person becomes better off without making any other person worse off. The Pareto optimality criterion states that general welfare is said to increase (or decrease) if at least one person is made better off (or worse off) with no change in the positions of others. The social welfare (change) is maximum when it is not possible to make any one better off without making any one else worse off. But this is not realistic, for all economic policies in a way benefit some and harm others (Jhingan 2003).

In providing remedies to externality problems, externality issues should consider not only the efficiency aspects, which internalize the external cost of an externality-generating activity by making the activity-doer bear the cost of his action, but also the equity, or welfare distribution, aspects, which restore the original distribution of income. Welfare economics indicates that we must consider the distributional implications of reducing pollution. This raises the question of 'who benefits' and 'who bears the costs' of the pollution control measure. Suppose there is an externality problem and the government intervenes through any of the control measures. The measure will force the firm to reduce output. As the firm reduces output, it lays off some workers, and the demand for other inputs it employs falls, thereby rendering the suppliers of those inputs unemployed and worse off. Some of the firm's workers may then suffer unemployment in the short run and be forced to work at lower wages in the long run. If these workers have low incomes, the control measure has increased income inequality (Rosen 1999).

Virtually all internalizing measures have the tendency to raise the price of the polluter's products. Pollution is the consequence of an absence of price for certain scarce environmental resources (such as clean air and water), and economists thus prescribe the introduction of surrogate prices in the form of taxes charges or prices paid for pollution permits, etc to provide the needed signals to economize on the use of these resources (Cropper and Oates 1992). If polluters are forced to take into account the social costs of their actions, their products tend to become more expensive. The price increase is worth it or desirable from an efficiency point of view; if not, prices and then the consequent profits would give incorrect signals as regards the full (private and social) costs of production. However, the buyers of the products are made worse off due to the price increase.

There is the need to consider the economic implications of this justifiable price increase. This is where efficiency and equity issues come in to analyze the problem. Virtually every one would agree that something must be done to prevent the pollution. That is where the agreement ends. The disagreement starts when it comes to who should bear the cost of pollution control. Should it be the producers or consumers of sachet water? Here comes a bone of contention. According to Mishan (1971), one of the crucial propositions of the consensus of the 1960s is that the question of liability for externalities cannot be properly settled by consideration of the equity involved. Matters of equity cannot be established a priori without detailed examination of the welfare level of each agent involved in the externality problems.

To evaluate the distributional implications of reducing pollution, we need to know the demand patterns of the goods produced by the polluting firms (Rosen 1999). Hence, if the product in question is consumed mostly by high income people of the society, the distribution of real income becomes more equal; but if consumed mostly by the low income groups (which is the case of sachet water), income inequality increases, other things being equal. Thus, using a control measure that has tendency to increase the price of sachet water, though efficient, can worsen the income inequality since sachet water is mostly consumed by low income groups of the country. Thus, there is no need to cause market distortions through price increase. The problem of price increase can be circumvented by using an approach, which does not necessarily increase the price of products.

III. REVIEW OF RELATED ISSUES

Many firms undertake research and development (R&D) investment in order to improve on their exiting products and to develop new ones or new processes. The research and development R&D investment generates intra-industry externality. This is because, as noted by Bernstein and Nadir (1989), a distinguishing feature of research and development (R&D) investment from other forms of investment is that firms which do the investing are often not able to exclude others from freely benefiting from the research and develop-

ment (R&D) projects. Hence, R&D investments generate a kind of positive spillovers in industries. The research and development (R&D) benefits spill over to other firms though they (other firms) do not pay for the use of knowledge generated by the research and development (R&D) projected executed by the investing (externality-generating) firms.

There have been very few studies on externalities in Nigeria, especially, externalities or pollution from water sachets. One of the earliest studies on externalities in Nigeria is Hutchful (1970) cited in Egwaikhide and Aregbeyen (1999). Hutchful reportedly made an attempt to document pollution arising from oil production activities in the Nigerian-Delta region. He attributed the environmental pollution in the region to the operations of the oil companies. The study purportedly notes that the pollution degrades the terrestrial, marine and atmospheric environment. Most of the recent studies also concentrate on industrial pollution. Few of these studies are Egwaikhide and Aregbeyen (1999), Egbu (2000), Aregbeyen (2001), Garba and Garba (2001), Jerome, (2001), Magbagbeola (2001), Oyeranti (2001), Orubu et al. (2004), and Adenuga et al. (2006). Virtually all these studies dealt with industrial pollution, especially pollution resulting from oil production.

Adenuga et al. (2006) examined environmental degradation via water pollution caused especially by oil production activities in the country. The paper identifies loss of revenue and declining health status as some of the economic implications of pollution. The authors recommend market-based economic instruments as the appropriate control instrument for mitigating environmental degradation, with particular reference to water pollution. According to them, the polluters should be made to incorporate environmental costs in their decision making process. The authors hold that water pollution control needs to be supported by coordinated policy, adequate legal and institutional framework which is essential tools for sustainable development. Incentives, such as reduced excise taxes, accelerated depreciation allowance, reduced customs duty, and soft loans and grants meant to enhance the purchase of pollution control equipment, should be put in place. Recently, Edoga et al. (2008) conducted an empirical study on the possibility of producing candle from used water sachets through recycling. Used sachets were collected in Minna, cleaned using nitrocellulose thinner, and recycled in to four different candles. The study points out that environmental degradation arising from polythene packaging can be controlled or reduced by recycling waste in to candles and other useful products. The authors view the large volume of used sachets as constituting unprecedented environmental hazards which span from littering the streets to blockage of drainages, channels and other water courses.

