

# **An Evaluation of the Benefits of the use of Flexible and Non-Flexible Plastic Materials among Agro-Enterprise Owners in the Calabar Agricultural Zone of Cross River State, Nigeria**

**Etim, Ofem Usang\* and Effiong, John Ben**

Department of Agricultural Extension and Rural Sociology, the University of Calabar, Nigeria.

\*Safety Awareness and Environmental Support Initiative (SAESI) – Nigeria

\*Corresponding Author: [Ofeminous@yahoo.com](mailto:Ofeminous@yahoo.com)

D.O.I: 10.56201/ijaes.v8.no5.2022.pg30.51

---

## **ABSTRACT**

*This study evaluates the benefits of the use of flexible and non-flexible plastic materials among agro-enterprise owners in the Calabar Agricultural Zone of Cross River State, Nigeria. The objectives of the study were to ascertain the benefits of the use of flexible plastic products by agro-firm owners in the study area, and to assess the benefits of the use of non-flexible plastic products by agro-firm owners in the study area. Both primary and secondary data were used for the study. Primary data was through a structured questionnaire while secondary data was gotten from the Cross River State Ministry of Agricultural. A total of 153 respondents were surveyed. The population of the study included farmers who operates selected agro-enterprises in the study area. Findings revealed that the use of plastic in various agro-firms/enterprises is not hazardous to their produce. Also indicated is that; the use of non-flexible plastic products improves the efficiency of their market, storage, movement of produce, retailing in smaller units, value addition, the physical condition of produce, among others. This study recommends that the production of plastic materials for agricultural use be void of toxic chemical and branded “Agricultural Plastic” and that small scale enterprises of any sought should be encouraged to utilize the benefits of plastic materials to enhance their business start-ups, rather than going for plastic alternatives which may be very expensive.*

---

**Keywords:** *Plastic Products, Marketing Enterprises, Horticultural Enterprise, Vegetable Enterprises, Packaging and Processing Enterprises, Poultry Enterprise*

---

## INTRODUCTION

The occurrence of plastics in agriculture expanded when farmers noticed certain features of plastic materials which made it desirable and fit for various use in the farm systems (Etim, 2018). The high rate of adoption in the farm system is due to its simplicity, low cost, availability, durability and longevity among other benefits which aid agricultural production, processes, storage and marketing. According to Europe's Association for Plastic and Rubber Machinery Manufacturers (EUROMAP), global production of plastics has grown 20 folds from 15 million metric tons (Mt) in 1964 to 311 Mt in 2014. With its ever-expanding applications, plastics have delivered many benefits for the society. Plastic packaged food lasts longer, reducing wastage and improves agribusiness (EUROMAP, 2017).

Plasticulture unveils noticeable opportunities for agro-enterprise owners which are relevant in their production, processing, storage and marketing activities. It provide a source of input with easy access, serve as capital for emerging business enterprises as it enhances their market efficiency, improve their earnings, enhance their packaging needs, reduces the cost of production and a means of value addition to their enterprises and farm produce.

The use of plastics in agriculture include mulch films, greenhouse covering, floating and hoop supported crop covers, netting for turf grass production and bird screens, netting and sprayed materials for erosion control, pots and trays, stakes and labels, irrigation systems, soil amendments, anti-transpirants, cordage, nursery poly-bags, flower pots for horticultural practices, and balewraps or silage bags (Trucost, 2016). Also there are feeding trough, water trough, water buckets, cans, tanks, nets, packer, and so on made with plastic materials. In addition, agro-chemical inputs such as pesticides, herbicides, and fertilizers come in plastic bags (flexible plastic products) or plastic containers (Non-flexible plastic products). The greatest application of plastic products occurs with the polyethylene-based mulch and greenhouse films (Trucost, 2016).

However there are alternative materials that can perform the same functions that plastic materials do if replaced. These are paper, steel, aluminum, iron and glass products or materials. For example, an iron bucket can replace a plastic bucket. But this comes with a higher burden because iron buckets are more expensive, not readily available in a large quantity and is subject to corrosion. Whereas, plastic can break overtime and is less expensive and widely available (Trucost, 2016).

