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Marketing Implications of the Ozone Layer Protection in Nigeria

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ABSTRACT: *A thin cloud of gas which protects the earth from the sun's harmful radiations is the ozone layer. The global response to the environmental threats of the ozone layer depletion, initiated the ozone depleting substances phase-out project in Nigeria. The aim of the project was to reduce and eliminate the production, consumption and use of the chemical substances that have been implicated in the depletion of the ozone layer. The intense pressure mounted on the industries that use ozone depleting substances to re-tool their facilities and commence production of ozone friendly (green) products yielded positive results. This study therefore attempts to appraise the consumers' preference and acceptability of the emerging ozone friendly products relative to the conventional (ozone depleting substances) products. Two hypotheses were formulated and tested. A sample of 329 respondents was derived from a population of 1850 respondents, comprising 122 marketing officers, 200 distributors and 1528 customers of the firms that participated in the ozone depleting substances phase-out project in Nigeria. Stratified random sampling procedure was used. All the administered questionnaires were returned, analyzed with Microsoft Excel and ANOVA (Single factor) technique was applied to test the hypotheses at 0.05 level of significance and 7 degrees of freedom. Findings revealed that consumers' preference for ozone-friendly products was significantly different from ozone depleting substances products. The market acceptability of the ozone friendly products was insignificant compared to the ozone depleting substances products. Recommendations were made towards improving consumers' preference and market acceptability of the ozone-friendly products.*

KEYWORDS: *Ozone layer, Ozone Depleting Substances, Green Marketing, Consumers Preference, Market Acceptability, Ultraviolet Radiation.*

I. BACKGROUND OF THE STUDY.

Life on earth is protected from the harmful solar radiations by a thin cloud of gaseous ozone. The cloud stretches from about 10 to 45 kilometers above our heads, encompassing the planet earth like an invisible shield (de Gruiji, 1995). It is above the height at which commercial aircrafts fly and far beneath the orbital paths of spacecraft. This thin cloud of gas is the ozone layer. It forms a barrier between us and the ultraviolet radiation that streams towards the earth daily from the burning surface of the sun. It has been estimated that the temperature of the sun is about 6000^0C at its surface and $15{,}000{,}000^0$C at its core (Ababio, 1998:587). The heat energy is transmitted through a distance of about 163 million kilometers (93 million miles) to the earth's surface. But ozone is selective in what it takes from the sunlight. It screens out the more energetic ultraviolet rays through a process of atomic absorption while allowing the visible light and the warm infrared to pass through untouched.

The deterioration of the natural environment has become a major global issue (Kotler and Keller, 2009:122). The use of certain chemical substances in the industry has been implicated in the physical abuse of the natural environment. These chemicals which include chlorofluorocarbons (CFC), halons, carbon tetrachloride (CTC), methyl chloroform (TCA), hydro- chlorofluorocarbons (HCFC) and methyl bromide have inflicted much damage to the ozone layer (Bayero,2003).The ozone depleting substances phase-out project in Nigeria was the initiative of the Montreal Protocol, compelling the user industries to develop non-ozone depleting substances formulations to replace the conventional ozone depleting substances products. It involved redesigning and conversion processes which entailed modification of production facilities to manufacture the newly formulated ozone friendly products. The marketing implications of the ozone depleting substances phase-out project in Nigeria, culminating into the ozone layer protection therefore provided the stimuli for this study.

1.1 Statement of the problem

Any persistent drop in the concentration of protective ozone resident in the stratosphere increases the intensity of solar ultraviolet radiation that reaches the earth's surface. Ozone depletion affects humans, animals and plants as ultraviolet radiation is associated with health related and environmental hazards.

Chronic ultraviolet exposure to the eyes causes Pterygium (an outgrowth on the most superficial cell layer of the eyeball) and climatic droplet keratopathy (a degeneration of the fibrous layer that covers the lens). Both afflictions reduce clarity of vision and can cause blindness. Cortical cataract (a condition that clouds the lens of eye) can result from ultraviolet radiation. It has been estimated that about 0.5% increase in cataract incidence occur for every persistent 1% decrease in average ozone concentration (Acevedo,et al,1993).Ultraviolet radiation damage DNA, the molecule that builds genes. For example, after a sunny day on the beach, a single typical exposed cell in the epidermis (upper part of the skin) has developed some 100,000 to 1,000,000 damaged sites in its DNA (Acevedo, et al, 1993).