Also, Egbu (2000) which explored the major sources of Nigeria's environmental problems, the weaknesses of existing legal and institutional arrangements as the constraints to effective pollution control and management in Nigeria. The study identifies untreated industrial and human wastes, gas flaring, oil spills, heaps of uncollected garbage and indiscrimination disposal of hazardous waste as the major sources of pollution in the country. According to the study, there is the need to improve the institutional capacity and adopt economic management measures for management of pollution problems in spite of a number of positive results achieved by FEPA. Egwaikhide and Aregbeyen (1999) drew attention to the paradox of oil wealth in the Niger-Delta region. Although the region produces the largest proportion of the country's crude oil, only a few of the transformational effects and benefits generated by oil have accrued to the region and its residents. Besides this, the region has suffered substantial negative externalities arising from oil production activities. The externalities include seismic surveys, canalization, poor waste disposal, oil spillage and gas flaring. The paper concludes that a satisfactory solution to the externality problems lies in a fiscal restructuring that would ensure that the oil producing firms bear the full costs of their externality-generating activities. The study therefore recommends a pollution tax to be borne directly by the oil firms in addition to the assignment of sufficiently high weight to the derivation principle.

Orubu et al. (2004) identify a large number of actual and potential impacts of oil operations on the environment, among which are the destruction of forest land, and vegetation, noise pollution and vibration from seismic shooting, land pollution from effluent water and solid waste of chemical cans and drums, air pollution from gaseous fumes during loading and spillage. Others are the destruction of fisheries, pollution of underground water, reduction in agricultural pro-

ductivity and alteration of the taste of fish. They hold the view that environmental externalities occasioned by oil production activities in Nigeria have to a large extent contributed to the lingering crisis in the Niger-Delta region. They point out that the role which oil communities could play towards mitigating environmental problems has been largely neglected by the various legislations and environmental management strategies adopted by petroleum operators. The study recognizes the need for sustainable partnerships between host communities and oil companies in order to address the environmental problems. This can be done through appropriate memoranda of understanding, and to address problems arising from such issues as compensation for environmental damage, impact assessment, managements of spills, pipeline surveillance, information management, conflict resolution, and decentralization of responsibility for abatement programmes.

In summary, only the study by Edoga et al. (2008) is considered the most recent one that sought to provide solution to an aspect of residential pollution usually caused by households rather than firms or their production plants. The authors collected used packaging of sachet water and recycled them in to candles. Although the literature reviewed here is by no means exhaustive, most of the authors (reviewed and those reviewed but not cited) concentrated on various sources of pollution or forms of environmental degradation other than the ones caused by the production and consumption of sachet water. Virtually every literature piece reviewed concentrates on pollution from either industrial activities or domestic waste other than the pollution from used sachets. Externality studies on sachet water are non-existent because of its novelty in the Nigerian economic scene. Nearly all the studies discussed pollution/externalities emanating from sources like crude oil production, industrial effluent, poor agricultural practices or industrial activities generally. This is a research loophole deemed necessary to be filled by this study.

IV. THEORETICAL FRAMEWORK AND METHODOLOGY

The study is situated within the framework of externality theory within which the concept of pollution falls. The theory explains that economic agents (consumers or producers) are interdependent in the market settings. They are interdependent in the sense that the actions of one economic agent favourably or adversely affect the well being of another agent. Externalities arise when the production or consumption of a good by one producer or consumer favourably or adversely affects the production or welfare of another producer or consumer, without adequate reflections of the effects in the market prices of the good or service. This constitutes a market failure, because the price of the good/service does not reflect the true costs of production. It only reflects the private costs to the firm or the consumer; it does not reflect the social or environmental costs to the society of producing that particular product. The market failure arises due to the divergence between private and social cost and benefits, which leads to misallocation of resources this. This situation is considered a failure because the market fails to efficiently allocation the resources, and sends wrong price or profit signal to the economic agents. In the case of negative externalities, the value of good and service are underpriced because private costs, which are reflected in market prices, fall short of the social costs of production or consumption of the goods or services. The under-pricing results in overproduction and overconsumption of the goods because they are cheaper to the producer and consumer, but they are not, from the view point of the society.

Positive externalities exit when the social benefit is greater than private benefit - another divergence, but this time, between the private and social benefit. The divergence results in overvaluing (overpricing) the goods and this leads to underproduction or under consumption of the goods, because less will be produced or consumed due to high prices. This study concentrates only on the negative externality theory, the classic example of which is pollution, arising from consumption of sachet water. The pecuniary negative externalities are not included in the framework because they are not true externalities: their effects are captured in market prices and do not affect the market's ability to allocate resources efficiently. The rise in the price of a product that results from increased purchase is an accurate reflection of the society's preferences, and the price increase ensures that the right mix of goods is produced

The theoretical conclusion is that first, when

a negative externality occurs the amount of production will be suboptimal and too much of the good will be produced at a too low price. If the externality-generating firms pay for the negative externalities they create, costs (private and social) of production will be higher and so will the prices. Less output will be produced and consumed because of the higher prices. Similarly, goods with positive externalities will be underproduced and under-consumed. Second, the zero-level pollution or externality is not the optimal level. The theory only suggests reduction of pollution to optimal level, which is not zero level. Zero level implies no production of the good that generates pollution. The theory suggests this, because the society needs those goods though they cause pollution/externalities. The externality theory explains that even if the cost of an externality or pollution control is placed on the producer or consumer of the goods or the polluter is made to pay for the pollution or compensate for the externality, the amount of pollution will not fall to zero. Pollution will fall to zero only if the production/output level of the externality-generating goods falls to zero.

At first, zero pollution sounds nice but not without a cost. The costs of 100 percent purity seem to be prohibitively high. There are tradeoffs, the theory explains, between the quality of the environment and production and consumption of goods that the society produces and consumes. The theory requires the optimal pollution level be a point where marginal social costs equate marginal social benefits, and that pollution abatement programmes be implemented and continued until marginal social cost is equal to marginal social benefit of reducing pollution.

The Model

The study adopted the model by Cropper and Oates (1992) in which the utility of a representative consumer is a function of a vector of goods consumed (X) and the level of pollution (Q). The model states that:

$U = U(X, Q)$ (1)

$X = X(L, E, Q)$ (2)

$Q = Q(E)$ (3)

Where U=utility, X= a vector of goods consumed, Q= level of pollution. L= a vector of conventional inputs such as labour and capital and E= waste emissions. The assumed signs of the partial derivatives are $U_X > 0$, $U_Q < 0$, $X_L > 0$, $X_E > 0$, $X_Q < 0$ and $Q_E > 0$.

