



# Influence of Polythene Bag Alternatives on Compliance to Environmental Legislation on Polythene Bag Ban in Rongai Sub-County, Nakuru County, Kenya

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## Abstract

Polythene bags have been preferred for packaging purposes because they are light in weight, cheap and resistant to degradation. Despite the benefits, poor disposal of polythene causes degradation and pollution of soil, water, land and air resources leading to health problems and climate change. Furthermore, polythene kills the wild game, livestock and aquatic organisms. These problems have led to the introduction of legislation banning polythene bags. Reports of availability of these polythene bags and emergence of poor quality alternatives present negative outcome of the environmental legislations. Therefore, this research study was aimed at studying the influence of alternative eco-friendly bags on compliance with the environmental legislation that banned its use, with a view to improving its adoption in Rongai. The descriptive research design was used in the study. A sample size of 259 respondents was selected using proportionate stratified random sampling from a target population of 18,377 households and 580 traders while purposively selected 6 key informants. Instruments used included Piloted questionnaires (0.74 Cronbach's alpha level) and focus group discussions. Data analysis was done using SPSS version 20. Percentages were used in descriptive statistic while Chi-square at 5% level of significance ( $\alpha = 0.05$ ) and correlation was used in the inferential statistic. Findings indicated that 50% of respondents used the outlawed propylene bags, the majority significantly agreed ( $p < 0.0001$ ). It is suggested that there is need for promotion of eco-friendly bags.

## Subject Areas

Chemical Engineering & Technology, Environmental Sciences

## Keywords

Compliance, Polythene Bag, Environmental Legislation

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### 1. Introduction

Polythene bags have been used for a very long time as packaging and carrier bags because they are cheap, light and resistant to degradation [1]. Despite the benefits, poor disposal of polythene has led to pollution of soil, water, land and air resources leading to health problems such as respiratory infections. An estimated 79% of the plastic waste ever produced lies in dumpsites, landfills or scattered in the environment [2]. This packaging polythene is meant for single-use and accounted for 47% of total waste generated across the world in 2015 and has presented a great challenge in solid waste management leading to environmental health hazards and economic losses [3]. Polythene was identified as a major environmental problem and European Union directives (EU) 2015/720 compelled nations to reduce consumption of lightweight polythene which leads European member states in adopting several measures including legislative, fee, tax and voluntary measures to address the environmental problems associated with polythene [4].

In the year 2004, Luxembourg came up with an initiative called Eco-sac project [3], it brought together the Ministry of Environment, trade confederations and non-profit organization in an attempt to find an eco-friendly alternative to polythene bags. This project led to the adoption of a re-usable bag named “Okot-Tut” that saw 85% drop in the use of polythene after 9 years [3]. This is a demonstration that the success of polythene bag ban in any country is dependent on initiatives of coming up with alternatives to replace the non-biodegradable polythene. Many countries have introduced the ban without any form of arrangement and collaboration for the development of polythene bag alternatives.

The partial ban was implemented in France in 2016 and was aimed at eradicating non-biodegradable and thin polythene bags and to promote the manufacture of biodegradable polythene bags. This partial ban was designed to maintain the economy without affecting the environment adversely and promoting the bio-based industries due to their economic potentials it presents [5]. Rwanda was the first country to ban polythene bags in 2008; the country faced noncompliance because of lack of recommended materials and this led to illegal introduction of polythene through black market, to control and stop the smuggling of polythene, Rwanda Government invested in promoting the alternatives coupled with strict enforcement in the country and this led to improved compliance to the polythene ban [6]. This implies that promotion of good quality alternatives is crucial in boosting compliance on polythene management legislations.

In countries that opted to ban polythene bags, the majority have realized that adoption of alternative non-biodegradable bags through the promotion of the

alternatives bags was through incentives which led to improved compliance [3]. Incentives were meant to encourage investments in eco-friendly carrier bags that are affordable and durable resulting in eradication of polythene bags [2]. Poor disposal of polythene bags in Kenya led to solid waste management challenges, flooding of roads due to clogging of drainage systems, the spread of water-borne such as cholera and Malaria since they create habitats for vectors [5]. Livestock, wildlife, and aquatic organism lives are being threatened by polythene when they ingest, some have been strangled, entangled and smothered [7]. Kenya banned the use of polythene bags in the country through an environmental legislation [8] of 2017, but was faced by non compliance in the community This research was aimed at improving the compliance levels of the environmental legislation and eradicate polythene bags and its negative impact leading to fewer risks and better health, improved environmental aesthetics, reduced Carbon dioxide levels caused by burning of polythene bags responsible for climate change and finally reduction of solid wastes in Kenya.