Exposure to ultraviolet radiation increases the risk of developing skin cancers such as malignant melanoma, basal and squamous cell carcinoma (Bora,2011). Non- melanoma skin cancer which is popular in white populations and are cosmetically apparent as red nodules or blotches, result from ultraviolet radiation. The incidence of non-melanoma skin cancer is expected to increase by approximately 2% for every persistent 1% loss in average ozone concentration (Acevedo,et al,1993).Natural immunity to infectious diseases can be weakened by prolonged exposure to ultraviolet radiation. Of special concern is the lowering of the effectiveness of preventive vaccinations against tetanus and similar ailments by ultraviolet radiation. A decrease in the stratospheric ozone can lead to an increase in the ozone present in the troposphere which is regarded as pollutant. Direct exposure to ozone is harmful as it causes respiratory complaints and exacerbates asthma. The same ozone that is "good up there" can be "bad down here". In the tropics, where the ozone layer is thinner resulting in the increased intensity of the sun, plant species are affected by the ultraviolet radiation. It can affect important crops like rice by adversely affecting cyanobacteria which helps them to absorb and utilize nitrogen properly. Phytoplankton, a plant like organism that provides base for entire marine food chain is affected by ozone depletion.

The ultraviolet radiation can affect the orientation and mobility of these organisms, thereby influencing their survival rates (Bora,2011). The global plant cover that serves as a sink for carbon dioxide and reduces the incidence of global warming is adversely affected by ozone layer depletion. The harmful effects of the ultraviolet radiation on animals affect the early stages of their life, such as the larvae or eggs of frog in shallow waters. The need for the industries that make use of the ozone depleting substances to re-tool equipment and seek environmentally compatible chemical substances as to protect the ozone layer and preserve life on earth became compelling. The ozone depleting substances phase-out project involved products innovations, variations and elimination, designed to match the marketing programmes with ecological requirements. Since the concept of marketing emphasizes giving the consumer what he wants, his attitude towards the emerging green products is of primary concern. The consumers' preference for the ozone friendly products and the extent to which the green products were accepted in the market therefore form the core subject of investigation of this study.

1.2 Objectives of the Study.

The broad objective of the study is to evaluate the marketing implications of the ozone layer protection in Nigeria by appraising consumer preference for the ozone-friendly (green) products. The specific objectives include to find out if Nigerian consumers prefer the ozone-friendly to ozone depleting substances products and determine the extent to which the ozone-friendly products have been accepted in the market compared to the conventional (ozone depleting substances) products.

1.3 Research Questions.

The study attempted to provide answers to the following questions:

[1] Do the Nigerian consumers prefer the ozone friendly products (in view of their green benefits) to the ozone depleting substances products?

[2] To what extent have the ozone friendly products gained market acceptance compared to the ozone depleting substances products?

1.3 Hypotheses Formulation.

At 95% confidence level, the hypotheses were formulated for testing;

Hypothesis 1.

Ho: Consumers' preference for ozone-friendly products is not significantly different from ozone depleting substances products.

H_1: Consumers' preference for ozone-friendly products is significantly different from ozone depleting substances products.

Hypothesis 2.

Ho: Market acceptability of ozone-friendly products is not significant compared to ozone depleting substances products.
H_1: Market acceptability of ozone-friendly products is significant compared to ozone depleting substances products