## STATEMENT OF THE PROBLEM

Several actions have been taken around the world to limit the utilization of plastic in agriculture due to its heavy weight pollution problem to the environment. Researchers have condemned this input resource vehemently while others have reiterated it beneficial impact in agricultural development. Giuliano, Rosa, Ileana, Giacomo, and Evelia, (2015) opined that the use of plastic materials in agriculture negatively impact on the soil. This assertion was corroborated by Abdul, Nannu, & Muhammad (2014), whereas Atuanya, Aborisade and Nwogu, (2012) insinuated that plastic materials rather constitute tremendous harm to the growth of agricultural produce. On this premise, different policies have been enacted with various degrees of restrictions, taxes imposition and ban around the world. However, strong assertions emanated from Franklin Associates (2013) and Trucost (2016) which modeled the substitution of plastic with alternative materials (such as paper, steel, Aluminum and glass), and suggested that a move away from plastics may come at an even higher net environmental cost, as Bernard (2015) also, has pitted against the move to ban plastic, and strongly emphasized that plastic has provided the bulk of farm implement used in agricultural businesses and its usefulness cannot be replaced easily. Little is known about the benefits of plastic materials in agricultural development among agro-enterprises in the study area, this is the knowledge gap that this study intends to fill by providing data on the benefits of the use

of plastic materials in flexible and no-flexible forms among enterprise owners and farmers in the Calabar Agricultural Zone of Cross River State.

## OBJECTIVES

The general objective of this study was to assess the benefits of the use of flexible and non-flexible plastic products by agricultural enterprises in the study area.

The specific objective of the study was to;

- i. ascertain the benefits of the use of flexible plastic products by agro-firm owners in the study area.
- ii. assess the benefits of the use of non-flexible plastic products by agro-firm owners in the study area.

## DEFINITION OF TERMS

**Agro-Firm:** otherwise known as agro-enterprises or businesses is a combination of words “agriculture” and “business” and refers to any business related farming and farming related commercial activities.

**Selected Plastic Products:** there are many products obtained from plastic materials which are polyethylene Polyvinyl Chloride Polypropylene and Polystyrene. All these come in two forms which are; Flexible and non-flexible or rigid plastic products. This study categorizes finished products into Plastic bags (for flexible Plastic Product) and Plastic Containers (for rigid or non-flexible plastic products).

**Flexible Plastic Products:** these are referred to as plastic bags or wrappers or mulch films which are used at one level or the other by agro-firms. They are thin, flexible, plastic films which have not been formed into a rigid sharp or form. They can be bended or molded and used to store farm products. The main focus of this study includes the polyethylene Terephthalate (PETE or PET), high-density polyethylene and low density polyethylene. Examples include: Tapolyne, Polyethene, Pouchor poly bags

**Non-Flexible Plastic Products:** these are plastic products that have been formed into a rigid sharp or form to contain different kinds of farm products. They are referred to as plastic containers. They include single-use, reusable or durable plastic products. This study focuses on molded plastic containers such as plastic buckets, cups, basin, drum, or bottles.

**Marketing Enterprises:** refers to business activities that a firm or enterprise undertake to promote the buying and selling of a product or service. Marketing firms had used most of the plastic products to promote quality, value addition, packaging, storage etc in order to buy and sell or advertise products

**Horticultural/Nursery Enterprise:** horticulture is the science and art of developing sustainable production, marketing and use of high-value intensively cultivated food and ornamental plants. The focus of this study is floriculture which is the area of ornamental horticulture associated with the production and use of flowers, potted plants and annual bedding plants which can be raised in a nursery.

**Vegetable/Garden Enterprises:** vegetable farming is the growing of vegetable for human consumption. It involves the cultivation or production, management practice, marketing and use of intensively cultivated herbaceous plants. The focus of this study is Olericulture which is the science

of vegetable growing and culture of herbaceous plants for food.

***Packaging and Processing Enterprises:*** are enterprises that uses plastic products such as wrappers films, bags, and containers to wrap materials around a consumer item that serves to contain, identify, describe, protect, display, promote, make product marketable and keep it clean.