It is assumed that pollution results from waste emissions (E) in the production of X as in (iii). The production function is taken as a function of a vector of conventional inputs, waste emissions and the level of pollution. Waste emissions are treated as another factors of production, since attempts to cut back on waste emissions will involve the diversion of other inputs to abatement activities, thereby reducing the availability of these other inputs for the production of goods. Reductions in E results in reduced output.

The production functions also includes as an augment the level of pollution (Q), since pollution may have detrimental effects on production (such as the soiling of the output of the proverbial laundry or reducing agricultural output) as well as producing disutility to consumers and non-consumers. The level of pollution is itself taken as a function of the vector of emissions (E) as in (iii). Q could be taken to equal the sum if all the emissions. Here the amount of pollution (Q) arising from water sachets is considered a function of variables such as weather(W), income (Y), National Agency for Food and Drug administration and Control certification, tap water availability (TA), borehole availability (BA), price of sachet water (P), and price of substitutes (bottled water (Pb)).

$Q = f(Ps, W, Y, Pb, NAFDAC, TA, BA, Pm,)$ (4)

Where Q is the amount of pollution caused by water sachets, and proxied by sachet water consumption level. The consumption level and the attendant pollution are assumed to be positively related.

Estimation Issues and Sources of Data

The study adopted a qualitative methodology and employed questionnaire, structured interviews, informal personal interviews, and observations during excursions to some recycling firms as the research instruments for data collection. Qualitative analysis was adopted to address the general objective, which was to identify and analyze the causes and externality effects of sachet water consumption. This required delving into both the remote and immediate causes of the externality problems and their effects on humans and the environment using inter-disciplinary inquiries in to the material composition of the packaging.

As for the first specific objective, qualitative

analysis was also adopted to assess the appropriateness, applicability and effectiveness of the various policy control measures vis-à-vis the externality problem of the study. As regards the second specific objective, a nonparametric test, chi-square, was carried out to see if the selected factors had significant effects on sachet water consumption and thus, on the resultant pollution. The purpose of this was to find out if the externalities from sachet water could be controlled or internalized via these factors. Cross tabulation, proportions and percentages were also used to analyse the qualitative descriptive data obtained. The above analyses were adopted because the data for the study are qualitative descriptive data and that chi-square is the most appropriate analytical tool given the nature of the data.

The data for the study was elicited from sachet water consumers in Ilorin. The data were qualitative given the nature of the study. Five hundred questionnaires were administered to 500 respondents using judgmental convenience sampling technique because of the characteristics of the study population. The choice of the sampling technique was due to difficulty or impossibility of getting a sampling frame that would contain all sachet water consumers in the country. The main research instrument was questionnaire, which was pre-tested through pilot study in order to test for its validity and reliability. This was necessary because the instrument had not been used by previous related studies.

V. ESTIMATION RESULTS

The estimation results below are a summary from the questionnaire. Section A of the questionnaire contains address, age, income level and educational level of the respondents. The respondents were secretive about giving information relating to these variables. The result of the section is thus not included. Section B contains such information as the declaration of brand's name if any, average daily consumption, the support for ban, while the potential factors affecting the demand for sachet water are contained in Section C, Section D has to do with the respondents' awareness about any anti pollution/law/policy, reasons why people litter and the acceptance of offer of an incentive to return used sachets to points of purchase. These results are presented in Tables 1, 2 and 3.

In an effort to find out if some people have specific brands of sachet water that they drink, it was discovered that 16% of the sampled respondents had specific brands for consumption, while 84% had no specific brands (Table 1). The reason advanced for the high discrepancy in favour of no specific brand is that the content of sachet water is almost indistinguishable and tasteless. And the product is thus considered homogenous by some people since all brands are being con-

Table 1: Variables and response from respondents

Variables	*Frequency*	*Percentage*	$\div^2$
Choice of brand	500		
Respondents with specific brand	80	16.0	
Respondents with no specific brand	420	84.0	
Daily Intake of Sachet Water			
1-3	400	80.0	
4-6	96	19.2	
7-9	3	0.6	
>10	1	0.2	
Effects of Previous Price Hike From N5 Per Sachet to N15 Per 2 Sachets			
Those affected by the price hike	195	39.0	
Those not affected	305	61.0	24.2
Preference of Sachet Water Over Borehole Water			
Those that preferred sachet water	480	96.0	
Those that preferred borehole water	20	4.0	
Support for Ban			
Support	152	30.4	
Not Support	348	69.6	
Preference of Sachet Water Over Tap Water			
Those that preferred sachet water	310	62.0	
Those that preferred tap water	190	38.0	
Acceptance of Incentives (Discount or Gift) to Return Used Sachets			
Those agreed to return used sachets	422	84.4	
Those who would not return	78	15.6	
Respondents that Litter			
Litter	467	93.4	
Do not litter	33	6.6	
Awareness About Anti-pollution Law/Policy			
Use of KWMC Bin			
Aware	200	40.0	
Not Aware	300	60.0	
Use	163	32.6	
Do not use	337	67.4	

Source: Field Survey, 2009

trolled by the National Agency for Food and Drug administration and Control. The market structure for sachet water sub-sector can thus be said to be perfectly competitive to this extent. The respondents with specific brands believed the brand to be of higher quality than others.

The modal average daily consumption is 1-3 sachets. Out of 500 respondents surveyed, 80% of them consumed, on the average, 2 sachets of water daily. This means that about 800 (400 x 2) sachets are thrown away/littered daily by the respondents (Table 1). Multiplying this average daily intake by the current population figure of the country implies that millions of water sachets are littered or thrown away on daily basis in to the streets of virtually every city, town and village in the country. This result is almost in line with the finding by Edoga et al. (2009) that about 70 percent Nigerian adults drinks at least a sachet of pure water per day. If this trend goes on unchecked, it would result in an outrageously polluted environment, with declining public health status.

Table 2: Tap water availability/accessibility in homes and the neighborhood.