## 2. Polythene Products

Polythene paper is a polymer manufactured by polymerization of ethylene (ethene) gas under suitable condition of temperature and pressure. Ethylene gas is obtained through fractional distillation of crude petroleum [9]. Through the process of polymerization Low Density Polyethylene (LDP), High Density Polyethylene (HDPE) and Very Low Density Polyethylene (VLDP) are produced [10]. Polythene (VLDP) is very light and cheap, in its production, therefore in the last decades, they have been used in the manufacture of polythene carrier bags commonly known as plastic bags, plastic bottles and containers. The single use polythene bags are non-biodegradable and most of them end up in landfills, poorly managed dumpsites and others littering in the environment causing serious pollution [3]. Control of manufacture, distribution and use of Polythene bags are vital to environmental health of the world, hence adoption of eco-friendly alternatives.

## 3. Effects of Polythene on the Environment

### 3.1. Terrestrial Ecosystems

Globally, solid waste management has been a problem in most cities and urban areas with polythene products (polythene bags, plastic bottle and plastic containers) making up a substantial volume, especially in developing nations where dumping of polythene products causes noise and visual pollution. The pollution is an eyesore especially in countries that have tourism industry, which is a competitive industry making it lose the market to other cleaner tourist destinations in the globe [11].

Polythene bags used are mostly non-biodegradable, when poorly disposed leads to their accumulation affecting the environment. Although polythene paper is a pollutant to the soil, it has some importance in the Agricultural sector

where colored polythene is used for mulching improving the yields, the crops mature earlier due to increase in temperature as a result of heat trapped by the polythene paper [12]. On the contrary, polythene in the soil affects water percolation and absorbs the solar radiation which leads to increase in the soil temperature and this affects the moisture contents and subsequently affecting the properties of agricultural land [13]. During rainy seasons there are incidences of floods in major towns and cities caused by non biodegradable polythene products that are washed down the drainage systems blocking the drainage system. The stagnant water creates habitats for pathogens that cause diseases such as *Vibrio cholerae* causing cholera and malaria caused by mosquitoes breeding in the flooded water [1].

Polythene products dumped disintegrate into micro particles that are ingested by microorganism which affect their digestive system causing death, mainly decomposers of organic materials in the ecosystem, subsequently affecting the soil characteristics such as porosity, fertility and soil temperature. Therefore the soil becomes nonproductive leading to loss of biodiversity [14]. The legislation was geared towards promotion of alternatives to create clean and safe terrestrial ecosystem.

### 3.2. Aquatic Ecosystems

Aquatic ecosystem has been modified by micro polythene particles caused by pollution of the polythene products. The microbes attach themselves to the polythene particulates affecting the natural aquatic ecosystem processes [15]. Examples, the polythene particulates cause the dispersion of light affecting the photosynthesis process of the aquatic plants, resulting in the death of aquatic plants. A number of marine organisms and birds have suffered through entanglement, smothering and ingestion of polythene particulates as they search for food and nesting materials. Some get entangled by the debris while trying to investigate and while others due to “playful” behaviors are caught up, this leads to death because they are not able to acquire food and escape from predators leading to being exposed to dangers [7]. The environmental legislation compliance is meant to protect the aquatic ecosystems from its negative impacts through eradication of polythene.

### 3.3. Human Health

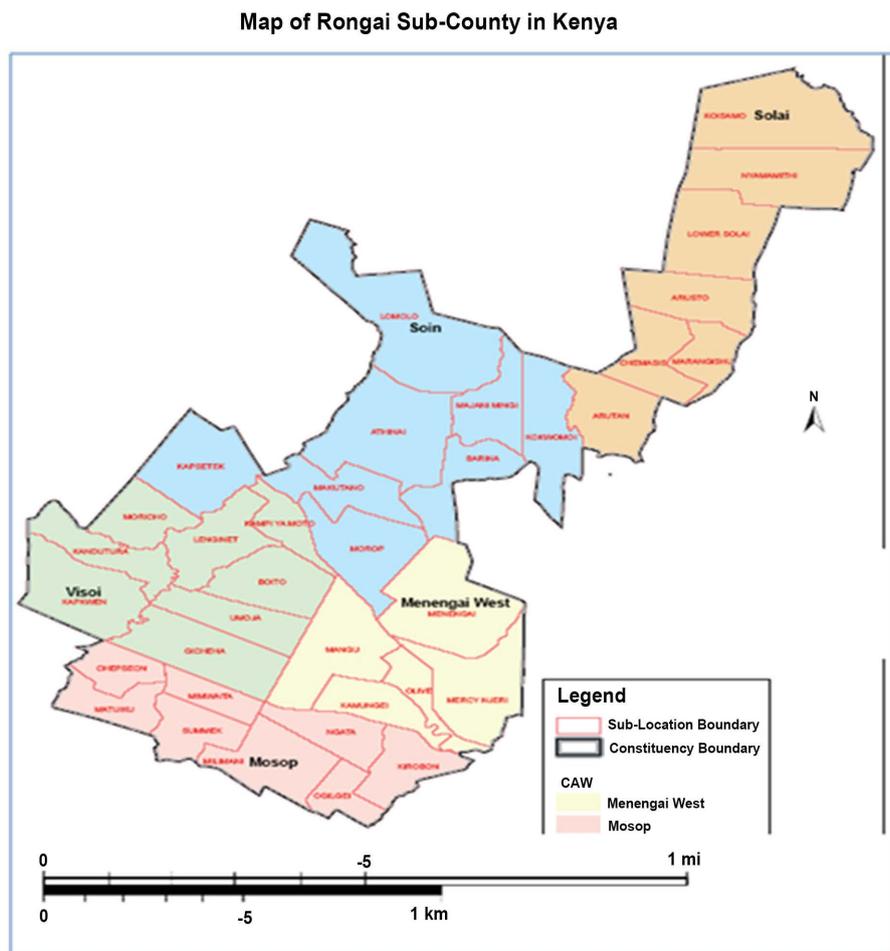
In homesteads and food production industries hot food are packaged in polythene and plastic containers which contaminate the food with dangerous chemicals such as styrene and phthalates described as carcinogenic agent while bisphenol associated with developmental and health problem to infants and children [16].