***Poultry Enterprises:*** Enterprises that raises various domestic birds like chicken turkey ducks geese, etc for egg or broiler. Poultry enterprises use plastic materials in diverse ways to enhance their business.

## LITERATURE REVIEW

*The Benefits of the use of Flexible Plastic Products (plastic bags) by Agro-Firms.*

According to Robinson (1991), the area of plastic greenhouses expanded from zero in the early 1950s to 60,000 ha in 1976. It now approaches 200,000 ha and is still increasing. Many factors indicate that further progress is inevitable. These include: the versatility of plastic; the development of new uses for plastic coverings; and improvements in structural design. Initially the rapid swing towards crop production under plastic in the Mediterranean area resulted from the availability of simple, cheap structures. These were used mainly to increase winter temperatures, and to protect crops against wind. In these areas, plastic greenhouses are considered by growers to be the best and cheapest insurance against climatic injury. In northwest Europe there is a tendency for plastic greenhouses to replace cold frames, glass cloches and single span glasshouses, but not heated glasshouses. The use of plastics in agriculture has spread throughout the agricultural industry and has been renamed —plasticulture. They defined plasticulture as the —science and technology of the use of plastics in agriculture, Orzolek (2003) as cited by the California Integrated Waste Management Board (2008) has more generally defined plasticulture as the use of plastic in agriculture. Some of the many uses of plastic in agriculture include the following: 1) plastic film mulches, 2) drip irrigation tape, 3) row covers, 4) low tunnels, 5) high tunnels, 6) silage bags, 7) hay bale wraps, and 8) plastic trays and pots used in transplant and bedding plant production. Agricultural plastics are used in this report to signify all types of plastics used by producers. Plastic has many advantages and disadvantages in agriculture. Plastics are used as a low-cost method to extend the season of some crops. It is also used to conserve water, control weeds, and maintain high quality fruit when used as mulch. One disadvantage of using agricultural plastic, especially as a season extender, relates to the disposal issues that come with the use of plastic.

*Benefits of the use of non-flexible plastic products (Plastic Containers) by agro-firms.*

The use of plastic pots in the nursery industry has expanded greatly in the last few years. As it is in other areas of commerce, horticultural businesses have taken advantage of plastic's light weight and low cost. Plastic is the packaging material of choice for growing and marketing flowers and foliage to an expanding public market with a "green thumb." The nursery container industry is itself a large market for recycled post-industrial plastic scrap. Most container manufacturers use no virgin resins. Plastics used by nursery container manufacturers range from virgin resins to plastic bag scrap, and from milk and detergent bottles to old nursery containers. Within the blends of scrap used for many containers, there are mixes of not only various melt indices within resin families, but also commingled mixes of different resins (Trucost, 2016).

The agricultural industry in the United States generates 60 million waste pesticide containers each year. For liquid concentrates, the majority of the non-refillable containers are 1 to 2.5 gallons, although the containers range from the quart-size to 50-gallon barrels to 110-gallon rotational molded bulk containers. Some of the larger-sized pesticide containers are refillable. Over the last 15 years, plastic containers have gradually replaced many of the metal containers and polyethylene-

coated paper bags. Today plastic containers are the packaging of choice for most agricultural pesticides, commanding an estimated 80 to 90 percent of the liquid and dry concentrate pesticide container market. All plastic pesticide containers are fluorinated to various degrees, making the plastic essentially impervious to migration of the mineral distillates through container walls. After proper rinsing, High and low density polyethylene (HDPE) pesticide containers are classified as normal solid waste, (American Chemistry Council, 2017).

According to Marsh and Bugusu (2007), Plastic containers such as plates, buckets, jerry cans, basket, bottles, and so on, have very important application in agriculture. Packaging maintains the benefits of food processing after the process is complete, enabling foods to travel safely for long distances from their point of origin and still be wholesome at the time of consumption.