Variables	*Frequency*		*Percentage*	
Tap water availability/ accessibility	*At home*	*In the neighbour -hood*	*At home*	*In the neighbour -hood*
Respondents having tap water	150	185	30.0	37.0
Those not having tap waters	350	315	70.0	63.0
Borehole Availability/ Accessibility Respondents having borehole water	9	154	1.8	30.8
Those not having borehole water	491	346	98.2	69.2

Source: Field survey, 2009

While 70% percent of the respondents did not have access to tap water in their homes, 63% did not have access to it in their neighbourhood (Table 2). This supports the lamentation by Gbadegesin and Olorunfemi (2007) that 60% of the Nigerian population did not have access to potable tap water, and points to the fact that the total water supply in the country is inadequate. In a bid to find out if the availability of tap water would reduce the consumption of sachet water and its resultant pollution, it was discovered that 62% of the respondents would prefer sachet water even though tap water was readily available (Table 2). The reasons advanced for the high votes for sachet water by the respondents are that:

- Sachet water is portable sold chilled, and found everywhere, while tap is not movable and its water is not run cold or severed chilled.
- It is approved by the NAFDAC
- There is no better equally affordable alternatives/substitutes
- Sachet water is more hygienically produced, that private production is always better than government production. It is more treated than tap water from public corporations.
- Its packaging is done in such a way that contamination is prevented.
- It is cheaper and safer.

As regards the borehole water as a source of drinking water, almost all the respondents said that they would not drink borehole at all, that it is not a comparable alternative drinking water to tap or sachet water. While 480 respondents (96%) out of the 500 interviewed chose not to drink borehole water, only 4% chose to drink it. A comparison between tap and borehole water availability reasons that tap water is more available and accessible than borehole water both at home and in the neighbourhood.

The hypothesis that the price of sachet water is a significant determinant of its demand is refuted by evidence from the survey data. A very high proportion of the respondent (365/500), i.e. 75%, did not considered the price of sachet water as a factor that determines their demand (Table 3). They said water is a basic need/necessity that must be consumed irrespective of the price increase, provided that the price is not prohibitively high. This renders sachet water price inelastic. Some said that even if the price was high they would consume it in the short run before they could shift their demand to its alternative in the long run. The remaining proportion 135/500 (i.e. 27%) account for why the sales of sachet water producers fell when the price was raised to 2 sachets for N15 or N10 per sachet. Hence, price is influential but not significant.

Thirty out of 500 respondents (a very low proportion) considered price of other packaged water a significant determinant of sachet water demand, while the remaining 470 respondents did not (Table 3). The reason advanced for the low proportion against the hypothesis is that the price differential between the price of sachet

water and that of bottled water is too wide to convince them to shift their demand from sachet water to bottled water, even if the price of the former increases. They added that even if the price of sachet water increased to say N20, there would still consume it (water consumption being a necessity), because the price is still not as high as that of bottled water, which starts from N60 (triple of the price of sachet water but not triple of its quantity).

Table 3: Potential determinants of sachet water demand.

Potential Determinants	*Frequency*		*Proportion of Influential*	*Percentage*
	Influential	*Not influential*		
Price of sachet water	135	365	135/500	27.0
Price of other packaged water	30	470	30/500	6.0
Income Level	8	492	8/500	1.6
Weather	500	0	500/500	100.0
Tap water availability	130	370	130/500	26.0
Borehole availability	20	420	80/500	4.0
NAFDAC Reg Number	354	100	400/500	70.8
Price of minerals (soft drinks)	36	464	36/500	7.2

Source: Field Survey, 2009

The hypothesis that the income level is also a significant factor is also rejected by the very low proportion (8/500) of the respondents who considered income as a significant determinant. They rationalize their opinion by saying that the price of sachet water takes a too infinitesimally small proportion of their incomes to have an impact. This, however, does not mean that income does not influence the demand for sachet water. It implies that the consumer's level of income must increase to a very high level before he could switch to the consumption of superior alternatives to sachet water. The 8 respondents that considered their income level as a factors are mainly rich respondents who disclosed that it was bottled water that they consumed. However, some rich respondents confessed to consume sachet water, despite their riches.

Weather is considered the most significant factor that determines the demand for sachet. All the respondents agreed that they drink more water in the dry or warm season than wet or cold season. Some even said that in the warm season, they drank more than the double of what they drank in the cold season. This confirms the hypothesis that weather is the most significant determinant of sachet water demand.

It was also revealed from the data that even if tap water was ever available, some given proportion of the population would still consider sachet water as their drinking water. This is evidenced from the proportion (370/500) of the respondents who declared that the availability of tap water would not affect their level of consumption of sachet water (Table 3). The reasons for this preference are the same as those earlier stated above, such as National Agency for Food and Drug administration and Control's control, refrigeration, cheapness/affordability, hygiene and packaging and portability. However, some respondents said that the only condition that could reduce their consumption is if the quality of tap water could be visibly improved upon, either by the extension of National Agency for Food and Drug administration and Control's mandate to water corporations or any other means.

A very large proportion (480/500) of sampled respondents did not consider borehole water as their drinking water. It was disclosed that even though borehole water was readily available, they would not give up sachet water because of the hardness of the former. This implies that improvements on the availability of borehole would not have any significant reduction in the consumption of sachet water. About 71 percent of the respondents looked for the National Agency for Food and Drug administration and Control registration number before consumption; while about 29 percent disclosed that these days; they did not look for the number anymore because of the National Agency for Food and Drug administration and Control's eradication of unregistered sachet water. This proves the potency of the regulatory agency in checking the circulation of poor-quality or substandard sachet water. It is probably the agency's control over the product that heightened respondents' confidence in the quality of the water.

Almost all the respondents litter with emptied sachet. This is evident from the percentage (93.4%) that litter, while a very low percentage (6.6%) said they did not litter because they did not just drink sachet water anywhere. They either drink it at home or in an enclosed place. Thus, antipollution law or policy made should be made to apply to all the consumers of sachet

water since virtually all of them litter. About 84% of the respondents were willing to return the used sachets to their points of purchase, if they were offered a discount, gift or any other incentive. This signifies that deposit-refund system would be successful if it is implemented.