II. REVIEW OF RELATED LITERATURES

The earth is one of the planets that orbit the sun. It is the only planet that is known to have life. The earth has three segments, namely, the atmosphere, hydrosphere and lithosphere (Ababio, 1998:583). The atmosphere is the layer of air that surrounds the planet. The hydrosphere is the solid part of the earth. The atmosphere extends to a height of more than 450 kilometers from the earth's surface. The lower layer of the earth (zero to about 10 kilometers) is the troposphere. This region determines the weather changes, viz, clouds, rains, thunder and lighting. The next layer of the atmosphere is the stratosphere which extends from about 10 to 45 kilometers above the earth's surface. The ozone layer is located in the stratosphere. The air surrounding the earth is made up of about 78% nitrogen, 21% oxygen and 1% of other gases including carbon dioxide, water vapor and rare gases (Ababio, 1998:584). When an oxygen molecule (O_2) absorbs solar ultraviolet radiation, it breaks down to two individual components called oxygen atoms (O). The free oxygen atom (O) then combines with an oxygen molecule (O_2) and forms an ozone molecule (O_3). The ozone molecule in turn absorbs ultraviolet radiation between 310 to 200nm wavelength and prevents harmful radiation from entering the earth's surface. In the process, the ozone molecule (O_3) splits into a molecule of oxygen (O_2) and an oxygen atom (O). The oxygen atom (O) again combines with the oxygen molecule (O_2) to regenerate an ozone molecule (Bora,2011).A delicate balance of stratospheric ozone layer is maintained by this continuous process of destruction and regeneration known as photochemical reaction. At any time in the reaction process, there is little ozone in space, enough to form a layer (about 3mm or $1/10^{th}$ of an inch in thickness), compressed under the atmospheric conditions that exist at the ground level.

The ozone layer, thin as it is, prevents most of the solar ultraviolet radiations from reaching the surface of the earth. Interestingly, the biosphere has created its own protective atmospheric ultraviolet filler under which life could evolve and exist on the planet earth (Acevedo, et al,1993,). Ultraviolet radiation under wild dosage can also be beneficial to human health. It initiates the production of vitamin D_3 in the skin that helps to build and maintain bones. The ozone layer as a component of the atmosphere has an inherently chaotic behavior. The layer is naturally thinner at the equator and exhibits substantial variations at any place due to changing solar intensity and atmospheric circulation (Acevedo, et al,1993). Certain chemical substances identified as damaging to the ozone layer include chlorofluorocarbons(CFC), Halons, carbon tetrachloride(CTC), methyl chloroform (TCA), hydro chlorofluorocarbons (HCFC) and methyl bromide. The industrial sectors that used these ozone depleting substances (ODS) were the Foam, Refrigeration/Air-Conditioning, Fire Protection (Halons), Paints, Textile, Degreasers and Stain Removers, Industrial Cleaning, Old Plants and Machine Refurbishing. The major substances that account for almost 80% of the total depletion of ozone in the stratosphere are chlorofluorocarbons (CFC). The chlorofluorocarbons are halocarbon gases. They are stable in the troposphere. They rise slowly into the sky, climbing high enough after a period of years, to be hit by direct ultraviolet radiation from the sun, releasing free chlorine atoms. A free chlorine atom reacts with an ozone molecule to form chlorine monoxide (ClO) and a molecule of oxygen.

The chlorine monoxide reacts with an ozone molecule to form a chlorine atom and two molecules of oxygen. The free chlorine atom again reacts with ozone molecule to form chlorine monoxide. The process continues, altering the natural photochemical reactions in the direction of ozone layer destruction. The desire to meet humanity's need without harming the existence of life on earth is the focus of green marketing. It consists of all activities designed to generate and facilitate any exchanges intended to satisfy human needs or wants, such that satisfaction of those needs and wants takes place with minimal harmful impact on the natural environment (Grundey and Zaharia, 2008).The principle is based on transforming consumer society into a sustainable society by avoiding or reducing environmental pollutions at every stage of the market-oriented activity (Ezeokafor, 2003:1). Environmental issues are intertwined with primary consumer needs. The increasing concern for the causes and effects of ozone depletion led to the signing of the Montréal Protocol in 1987. The Protocol calls on the nations around the world to take concrete actions to protect the ozone layer by reducing and eliminating the production and consumption of ozone depleting substances. Nigeria acceded to both the Montreal Protocol on substances that deplete ozone layer and Vienna Convention for the protection of the ozone layer on 31^{st} October 1989 (Bayero, 2003). The international policy response to this environmental threat of ozone layer depletion led to the declaration of **15^{th} September of every year as the ozone layer protection day**. Ozone depleting substances legislation was enacted in Nigeria to restrict trade in ozone depleting substances, prohibit the importation of refrigerators and air conditioners using CFC, refill and use of fire extinguishers with halon,