Food is the only product class typically consumed 3 times per day by every person. Consequently, food packaging accounts for almost two-thirds of total packaging waste by volume (Hunt, Sellers, Frankalin, Nelson, Rathje, Hughes, and Wilson, 1990) as cited by Marsh and Bugusu (2007). Moreover, food packaging is approximately 50% (by weight) of total packaging sales. The principal roles of food packaging in containers are to protect food products from outside influences and damage, to contain the food, and to provide consumers with ingredient and nutritional information. Traceability, convenience, and tamper indication are secondary functions of increasing importance. The goal of food packaging is to contain food in a cost-effective way that satisfies industry requirements and consumer desires, maintains food safety, and minimizes environmental impact. Plastic containers offer Protection/preservation for agricultural products like any other container. Food packaging can retard product deterioration, retain the beneficial effects of processing, extend shelf-life, and maintain or increase the quality and safety of food. In doing so, packaging provides protection from 3 major classes of external influences: chemical, biological, and physical.

Biological protection provides a barrier to microorganisms (pathogens and spoiling agents), insects, rodents, and other animals, thereby preventing disease and spoilage. Physical protection shields food from mechanical damage and includes cushioning against the shock and vibration encountered during distribution. Packaging also provides information to the consumer. For example, package labeling satisfies legal requirements for product identification, nutritional value, ingredient declaration, net weight, and manufacturer information. Additionally, the package conveys important information about the product such as cooking instructions, brand identification, and pricing. All of these enhancements may impact waste disposal.

#### *Summarized Benefits of the Use of Plastic Container in Agriculture*

Over the past 20 years, plastics have been relied upon increasingly to help raise record for food and fiber crops. As our population grows and as more uses for plastics are developed, more film and other plastic products will enter the greenhouse, nursery and farm environment to cut costs and increase productivity. Some of the essential benefits derived from agricultural plastics are:

- earlier crop production,
- higher yields per acre,
- higher quality produce,
- control of some pathogens,
- decreased costs,
- more efficient use of water,
- fertilizers and pesticides,
- increased transplant survival,
- minimized cold injury, and
- reduction of nutrient loss of cattle feed.



The use of plastic increases production in quality and quantity, while reducing the consumption of valuable resources (water, pesticides, fertilizers, energy). Plastics retain CO<sub>2</sub> and warm the soil, reserving humidity and reducing the leaching of pesticides and fertilizers. Plastics protect plants, roots, soil structure. This is the contribution of agri-plastics to an Intensive Ecological Agriculture necessary to feed the growing human population. Without plastics, 60% of fruit, vegetable and dairy production would be endangered. Michel, (2010) posited that agri-plastic is a very promising product thus: “Agri-plastics will face a growing demand in volume and in techniques. Agri-plastic brings its contribution to the circular economy. Agri-plastic is an ally for farmers and growers. Farmers, distributors and producers are allied in the protection of the environment. (Bernard, 2015)

For crop production in horticulture, fruit and vegetables, plastic plays an amazing role in greenhouses, small tunnels, mulching and irrigation pipes. Conceived and used since its origin in agriculture as an accelerator and amplifier of natural effects on plant growth, agri-plastic fulfills a biomimetic perspective: it duplicates and improves what exists in nature. Plastics' impacts on fruit and vegetable production are:

- Allowing better control of climatic conditions for the root systems, vegetable leaves and fruit, photosynthesis, temperature.
- Encouraging the mulching effect, capturing CO<sub>2</sub>, heating the soil and preserving soil humidity.
- Resistance to climatic change, protection against bad weather (rain, hail, sun) and prevent loss of moisture
- Increasing production by enlarging the harvesting calendar, improving the yield by square meter, and the dried material content, allowing precocity.
- Improving production quality with a more regular plant growth, and a reduction in rot and waste.
- Limiting the “splash” effect from rain conducive to proliferation of fungus at the foot of plants.
- By the transfer or production from open field to greenhouses, and the increasing production per square meter, plastics liberate cultivation surfaces for other crops, increasing overall production.