The null hypothesis that price is a significant determinant of the demand for sachet water is rejected since $\div^2$cal (24.2) is greater than the $\div^2$tab (3.84), the critical value. The $\div^2$cal is significantly high at 95% confidence level and 1 degree of freedom, to accept the hypothesis. Hence we could say that price does not significantly determine the demand for sachet water; though it does so to certain extent. That is, price has to be increased to certain level before it could significantly impact on the consumption level.

The null hypothesis that sachet water plays an important (economic) role in the country is supported by the data: 69.6% support against 30.4%. If the continued production of sachet water is supported by a significantly high proportion of the respondents, then sachet water lays an important role in the economy, and putting a ban on its production as some of the respondent said could or worsen the unemployment situation in the country. Almost 70% of the respondents did not support the ban on sachet water production, even though they were aware of the inherent dangers or damage it causes to human health and the environment: 40% being aware of the dangers/damage. Some respondents advised that government should make efforts to eliminate or reduce the potential of dangers/damage if any, instead of the outright ban on the production; and that every problem has a solution. The *roro* bin provided by the KWMC is proved useful as 32.6% of the respondents made use of the bin for the disposal of domestic waste, while the remaining 67.4% did not use it. This is because the designated places for the bins are too far from their homes. They enjoined the government to provide more to reach virtually every street.

Policy Measures for Controlling/ Internalizing Externalities

Every internalization measure is a control measure, but not every control measure is an internalization measure. A measure may control pollution or externality but may not take into account, or internalize, the social costs of the pollution-generating activity. For example, measures like direct regulation may control pollution but do not internalize its social costs. In addition, internalization follows the polluter-pays-principle. It ensures that polluters pay for social costs or the damage they cause. With control measures, externalities will still exist though at reduced level; with internalization, externality will still exist but will have been internalized, and are thus not called externalities as again, since the externality effects have been 'priced' and paid for. It is when external effects are produced and not compensated for that they are called externalities (Adewuyi 2001; Ukpak 2001). Besides, some control measures simply transfer pollution from one sink to another. For example, the burning of refuse simply transform land pollution into air pollution, and the use of dumping sites or landfills could also transform land pollution into the pollution of underground water (water pollution).

Using judgemental convenience sampling, there are various control measures, economic or otherwise, to externality problems. These are:

Economic Instruments

i. Merger
ii. Taxes/ Subsidies
iii. Extending Property Rights (Coase Theorem)
iv. Pollution Permits
v. Deposit-Refund Systems

Non-economic Instruments (Measures)

vi. Direct Regulation
vii. Suasive Instruments

(i) Merger

A traditional cure for externalities, especially between two firms, is for the two firms to merge in order to internalize the externality. That is, the polluting firm (source of pollution) and the affected firm (the receptor) merge to become a firm. By coordinating the activities of the firms, the profit of the joint enterprise would be higher than the sum of their individual profits when they don't coordinate (Rosen 1999:92). Either party can buy the other party; the polluter can buy the pollutee, the pollutee can buy the polluter or some other party can buy them both. This process is also called *unitization*. Once the two firms have been integrated, the externality has been internalized. That is, the externality has been taken into account by the party that generates it. As a result,

the externality would not lead to inefficiency. As Rosen would put it, an outside observer would not even characterize the situation as an externality because all decisions would be made within a single firm.

Evaluation and Appropriateness vis-à-vis the Research Problem

Merger is not appropriate for consumption externalities, such as the one arising from consumption of sachet water because the consumers and non-consumers of a product cannot merge or be merged to internalize externalities. The consumers (the polluters) and the non-consumers (the affected party) cannot be asked to merge just because we want to internalize the externality arising from the consumption of sachet water. Hence, this measure is not applicable, and thus not considered appropriate for solving the externality problem from used sachets.

(ii) Pigouvian Taxes/Subsidies

As the name implies the solution was suggested by Pigou (1920). This classic remedy to externality problems remains, until recently, the standard solution most favoured by economists. It is one of several ways in which government can intervene when individuals acting on their own cannot attain an efficient solution. Pigou suggests a tax to be levied on the polluter or the externality-generality activity. He advocates a tax, now called the Pigouvian tax, on each unit of a polluter's externality-generating output in an amount just equal to the marginal damage it inflicts at the efficient level of output. It is usually levied on the polluting agent in an amount equal to marginal social damage. This raises the prices of output and reduces both the amounts of output produced and consumed, thereby eliminating the suboptimal overproduction and over consumption brought about by externalities.

Evaluation and Appropriateness vis-à-vis the Research Problem

Practical problems confronting the use of Pigouvian taxes/subsidies are used to evaluate their appropriateness. These problems are:

- Measuring damage is difficult, if not impossible. For instance, the monetary value of damage to health and loss of life is very difficult to estimate. Hence, finding the correct optimal tax rate is extremely hard.
- It is also difficult to reduce damage to an efficient level. If we knew the optimal level, we could just tell the polluter to produce exactly that amount and not have to mess with the tax
- It is alleged that the Pigouvian taxes overlook a particular contingency that can result in "over-correction".
- The costs of collecting the necessary information and supervision are prohibitively high

In addition to the foregoing, there is high tendency for the tax scheme to lead to high price of sachet water, irrespective of on who the tax is levied. Even if the tax is imposed on the producers, they will definitely shift part of the burden to the consumers through price hike. This would worsen the economic welfare of both the consumers and non-consumers; it affects non-consumers through a chain reaction in other sectors of the economy.

(iii) Establishing Property Rights/Coase Theorem

In the quest for the best solution to externalities, Coase (1960) points out that the government need not intervene in every case of externality and that many externality problems result from the fact that property rights to certain resources are ill-defined or not defined at all. Clean air, for instance, is a resource not owned by any one. The polluter can, therefore, use the clean air as a method of waste disposal of his noxious gaseous emissions without compensating the affected party who is deprived of clean air. This is because there is no clearly defined owner to demand compensation. The Coase' conclusion that once a costless negotiation/bargaining is feasible, the efficient solution would be achieved irrespective of who is assigned the property rights - either the polluter or the victim – as long as one party is assigned those rights, is what is referred to as *Coase Theorem*.