Burning of polythene materials in dump sites releases high volume of CO<sub>2</sub> to the atmosphere. CO<sub>2</sub> gas is a greenhouse gas; it causes increase in temperatures of the earth causing global warming resulting in climate change affecting the ecosystem and human health [10]. Burning of polythene products results in

release of persistent organic pollutants (POPs) such as dioxin which affects human healthy by causing respiratory diseases [17]. Community having eco-friendly alternatives to polythene bags plays an important role in accepting the Environmental legislation meant to eradicate pollution caused by polythene.

#### 4. Methodology

The study employed descriptive research survey design [18]. The study targeted a population of 147,017 people (18,377 households) and 580 traders from the study area shown below [19].



The sample size was determined using Nassiuma 2000 [20] formula and obtained 159 respondents, the six key informants and the five focus group discussion participants were selected purposively. A stratified sampling allocation proportional to strata size was adopted. The study utilized secondary sources of data and primary sources that were randomly collected in each stratum using piloted questionnaires from the month of June to July 2019. The study involved a total of 265 respondents. The data was analyzed using SPSS version 20. Descriptive statistics involved percentages and correlation was used in inferential statistics.

## 5. Results and Discussion

### 5.1. Demographic Characteristics

The response rate of questionnaires was 95 percent and this was made up of 115 (47 percent) female and 130 (53 percent) male. Majority of the respondents were youth between the ages of 18 - 35 in both genders, male in this age bracket were 37% and female 33%, this support the fact that youth are the majority in Kenya engaging in various economic activities including trading [11] KNBs. The results also indicated that the majority (46%) of the respondents have a Kenya Certificate of Secondary Education certificate as their highest level while 37% had a college Diploma and above, education is important in the understanding of the environment and the dangers humans pose to it through pollution [5]. Approximately 50% of the total respondents had an income of less than ten thousand shillings a month while 33% had an income between Ksh 10,000 and 20,000. Poverty has been indicated as a barrier in the conservation of the environment [3].

Findings displayed in **Table 1** indicate that majority of the residents (49.8%) responded significantly ( $\chi^2 = 163.6$ ,  $P < 0.0001$ ) that they are using the propylene bags despite the ban and confirmed that they are of poor quality and not durable. Those respondents using cloth were 57 (23.27 percent), those using canvases were 38 (15.51 percent), grass baskets 19 (7.76 percent) and the least were those using sisal baskets 9 (3.67 percent). This was an indication that little was done in production and promotion of good quality alternatives carrier bags such as sisal baskets because it is a cash crop grown in plantations in the study. Therefore, Promoting the production and consumption of eco-friendly bags through incentives will improve compliance of the environmental legislation [3].

### 5.2. Carrier Bags Alternatives and Its Economics

The study sought to determine the extent to which polythene bag alternatives influences compliance to Polythene bag ban legislation in Rongai Sub-County. The following results were obtained.

Findings displayed in **Table 2** indicate that majority of the residents (46.94%) responded significantly ( $\chi^2 = 164$ ;  $P < 0.001$ ) that are acquainted with at least some of the alternative carrier bag materials used. This was contrary to 47.35% of the respondents who agreed significantly ( $\chi^2 = 143$ ;  $P < 0.001$ ) that they have not been informed adequately on the types of recommended alternatives carrier bags despite having been identified [21]. The success of polythene ban in Rwanda was dependent on the sharing of information and knowledge on the available resources that can be used for making alternative bags [6].