## RESEARCH METHODOLOGY

### 3.1 The Study Area

The research was conducted in the Calabar Agricultural Zone of Cross River State which lies between latitudes 5°32' and 4°27' North and longitudes 7°50' and 9°28' East of the Greenwich meridian. It has a tropical humid climate with wet and dry seasons and average temperature ranging between 15°C – 30°C and annual rainfall between 1300 – 3000mm. It has three major ethnic groups with their dominant languages as the Efiks, Bekwarra and Ejagham ([www.Kekerete.tripod.com/CRSG](http://www.Kekerete.tripod.com/CRSG)). Cross River State is bounded in the North by Benue State, in the South West by Akwa Ibom State, in the west by Ebonyi and Abia States. The Calabar Agricultural Zone has seven blocks which are; Calabar South, Akamkpa, Calabar Municipality, Biase, Akpabuyo, Bakassi, and Odukpani. Occupation is mostly farming, marketing and civil services. Farming activities includes; fishing, crop and livestock production, agro-marketing, processing and milling of agricultural produce among other. The zone is chosen for this study because of the huge presence of plastic companies and plastic use in the area.

### **The Population of the study**

The population of the study included all registered 1230 agro-firms and their owners in the Calabar Agricultural Zone that use plastic materials for their farm activities.

### **Sampling Procedure and Sample Size**

Multi-stage and purposive sampling techniques were adopted for this study. The First stage; was the purposive selection of five blocks out of the seven blocks in the zone which were; Akpabuyo, Calabar South, Calabar Municipality, Odukpani and Akamkpa. This is because they share similar developmental features in; proximity, agriculture and presence of farm enterprises that make use of plastics. The second stage; was the purposive selection of five agro-firms that makes use of plastic materials in the five blocks. This is because these agro-firms require plastic product in one way or the other for its production, processing, storage, packaging or marketing activities. They were; processing and packaging enterprises, Vegetable farms/Gardens, Poultry farms, Nursery/horticultural enterprises, and Agro-marketing enterprises. These enterprises comprises of the cells in this study. The third stage; was the purposive sampling of 18% of the total population from each enterprise. The fourth stage; was the selection of respondents (owners of the agro-firms). This is because they are in the position to better access the benefits of the utilization of plastic products in their enterprises. From the sample frame, a total of 153 respondents were used for the study.

Table 1. Sample Size of Registered Enterprises Studied

Enterprises	Calabar South	Calabar Municipality	Akamkpa	Akpabuyo	Odukpani	Total	Percentage (18%) Sampled
1. Poultry	27	30	71	39	60	227	40
2. Nursery/Horticulture	21	26	27	40	30	144	26
3. Processing/Packaging	20	25	12	13	27	97	17
4. Vegetable/Garden	79	40	15	10	80	224	40
5. Agro-marketing	40	50	27	23	31	171	30
<b>Total</b>						<b>863</b>	<b>153</b>

Source: Field Survey Data 2022



## Data Collection Procedure

For the purpose of this research, primary data were interviews and a questionnaire which were used to elicit information necessary for the study. Secondary information was the number of registered agro-enterprises in Calabar zone obtained from the Cross River State Ministry of Agriculture on the number of registered agro-enterprises in the Calabar Agricultural Zone.

## Data Analysis

Descriptive statistics such as; percentages, means score and ranking were used to analyze the data. Data collected were sorted and coded before being analyzed.

## Measurement of Variables

Objective 1: The benefits of the use of flexible plastic products by agro-firms in the study area was measured using binomial regression and frequency count on variables such as; improvement of seedling growth, reduction of stress to seedling, prevention of drought, hazardous to farm production, among others. Variables were coded as: Yes =2 and No = 1.

Objective 2. The benefits of the use of non-flexible plastic products by agro-firms in the study area was measured using binomial regression and frequency count on variables such as; use of plastic containers enhances easy collection of harvested crops, improve the physical condition of my vegetable to avoid bruise injury or damage, improves my income, is hazardous to my crops, among others. Variables were coded as: Yes = 2 and No = 1.

## RESULTS AND DISCUSSION

### 1. Benefits Derived from the Use of Flexible Plastic Products (Plastic Bags) by Agro-Firms Owners

	<b>BENEFITS OF PLASTIC USE IN AGRO MARKETING</b>	<b>YES</b>	<b>NO</b>	<b>MEAN RATINGS</b>	<b>REMARK</b>
1.	Increase my income	24	6	1.8	Beneficial
2.	Increase my sales	25	5	1.8	Beneficial
3.	Improve my product storage life	28	2	1.9	Beneficial
4.	Different designs and colours makes product attractive	27	3	1.9	Beneficial
5.	Better packaging for market products	26	4	1.8	Beneficial
6.	Sales of plastic bags is lucrative	23	7	1.7	Beneficial
7.	Plastic bags are hazardous to my products	7	23	1.2	Not Beneficial