However, for Coase solution to work, four conditions must be satisfied, and these conditions constitute its peculiar practical problems. The conditions are:

- The property rights at issue must be clearly defined and understood. However, there are certain resources, such as clean air, to which property rights cannot be assigned.
- There must be no impediments to bargaining. The theorem requires that the costs of bargaining do not deter the parties from finding their way to the efficient solution and that the parties involved must be willing and able to discuss the externality issues openly and with little or no cost.

- Only a few people can be involved. Serious problem can develop when one of the parties to the externality bargain is a large group of people such as all residents of Kwara State or Nigeria as with the case of water sachet externality. Even the whole universe may be involved in the case of the air pollution. For instance, global warming involves the whole universe
- The source of pollution or damage done to the affected party is traceable to a particular polluter or an externality-producing activity.

Critical Evaluation/Appropriateness vis-à-vis the Research Problem

The theorem critics have pointed out that the conditions required for the theorem to produce the efficient results are not always present. First, the solution is premised on the notion of extending property rights to the resources at issue. But there are certain resources that cannot be owned by any one. This is the case of clean air polluted by burning used-sachets. Since property rights cannot be extended to clean air, the non consumers of sachet water cannot claim compensation from the consumers of sachet water. Hence, going by this, we can say that the property rights approach is not applicable, and thus not appropriate for solving the externality problems arising from the burning the water sachet. As this is not enough evidence to disqualify the approach, we shall explore other conditions of the scheme.

Second, the theorem requires that few people are involved and that the costs of bargaining do not deter the parties from attaining the efficient solution. However, externalities such as air pollution caused by burning water sachets involve millions of Nigerians (both the consumers and non-consumers). It is difficult bringing these involved parties together without a cost or at a very low cost. Third, the theorem also requires that the pollutees can identify the particular polluters that cause damage to their property, health or environment. However, the non-consumers of sachet water cannot identify the source of air pollution. Even if the source is identified, the used or disposed sachets comprise variety of sachets from different water producers. The consumers and non-consumers are also intertwined and both affected. After all, it is not even the water producers that pollute the environment; it is the consumers. It is very difficult to trace pollution (air, land or water) to a particular consumer. The consumers simply drink the water and throw away or litter the sachets. For these reasons advanced above, the use of property rights approach is not applicable to the sachet-water externality problems.

(iv) Pollution Permits

This is another way in which government can intervene when individuals fail to attain an efficient solution on their own. Some economists prefer to use the term ''creating a market'' for this type of measure. This is because the government creates a market for clean air or water that otherwise would not have emerged, by selling permits (to pollute) to producers of the pollution-generating products. Creating markets is deemed necessary because of the belief that it is the lack of markets for externalities that causes the problems (Varian 2003). Under this scheme, government will announce the auction or sale of pollution permits to spew certain level of pollutants such as sulphur dioxides in to the environment. Firms then bid for the right to pollute the environment, and the highest bidder gets the permits. A market clearing *effluent fee* is charged so that amount of pollution is equal to the level set by the government.

Evaluation and Appropriateness vis-à-vis the Research Problem

The Nigerian economy is not ripe for the scheme of using pollution permits auction to control pollution generally, let alone the pollution caused by used water sachets. This is because considering the level of education and sophistication of sachet water producers, the market is not yet developed for the scheme. Even in the developed countries with well developed markets, pollution permits approach is not popular. The US, for example, relies heavily on regulation.

Even if the allocation process is to be used, the problem of which producer is to get the allocation and in what quantities arises. Government is composed of self-interested individuals who make economic decisions to favour their interests, those of their electorates or their political godfathers/stalwarts. Some of them have factories producing sachet water and thus, they may allocate large proportions of the permits to their firms. This is why public choice economists see government as an imperfect intervener in its attempt to correct for market failure. Thus, the approach is not considered appropriate for the externality problem.

(v) Deposit-Refund Systems (DRS)

A deposit–refund system is a method of pollution control in which the buyers or consumers of a polluting product pay a surcharge, which is later refunded to them when they return the used packaging of the product or it's leftover to a point of purchase or designated centre. The purpose of this is to make the used packaging available for reuse, recycling or proper disposal in order to curb pollution. Deposit-refund scheme is usually adopted for products whose polluting packaging material are recyclable, costly to incinerate, generating large volume of waste, and occupying large space in landfills. It is also adopted for products which packaging contains toxic substances, the control of which poses special problems to waste handlers and the improper disposal of which poses serious health hazards (Jerome 2001). The packaging of sachet water aptly fits into the above description of the products whose pollution can be controlled by the scheme. One, the packaging of sachet such

The deposit-refund scheme is based on user-pays-principles (UPP). The UPP emanates from the thinking that the consumers of goods and services that generate pollutions should be made to share in the abatement cost, because waste disposal involves cost that should be borne by those responsible for the waste. The scheme is also based on the principle that incentives should be provided to encourage waste recovery or reclamation, and recycling.

The deposit levied on the polluting product represents a charge designed to cover the costs of waste disposal in the event that the used packaging or leftovers are not returned for recycling or safe disposal. But when they are returned to the designated collection points, the supplier gives either a total (or partial) refund of the initial deposit, depending on the economics of recovery or recycling of the material. The fund represent on effective subsidy to waste-recovery effort (Jerome 2001)

Instead of accepting deposit as in the deposit-refund systems, reclamation, refuse and recycling can also be done informally by firms themselves or opportunistic investors or capitalists. This has since been in existence in Nigeria and covers a wide range of products such as papers, plastic containers and packaging, rubber slippers, bottles, and other recyclable materials.

The informal approach allows the polluters to pollute or dispose waste improperly, while 'scavengers' go around nooks and crannies to pick up those waste for the purpose of selling them to recycling firms. Allusion can be made to the case of rubber slippers and plastics in Kwara State. The scavengers in the state do their business by using the barter system to get worn-out slippers, besides freely scavenging, by exchanging a product such as matches or a plastic container for two old pairs of rubber slippers. It is called "bata meji rubber kan, isana kan" meaning two old/worn-out rubber slippers for a plastic container or a box of matches. This system works very well because you can hardly see any rubber slippers littered round the streets, unlike before when they constituted large proportion of domestic waste.