prohibit CFC -II and 12 as blowing agent/ refrigerant and venting of controlled substances, provision of storage facility and disposal of controlled substances, among others. Ban was imposed on importation of used refrigerators, air conditioners and cars older than eight years. Because evidences abound that all second-hand refrigerators, cars and air conditioners imported into the country contained gases that are damaging to the ozone layer. The collaboration of the Federal Government of Nigeria with the United Nations Development Programme (UNDP) and the United Nations Industrial Development Organization (UNIDO) facilitated the programme of phasing out about 3075.71 metric tons of ozone depleting substances in the Foam, Refrigeration/Air-Conditioning, Halon Aerosol and Solvent sectors in Nigeria (Bayero, 2003).Consequently the measure affected the availability of the ozone depleting substances products in the Nigerian market as they were substituted with the ozone-friendly(green) products. The consumers' preference for the green products and their market acceptability relative to the conventional ozone depleting substances products could pose challenges to the industries producing the newly formulated products. The extent to which the ozone friendly products are preferred and accepted in the market constitutes the focus of this study.

III. METHODOLOGY

The study adopted survey research design. Questionnaire, interviews, official documents, seminar/workshop papers and internet materials were used to generate the primary and secondary data. The questionnaire applied the five point Likert Scale format, viz, Strongly Agree (5points), Agree (4points), Undecided (3points), Disagree (2points), and Strongly Disagree (1point). The sampling method comprised stratified random sampling and judgmental techniques. The sample size was determined, using the formula developed by Yamane (1967, cited in Eboh 2009: 94).Mathematically, the formula is expressed as: $n = N/1 + N (e^2)$;where n =sample size, N=Actual Population, e=Level of significance (5%), I=constant The target population for the study was 1850 respondents drawn from 122 marketing officers, 200 distributors and 1528 customers of the firms that participated in the ozone depleting substances phase-out project in Nigeria from 2002 to 2012. The population of the industrial sector was 122 comprising Foam (53), Refrigeration and Air-conditioning (34) and solvent (35). A sample size of 329 was derived. The questionnaire and interview questions were validated using the opinions of professionals in academics and industry. A pilot study involving 90 respondents was conducted to determine the reliability of the research instrument using Cronbach Alpha Technique. The reliability coefficient was 0.942, indicating high degree of internal consistency of the research instrument. The sample size for each category of the respondents was estimated using Bowley's Proportional Allocation Technique; Nh = nNh/ N; where, nh=number of unit allocated to each sub-group, Nh=number of respondents in each sub-group, n=total sample size, N=total population. The sample sizes were the industrial sector (22),distributors (35) and customers (272) .A total of 329 questionnaires were distributed in Aba, Onitsha, Lagos and retrieved. The data generated were analyzed with Microsoft Excel and the hypotheses tested using the ANOVA (Single Factor) technique and F-distribution as the test statistic at 0.05 level of significance and 7 degrees of freedom.

IV. DATA PRESENTATION AND ANALYSES

The data generated from the study were analyzed and tabulated as under listed.

Table 4.1**.** The population distribution of the industrial sectors that participated in the phase- out of the ozone depleting substances project in Nigeria.

S/N	Sectors	Population	Percentage. %
1.	Foam	53	43.44
2.	Refrigeration & Air-Conditioning	34	27.87
3.	Solvent	35	28.69.
4.	Halons	not available	-
	Total	122	100

Source: National Ozone Office, Federal Ministry of Environment, Abuja Nigeria.

Table 4.1 showed that the Foam industry (43%) topped the list of the industries, followed by the Solvent (29%), Refrigeration & Air-conditioning (28%), that participated in the phase-out of the ozone depleting substances project in Nigeria. Data on the firms in the Halons industry were not available.

Table 4.2. Consumers' preference for Ozone Friendly Products (OFP) and Ozone Depleting Substances Products (ODSP).