8	Improves my hygiene and handling of products	25	5	1.8	Beneficial
9	Less expensive	29	1	1.9	Beneficial
10	Help to quantify and wrap large products into smaller units	23	7	1.7	Beneficial
11	It is very easy to use	27	3	1.9	Beneficial

Table 2 – Distribution of Respondents Based on the Ratings of Benefits Derived from the Use of flexible Plastics in Agro Marketing

Field survey, 2022

*Benchmark mean  $\geq 1.5$  implies beneficial*

Table 2 shows the distribution of respondents based on the ratings of benefits derived from the use of flexible Plastic products in agro-marketing enterprise. According to the findings, all the variables were beneficial and their mean ratings above the bench mark mean of 1.5, except for the 6th variable which indicated that plastic products are rather not hazardous to products ( $\bar{x} = 1.2$ )

More so, for Agro-marketing enterprises as observed in Table 2, Plastic usage increases the income of Agro-marketer with a mean of 1.8. This showed that, it helps marketers to sell more due to the quantification of products to smaller units and it use for rappers enhances product durability in airtight and water proof condition while it use as customer bags enhances protective and concealed conveyance. This is also in line with the second variable, that plastic bags increases marketers sales with a mean of 1.8, enhance durability of product by improving product storage life ( $\bar{x} = 1.9$ ), provide different design and colours for attraction ( $\bar{x} = 1.9$ ), provide better packaging of agricultural produce ( $\bar{x} = 1.8$ ), promote sales of plastic bags as a lucrative business ( $\bar{x} = 1.7$ ), improve hygiene and product handing ( $\bar{x} = 1.8$ ), provide cheap material for packaging ( $\bar{x} = 1.9$ ), enable product quantification into smaller units for easy and fast marketing ( $\bar{x} = 1.7$ ) and it is easy to use ( $\bar{x} = 1.9$ ).

To collaborate this findings, Marsh and Bugusu (2007) asserted that; Food packaging can retard product deterioration, retain the beneficial effects of processing, extend shelf-life, and maintain or increase the quality and safety of food. A good package will enhance the market value of produce.

Table 3 – Distribution of Respondents Based on their ratings of benefits of utilization of Flexible Plastic Products in poultry enterprises

S/N	BENEFITS OF PLASTIC USE IN POULTRY	YES	NO	MEAN RATINGS	REMARK
1.	Improve packaging of dungs for movement or sales	30	10	1.7	Beneficial

2.	Improve covering of brooding house to control the temperature	36	4	1.9	Beneficial
3.	Enhance packaging of dressed chicken for the kitchen	34	6	1.8	Beneficial
4.	Use of plastic is hazardous to my production	6	34	1.1	Not Beneficial
5.	Use to store drugs and supplements for the farm	36	4	1.9	Beneficial

Field survey, 2022

*Benchmark mean  $\geq 1.5$  implies beneficial*

Table 3 shows the distribution of respondents based on their ratings of benefits derived from utilization of flexible plastic products in Poultry enterprises. All the variables are beneficial with their mean ratings higher than the benchmark mean, except for the 4th variable which rather indicated that the use of flexible plastics is not hazardous to products ( $\bar{x} = 1.1$ ) with a low response of (f= 6). According to findings, Plastic bags utilization in poultry enterprises improve packaging of dung for movement and sales with a mean of 1.7, improve covering of brooding house to control the temperature ( $\bar{x} = 1.9$ ), it provides a means of packaging for dressed chicken for the kitchen ( $\bar{x} = 1.8$ ), it provides a means of storage for drugs and supplement ( $\bar{x} = 1.9$ ).

Michel, (2010) supported the findings of this study after asserting that flexible plastic products offer resistance to climatic change effects and offer animals protection against bad weather (rain, hail, sun) and also gives a complete control in quantity and quality of herd and flock feeding all year long.

**Table 4** - Distribution of Respondents Based on their ratings of benefits of the Utilization of Flexible Plastic Products in Vegetable/Garden Enterprises.