Recycling: The Pivot of the DRS

Recycling is a method of pollution control used where the sources of pollution, such as plastics, are recyclable. Other plastic packaging lends themselves to be reused many times over. Here, the already used packaging is collected to produce the same type of packaging or other materials. Some firms that are specialised in collecting the used packaging collect the packaging that has been used and sell them to the recycling firms. Some producers re-claim the packaging of their products from the consumers and reuse them for packaging same products. Reuse and reclamation are usually possible where the packaging is reusable and recyclable. The government may direct the producers to reclaim their packaging from end-users or from the streets. This reduces the number of used packaging littered about. For instance, a law has been passed in Germany to force manufacturers to take back their packaging materials. Nürnberger, 1999, however, notes that measures like this upset the economy, but why should society suffer to prop the profits of the elite?

Reusing plastics is preferable because of its economical use of energy and resources. It is believed to use less energy and fewer resources. Long life, multi-trip plastic packaging has become wide spread in recent years, replacing less durable and single-trip alternatives, therefore reducing waste. In the UK, for instance, the major supermarkets have increased the use of returnable plastic crates for transport and display purpose four-fold from 8.5 million in 1992 to 35.8 million in 2002[1]. A report has it that Japan places 20 percent of its waste into landfills, and recycles 95 percent of its beer bottles (Nürnberger, 1999).

It has been noted that cost-effective high-achieving plastic collection can be achieved by integrating used polythene sachets collection with other recyclable materials. Boxes designated for polythene and other plastics collection can be placed by roadsides for sorting by the refuse collectors. Thus, the main sources of 'raw' materials for recycling are designed boxes, free scavenging and DRS.

Literature reveals four types of plastic recycling, namely, (i) process-scrap (ii) post-use (iii) mechanical, and (iv) chemical or feedstock recycling

(i) Process Scrap Recycling: It involves the recycling of industrial plastic scraps left over from the production of plastics. This type of recycling, usually described as reprocessing, is relatively simple and economical as a regular and reliable source of relatively uncontaminated materials.

(ii) Post-Use Recycling**:** It is a recycling process where the already used plastics are collected from different sources or locations and recycled into new plastics. Households are the biggest source of getting the materials for this type of recycling. The post use recycling is the type most needed to solve pollution problems, especially the sachet pollution. One of the challenges of using this type of recycling to control pollution is that of collection. We hardly have any federal, state or local authorities offering some form of plastic or polyethene collection services in Nigeria.

(iii) Mechanical recycling: This refers to processes in which waste plastics are melted, shredded, and granulated. Plastics must be sorted prior to mechanical recycling. The different between post use and mechanical recycling is that in the former only a particular type of packaging, say used sachets, are collected and recycled. But in mechanical recycling, various plastic packaging are collected and then sorted into polymer type and/or colour. After sorting, the plastic is either melted down directly and moulded into a new shape, or melted down after being shredded into flakes and then processed into granules. It is reported that technology is being introduced to sort plastics automatically, using various techniques such as x-ray florescence, infrared and near infrared spectroscopy, electrostatics and flotation. In the case where sorting is very difficult, indirect cycling can be used to circumvent the problem. Indirect cycling converts mixed plastics into materials which do not need a high degree of purity or uniformity, e.g. shoe soles, carrier bags, toys, pipes and bicycle saddles

(iv) Chemical Recycling: these recycling breaks down polymers into their constituent monomers, which can be used again in refineries or chemical and petrochemical production. A number of feedstock recycling technologies is reportedly being explored. These include pyrolysis, hydrogenation, gasification and thermal cracking. Chemical recycling is capital-intensive and requires very large quantities of used plastics for reprocessing to be economically viable. This recycling type is required to control the pollution created by water sachets, provided they are recyclable to chemicals or petrochemicals.

Evaluation and Appropriateness vis-à-vis the Research Problem

It appears from the foregoing analysis that DRS is most appropriate for controlling the externality created by water sachets, since the packaging material (polyethylene) is recyclable. It provides polluters with economic incentives (refundable deposit) to disengage from polluting activities. Besides, recycling has the capacity to generate employment opportunities for the economy, and thereby reducing the unemployment problem (a by-product) in the country. It is not as costly as other afore-discussed control measures, and will not necessarily increase the price of the product. Lots of other measures have tendency to make firms cut back production and shed off some workers, thereby aggravating the unemployment problems. But instead, DRS engage people either in the recycling plants or the polythene collection services. A report on the production of carrier bags made from recycled rather than virgin polythene concludes that the use of recycled plastic result in the following advantages:

- Conserves non-renewable fossil fuels
- Reduces energy consumption
- Reduces the amounts of waste plastic going to landfill
- Reduces emissions of gaseous pollutants such as CO_2, NOx and SO_2

· Reduces the amounts of plastics waste requiring disposal

A different study also concludes that 1.8 tonnes of oil are saved for every tonne of recycled polythene produced[3].

(vi) Direct Regulation

Direct regulation is another way in which government intervenes in externality problems. This is a conventional method widely used all over the world, especially in the industrialized nations, to control pollution or any other externality problems. Government may lay down maximum pollution level or ban outright the production of output that generates pollution. However, it would be prohibitively expensive, if not impossible, to eliminate entirely all trace of some of the pollutants. Optimality does not require that external diseconomies be eliminated, but simply that their amounts are consistent with the optimal amounts of the good that creates them. However, the cost of discovering and maintaining an optimal amount of the pollution may itself be prohibitive. The community may then be faced with the choice of zero or unchecked pollution.

Taxes, subsidies, and pollution permits are all methods of market-based, indirect regulation designed to induce polluters to weigh the social costs of their activities against their benefits. It is in the light of this that some researchers prefer to call these methods market-based approach, while direct regulation is called command-and-control approach. Regulation is relatively easy to understand. However, pollution control through regulation has its own peculiar problems. One, the major constraint of direct regulation is the high administrative cost of enforcing the set standards.