Item	Products attributes	No of Respondents (OFP)	Scores of Respondents (OFP)	No of Respondents (ODSP)	Scores of Respondents (ODSP)	Total no of Respondents
A	Quality	175	346.50	154	329.00	329
B	Durability	203	224.00	126	301.00	329
C	Performance	193	252.00	136	311.50	329
D	Price	147	234.50	182	357.00	329
E	Packaging	193	220.50	136	311.50	329
	Total	911	1277.50	734	1610.00	1645
	Aggregate mean	182	255.50	147	322.00	329

Source: Field Survey,2013.

Table 4.2 showed the responses on the consumers' preferences for the ozone friendly and ozone depleting substances products as derived from the questionnaire.

Table 4.3 Scores for test of hypothesis 1.

S/N	Scores of Respondents (OFP)	Scores of Respondents(ODSP)
A	346.50	329.00
B	224.00	301.00
C	252.00	311.50
D	234.50	357.00
E	220.50	311.50

Source: Field Survey, 2013

The data in Table 4.3 were analyzed with Microsoft Excel using ANOVA (Single factor) technique at 0.05 level of significance and 7 degrees of freedom.

Table 4.4 Anova: Single Factor

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	15312.5	1	15312.5	37.12871287	0.000889	5.987378
Within Groups	2474.5	6	412.41667			
Total	17787	7				

Source:FieldSurvey, 2013.

VI. DECISION .

Considering Table 4.4, F-computed (37.1287) was greater than the F-critical (5.9874), the null hypothesis, Ho, was rejected. The p-value gave additional insight into the strength of the decision. Assuming the null hypothesis was true, p-value would have reported the probability of getting a value of the test statistic, at least as extreme as the value actually obtained. The procedure involved a comparison of the p-value with significance level. If the p-value is smaller than the significance level, the null hypothesis will be rejected. In this case, the p-value (0.0009) was less than the significance level (0.05), ie, $P<0.05$.The null hypothesis was not true and therefore rejected. The alternate hypothesis, H_1, was upheld with the conclusion that the consumers' preference for the ozone friendly products was significantly different from the ozone depleting substances products.

Table 4.5 Market acceptability of Ozone-Friendly Products (OFP) compared to Ozone-Depleting Substances Products (ODSP)

Item	Reasons for products acceptance	No of Respondents (OFP)	Scores of respondents (OFP)	No of Respondents (ODSP)	Scores of Respondents	Total no of Respondents
A	Personal &planetary health consideration	165	234.50	164	234.50	329
B	Cost-effectiveness	151	208.00	178	210.00	329
C	Environmental &social responsibility	123	234.50	206	245.00	329
D	Current trends	151	286.00	178	217.00	329
E	Product availability	193	248.50	136	238.00	329
	Total	783	1283.50	862	1144.50	1645
	Aggregate mean	157	256.70	172	228.90	329

Source: Field Survey, 2013

Table 4.5 showed the responses on the market acceptability of ozone friendly products relative to ozone depleting substances products.

Table 4.6 Scores for test of hypothesis 2.

Item	Scores of Respondents (OFP)	Scores of Respondents(ODSP)
A	234.50	234.50
B	280.00	210.00
C	234.50	245.00
D	286.00	217.00
E	248.50	238.00

Source: Field Survey, 2013.

In analyzing the responses in Table 4.6, Microsoft Excel was used and ANOVA (Single factor) technique was applied at 0.05 significance level and 7 degrees of freedom, with F-distribution as the test statistic.

Table 4.7 Anova: Single factor

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	2415.5	1	2415.125	5.42478	0.05873	5.98738
Within Groups	2671.5	6	445.20833			
Total	5086.5	7				

Source:FieldSurvey,2013

Decision

Table 4.7 showed that F-computed (5.4248) was less than the F-critical (5.9874), the null hypothesis, Ho, was not rejected. The p-value gave additional insight into the strength of the decision. Assuming the null hypothesis was true, p-value would have reported the probability of getting a value of the test statistic, at least as extreme as the value actually obtained. The procedure involved a comparison of the p-value with significance level. If the p-value is greater than the significance level, the null hypothesis will not be rejected. In this case, the p-value (0.06) was greater than the significance level (0.05), ie, P>0.05.The null hypothesis was true and therefore accepted. We concluded that the market acceptability of the ozone friendly products was insignificant compared to the ozone depleting substances products.