	BENEFITS OF PLASTIC IN VEGETABLE ENTERPRISES	YES	NO	MEAN RATINGS	REMARK
1.	Enable storage/wrapping of seeds	36	4	1.9	Beneficial
2.	Help to provide shade in my farm	35	5	1.8	Beneficial
3.	Increase my profit and income	28	12	1.7	Beneficial
4.	Decrease my profit and income	14	26	1.3	Not Beneficial
5.	Useful to spread garden produce	34	6	1.8	Beneficial
6.	protects young plants from the impact of heavy rain drops	32	8	1.8	Beneficial
7.	Aids fragmentation of garden plots	37	3	1.9	Beneficial

8.	Used to restrain animals and control insects	33	7	1.8	Beneficial
9.	Use of plastic is hazardous to my production	4	36	1.1	Not Beneficial

Field survey, 2022

*Benchmark mean  $\geq 1.5$  implies beneficial*

Table 4 shows the distribution of respondents based on their ratings of benefits of the utilization of flexible plastic products in vegetable/garden enterprises. Most of the variables occurred above the bench mark mean which implies that the use of plastic in vegetable enterprises is beneficial. However, other benefits included that it does not decrease profit ( $\bar{x}=1.3$ ) and it is not hazardous to production ( $\bar{x}=1.1$ ). This also showed that use of flexible plastic products in vegetable farms or garden enables storage and wrapping of seeds ( $\bar{x} = 1.2$ ), provide shade for the farm ( $\bar{x} = 1.8$ ), increase profit and income ( $\bar{x} = 1.7$ ), is useful to spread garden produce ( $\bar{x}=1.8$ ), protect young plants from the impact of heavy of raindrops ( $\bar{x} = 1.8$ ), aid fragmentation of garden plots into sections ( $\bar{x}= 1.9$ ), and it is also used to restrain animals and control insects when used to build fence round the farm ( $\bar{x}= 1.8$ ). This is because farmers/agro-firm owners see plastic bags as a means of aiding their sales, This implied that the importance, usefulness and effects of plastic bags in vegetable and Garden enterprises is mostly positive than negative. This supports the works of Robinson (1991) that the area of plastic green house expanded from zero in the early wimps, to 60, Papua in 1976, it now approaches 200, 000ha and is still increasing.

**Table 5** – Distribution of Respondents Based on their Ratings of Benefits Derived from the utilization of Flexible Plastic Products in Packaging and Processing Enterprises

S/N	BENEFITS OF PLASTIC IN PROCESSING AND PACKAGING ENTERPRISES	YES	NO	MEAN	REMARK
1.	Increase my income	14	3	1.8	Beneficial
2.	Improves my packaging need	14	3	1.8	Beneficial
3.	It is hazardous to my produce	4	13	1.2	Not Beneficial
4.	Improve convenience for carrying goods	15	2	1.8	Beneficial
5.	Light weight and flexibility makes delivery easy	14	3	1.8	Beneficial
6.	Increase my profit due to low cost plastic	8	9	1.4	Not Beneficial
7.	Reduce waste of valuable products	13	4	1.7	Beneficial
8.	Easy packaging into smaller quantified unit	14	3	1.8	Beneficial
9.	Good for storage of products	14	3	1.8	Beneficial
10.	Improve spreading and drying of farm products	11	6	1.6	Beneficial
11.	Stores products in air tight conditions	12	5	1.7	Beneficial
12.	Transparent or coloured design to make products attractive	13	4	1.7	Beneficial

13.	Flexibility accommodates different shapes of product.	13	4	1.7	Beneficial
Field survey, 2022		<i>Benchmark mean <math>\geq 1.5</math> implies beneficial</i>			