Evaluation/Appropriateness vis-à-vis the Research Problem

With to this study, it is very difficult, if not impossible, for governments to regulate pollution (especially, air pollution) arising from water sachets because of the following reasons. First, the producers are not the immediate polluters; it is the consumers that pollute the environment with sachets. And the consumers can not be asked to reduce water intake or to stop taking sachet water outright, where the alternatives, such as borehole or tap water supply, are grossly inadequate for the populace, or even where the superior alternative (bottled water) is not affordable to a significant proportion of the population. The only way in which the government can effectively regulate the pollution is by providing alternative sources of drinking water that can adequately compete with sachet water both in terms of quantity and quality. This is premised on the notion that circulating sachet water is of proven quality due to the National Agency for Food and Drug administration and Control certification. The government can then prohibit outright the production and consumption of sachet water. Even if the government can ban the product outright, the negative macroeconomic implications of the ban will prevent the government from doing so. The government may not be able to cope with the resultant increased unemployment from shutting down the water factories. It is believed that the sector absorbs large proportion of the country's labour force.

Second, on what grounds will the government ask the sachet water producers to reduce their production? Water is an indispensable commodity that every one consumes. Reducing the output will raise the price of sachet water, and thus, the price of its alternatives like bottled water. This is another macroeconomic implication: it can bring about of inflation. This implies that regulation is not cheap as it appears. The consumers have to pay for the price increase to avoid loss of welfare that the pollution imposes on them. By reducing the production, the government is indirectly instructing the populace to reduce their water intake without adequately providing the alternatives. How feasible is this?

Third, the regulation of pollution from of water sachets might be inefficient since the consumers or the producers are very large, and since it subjects all to equal pollution standards irrespective of individual level of pollution. It might also be inefficient because of the tendency for high administrative and compliance cost to overwhelm the potential benefit of pollution abatement. Since direct regulation is deemed to fail the major economic test of efficiency (cost-benefit analysis) by not being cost-effective in meeting the desired goal. Economists always favour economic (market based) approaches to controlling externalist. Hence, there is tendency for the producers to violate the regulation

Furthermore, governments can legislate against littering, indiscriminate waste disposal or illegal waste dumping. But this will not solve the problems. Legislation cannot effectively work in developing countries like Nigeria, where the lit-

eracy level is relatively low. Enacting a law against littering or illegal indiscriminate waste disposal is not the problem, but the enforcement of the law. Effective law enforcement is a tall order in corruption-ridden countries like Nigeria, where the enforcement agency or their officials are highly corrupt. Thus, there is high tendency for violators to go scot-free or with a bribe.

(vii) Suasive Instruments: Awareness and Anti-Litter Campaigns

Suasive instruments include moral suasion, awareness, and anti-litter campaigns. These three strands are lumped together under the name suasive instruments or social conventions. They are more or less the same and serve the same purpose. By moral suasion, the polluters are called upon and cajoled to desist from, or reduce, their externality-generating activities. Both awareness and anti-litter campaigns seek to inform and sensitize the polluters about the causes and effects of the polluting activities. The basic aim is to persuade the polluters to eliminate or reduce pollution voluntarily. School children are taught that littering is irresponsible and not a nice or proper way of disposing of waste. If this teaching is at all effective then a child learns that even though he bears a small cost by holding on to a biscuit wrapper or a banana peel until he finds a garbage can, he should incur this cost because it is less than the cost imposed on other people by having to view his unsightly garbage (Rosen 1999).

Evaluation/Appropriateness Vis-à-Vis the Research Problem

This three-in-one approach to controlling pollution is not all that effective because none of them carries any legal authority. Hence, they least affect the market. This is evidenced from our Nigerian university campuses, where there are various anti-litter campaigns, provision of wastecans, anti-litter inscriptions on bill boards, like "always keep the campus clean" or "don't be a litterbug". Nonetheless, the campuses are still being littered. However, these methods have been partially successful in reducing the amount of trash, educating and sensitizing people to pollution problems.

VI. CONCLUSION

The externalities discovered from sachet water consumption are of three dimensions namely, land water and air pollution. The used sachets littered round the environment to cause land pollution, which could result in unsightly environment, and diseases. Poor disposal of emptied sachets threatens the public health, harbours and encourages diseases, pests; and turn urban areas, even villages, into unsightly, dirty and unwholesome places to live in for both the consumers and non-consumers of sachet water. It was discovered that inadequacies of public water supply in terms of quality and quantity led to the evolution of packaged water industry. It is the inability of the Government to persistently provide adequate potable water for its growing population that precipitated the emergence and proliferation of the sachet water production in the country.

The study found that consumers are generally ignorant of any anti-pollution law/policy, if any. This is evidenced from about 80% of respondents who disclosed that they were not aware of any anti-pollution policy. But there exist some laws or policies, such as war against indiscipline (WAI), to that effect. But they were ignorant of them. This signifies poor law enforcement orientation and information dissemination in the country. Given the expositions and analyses we have made so far on the pollution/externality problems from sachet water consumption, the study strongly recommends primary and secondary policy instruments. While the primary policy instrument is the Deposit-Refund System (DRS), the secondary policy instruments are ways or avenues in which effective and efficient DRS results could be achieved.

The primary policy instrument, the deposit-refund system, is a method of pollution control in which the consumers of a polluting product are made to pay a surcharge, which is later refunded to them when they return the used packaging of the product or its leftovers to a point of purchase or any designated center. The purpose of the scheme is to make used-packaging materials available for reuse, recycling or proper proposal so as to curb pollution. An assessment of the applicability/appropriateness of the various solutions to externalities reveals that the Deposit Refund System (DRS) is the most appropriate, potentially effective policy instruments for the pollution/externalities resulting from sachet water consumption. The pivot of this scheme is recycling, which has the potential to reduce the pollution level, provide employment opportunities and thus enhances economic growth and de-

velopment. If even recycling is costly in monetary terms, it still pays to recycle: that is when faced with two evils; it is better to choose the lesser one. The cost in the absence of recycling would be much higher.

NOTES

[1] Sinks are the spaces where waste and pollution are deposited.

[2] From: www.wasteonline.org

[3] www.wasteonline.org

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