V. DISCUSSION OF RESULTS.

The findings of the study revealed that the Nigerian consumers' preference for the ozone-friendly (green) products was significantly different from ozone depleting substances (conventional) products and the market acceptability of the ozone friendly products was insignificant compared to the conventional products. Interviews held with the respondents corroborated this discovery. For the foam products, the customers complained about the elasticity and durability of the green products relative to the rugged conventional products. The materials when used for bus/ car seats and mattresses rarely withstood the pressures over time and easily collapsed. In refrigeration and air-conditioning, the new (green) refrigerators/split unit air-conditioners hardly match the performances of the conventional products. Though the prices of the green products are affordable and the packaging attractive, the consumers' interests are centered on utility as they are not ornamental products. The incessant breakdown of these products which may partly be attributed to the epileptic power supply in the country was also a minus. The ozone depleting substances products over the years have shown outstanding performances even under low electric currents with minimal cost of maintenance. The customers showed willingness to buy the ozone depleting substances products (ODSP) if available in the market, the environmental health implications notwithstanding. The impact of current trend and social responsibility on the customers purchase decision was insignificant. The second hand refrigerators and air-conditioners (ODSP) were preferred even at higher prices to the ozone-friendly products and widely accepted due to better performances and cost-effectiveness in terms of maintenance. In the solvent sector, the newly formulated products like heavy duty degreasers, paint dispersants(genopur) and stain removers were less efficient when compared with the conventional products containing trichloroethane or methyl chloroform(TCA) and carbon tetrachloride(CTC).With the high costs of the substitute solvents used to replace the ozone depleting solvents in the formulation, the prices of the cleaning agents became exorbitant. The customers' preference for and the market acceptability of the ozone friendly products therefore may present serious challenge to the complete phase-out of the ozone depleting substances products in Nigeria if the core benefits are continually not derived from the newly formulated products.

5.1. Conclusion.

The study appraised the preference of consumers for the ozone friendly (green) products and the extent to which the products have gained acceptance in the market place. The findings showed that the consumers preferred the ozone depleting substances products to the ozone friendly products and the green products have not gained much market acceptance when compared with conventional (ozone depleting substances) products. The implication is that consumers would likely patronize the ozone depleting substances products if available in the market which may affect the ozone layer protection efforts of various governments and organizations.

5.2. Recommendation

Based on the findings of the study, the following recommendations were made;

[1] The industrial sectors of Foam, Refrigeration & Air-conditioning and Solvent should embrace holistic eco-strategies to satisfy consumers' unique needs. Consumers must derive benefits from the offer of the ozone friendly products. If the products offer neither extra individual benefits nor economic incentives, market failure is imminent and the ozone-depleting substances products would be preferred to the ozone friendly alternatives, the health hazards notwithstanding.

[2] The various sectors should consider lower introductory prices for the ozone friendly products to re-orient buyer behavior, thereby facilitating a more rapid diffusion of the environmentally compatible products.

[3] Manufacturers and marketers of ozone friendly products should seek the intervention of both the States & Federal Government. Such interventions like the Environmental Protection Acts can induce consumer environmentally oriented behavior that can lead to improved market acceptability of the ozone friendly products.

[4] The various legislations on ban of the ozone depleting substances products should be strictly enforced to guarantee competitive advantages for the Foam, Refrigeration &Air-Conditioning, Solvent and Halons industrial sectors.

[5] The replacement of the ecologically harmful raw materials with more environmentally friendly inputs should be on-going. Effects should be directed to the use of recycled materials. Pricing incentives should be offered to suitable retro-distribution channels to encourage reasonable return of used materials. Using recycled materials would reduce unit costs of production and create cheaper prices for the ozone friendly products.

[6] The notion of the environmental benefits, like ozone-friendly, recyclable, refillable, bromide free, should be incorporated in the eco-labels and highlighted in the advertising campaigns to stimulate market penetration of the ozone friendly products. Integrated awareness campaigns through seminars

and workshops should be embarked on by Manufacturers Association of Nigeria, chambers of commerce and other professional bodies, churches and town unions to educate consumers on the harmful effects of the ozone depleting substances products. This measure would adversely affect the acceptability of the ozone depleting substances products in favor of the ozone friendly products.

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