When asked whether the cost for alternative materials is cheap, 46.53% of the respondents agree that it was not cheap ( $\chi^2 = 156$ ;  $P < 0.001$ ). This information was supported by a confirmation that the hindrance to the adoption of polythene bag legislation was due to expensive alternatives at 43.03% compared to polythene bags. Luxembourg was successful in eradication of polythene bag ban

**Table 1.** Kind of Carrier bags used.

What kind of carrier bag do you use?	Frequency	Percent	$\chi^2$	$P > \chi^2$
Canvas	38	15.51		
Cloth	57	23.27		
Grass basket	19	7.76	163.6	<0.0001
Polypropylene	122	49.8		
Sisal basket	9	3.67		

**Table 2.** Carrier bags alternatives and its economics.

	SD	D	UN	A	SA	$\chi^2$	$P > \chi^2$
Familiarity with alternative materials for carrier bags	3.27	7.76	11.43	46.94	30.61	164	<.0001
Informed well on recommended alternatives to polythene bags	6.12	10.61	9.8	47.35	26.12	143	<.0001
Cost of alternative bags is cheaper to the cost of polythene bags	30.61	46.53	7.35	8.16	7.35	156	<.0001
Cost of the polythene bag is cheaper than alternative bags	6.56	6.15	8.2	43.03	36.07	159	<.0001
Materials for making eco-friendly bags are easily available.	14.69	21.22	25.31	27.35	11.43	22.7	<.0001
Alternative carrier bags are made in Rongai sub-county	24.9	28.16	27.35	12.65	6.94	45.2	<.0001

(Research Data, 2019). KEY: SD-Strongly Disagree, D-Disagree, UN-Unaware, A-Agree, SA-Strongly agree.

because of an initiative Eco-Sac project named “Okot-Tut” that came up with a cheap alternative that was affordable and durable [2]. The six key informants and the five focus group discussions were all in agreement that the resources for making eco-friendly carrier bags were available but the finances and skills were lacking, hence the need for collaborations and partnership.

Respondents totaling above 60 percent significantly agreed ( $\chi^2 = 22.7$ ;  $P < 0.001$ ) that the materials for making alternative carrier bags are not easily available in Rongai Sub-County This is contrary to focus group discussions, interviews and observation that Sisal, Bananas, and reeds were found within the area, this was an indicator of gaps in their knowledge on alternative materials. It was also clear that compliance to polythene bag ban legislation was slow because 24.9 percent strongly disagreed while 28.16 percent disagree that materials for making eco-friendly carrier bags are found in Rongai while 27.35 percent were unaware, hence the need for campaigns to sensitize the community on alternatives which is an important component in implementation and reduces cases of arrest of offenders [22]. 122 (50 percent) of the respondents accepted that they are using the propylene bags and confirmed that they are of poor quality. The challenges faced identified were that the alternatives were expensive, not durable and

**Table 3.** Regression coefficient.

Variables	Coef	SECoef	T	P	VIF
(Constant)	2.533	0.362	7.00	0.000	
Alternatives to polythene bags	0.047	0.053	0.88	0.378	1.270

Research Data, 2019.

cannot be used for packaging products such as meat as well as not waterproof, this was an indication that little is being done in production and promotion of good quality alternatives carrier bags which is important for compliance to be achieved [23].

Correlation coefficient was used to measure the association between the variable. In correlation, a positive correlation is an indicator of the extent to which the variables increase or decrease in parallel while a negative correlation portrays the extent to which one variable increases while the other decreases [24]. Results showed a positive and significant relationship ( $r = 0.151$ ,  $p = 0.001$ ), this suggested that alternative polythene products are a significant factor in compliance to the environmental legislation.

Regression coefficient in **Table 3** established that polythene bag alternatives were related positively and significantly with compliance ( $r = 0.047$ ,  $p = 0.001$ ).

Alternative polythene bag products had a positive coefficient of 0.047 implying that for each unit increase on alternatives of polythene bags, there is up to 0.047 increases in compliance levels. In summary, Polythene bag alternatives adoption is one of key factors to be considered in order to improve compliance to the environmental legislation on polythene bag ban and combat the negative effects associated with its use.

## 6. Conclusion

The success of the Environmental Legislation in Kenya is dependent on the uptake of the eco-friendly alternatives. The government and its agencies need to put in place clear plans on ways to promote and encourage production and consumption of environmental friendly carrier bags and support research, innovation and development of alternatives eco-friendly carrier products in the country. Promotion of alternatives should be done by assessment of alternative materials and document and this information shared with the public to encourage utilization in manufacturing eco-friendly carrier bags.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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