Table 5 shows the distribution of respondents based on their ratings of benefits derived from the utilization of flexible plastic products in processing and packaging enterprises. All the variables are beneficial except for the 6th variable which implies that plastic use does not increase profit due to low cost ( $\bar{x}=1.4$ ). It is however not hazardous to produce ( $\bar{x}=1.2$ ). Table 5 also showed that the use of plastic bags has the following benefits on agro-firms in the study area; increase income of farmers and agro traders ( $\bar{x}=1.8$ ), improve the packaging needs of agro-firm owners ( $\bar{x} = 1.8$ ), it improves convenience for carrying goods ( $\bar{x}=1.8$ ), it light weight and flexibility makes delivery easy ( $\bar{x} = 1.8$ ), it helps to reduce waste of valuable products ( $\bar{x} = 1.7$ ), provide easy means of packaging produce into smaller units ( $\bar{x} = 1.8$ ), it is good for storage of products ( $\bar{x} = 1.8$ ), improves spreading and drying of farm products ( $\bar{x} = 1.6$ ), enables storage of products in air tight condition ( $\bar{x} = 1.7$ ), transparent or coloured design to make products attractive ( $\bar{x} = 1.7$ ) and has a flexible form which can accommodate different shapes of product ( $\bar{x} = 1.7$ ). This implied that flexible plastic products does not incorporate any hazard in the processing and packaging enterprises. On this, Robinson (1991) posited that further progress is inevitable for plastic agriculture.

**Table 6** - Distribution of Respondents Based on their Ratings of Benefits Derived from the Utilization of Flexible Plastic Products in Nursery and Horticultural Enterprises

S/N	BENEFITS OF PLASTIC IN NURSERY AND HORTICULTURAL ENTERPRISES	YES	NO	MEAN	REMARK
1.	Increase my income	26	0	2.0	Beneficial
2.	Improve my seedlings growth	26	0	2.0	Beneficial
3.	Cause mould/fungi attack on seedlings	6	20	1.2	Not Beneficial
4.	Reduce stress to my seedlings	26	0	2.0	Beneficial
5.	Enable easy transportation and relocation of seedlings	24	2	1.9	Beneficial
6.	Incubate disease	5	21	1.1	Not Beneficial
7.	Enable easy transplanting	26	0	2.0	Beneficial
8.	eliminates uprooting shocks that kills plants	26	0	2.0	Beneficial
9.	prevents root damage during up rooting	26	0	2.0	Beneficial
10.	helps to keeps plants/seedling root intact and complete	26	0	2.0	Beneficial
11.	prevent drought	23	3	1.8	Beneficial

12.	increase seedling temperature and condition	22	4	1.8	Beneficial
13.	prevent loss of moisture	23	3	1.8	Beneficial
14.	presents an opportunity for farm expansion	26	0	2.0	Beneficial
15.	increase profit due to low cost of plastic	23	3	1.8	Beneficial
16.	reduce credit risk	23	3	1.8	Beneficial
Field survey, 2022		<i>Benchmark mean <math>\geq 1.5</math> implies beneficial</i>			

Table 6 shows the distribution of respondents based on their ratings of benefits derived from the utilization of flexible plastic products in nursery and horticultural enterprises. According to the findings, the use of plastic in nursery and horticultural enterprises do not cause mould/fungi attack on seedlings ( $\bar{x}=1.2$ ;  $f=20$ ) and does not incubate disease ( $\bar{x}=21$ ;  $f=21$ ). All the variables are beneficial whose means are above the bench mark mean of 1.5.

According to the result in Table 6, the benefits or usefulness of flexible plastic in Nursery and Horticultural enterprises showed the following; that plastic bags increase the income of agro-firm owners ( $\bar{x}=2.0$ ), improves seedling growth ( $\bar{x}= 2.0$ ), does not cause mould and fungi attack on seedlings ( $\bar{x}= 1.2$ ), reduce stress to seedlings ( $\bar{x}= 2.0$ ), enable easy transportation and relocation of seedlings ( $\bar{x}= 1.9$ ), does not incubate disease ( $\bar{x}= 1.1$ ), enable easy transplanting ( $\bar{x}=2.0$ ), eliminate uprooting shocks that kills plants ( $\bar{x}= 2.0$ ), prevent root damage during up rooting ( $\bar{x}= 2.0$ ), helps to keep plants/seedling root intact and complete ( $\bar{x}=2.0$ ), prevent drought ( $\bar{x}= 1.8$ ), increase seedling temperature and condition ( $\bar{x}=1.8$ ), prevent loss of moisture ( $\bar{x}=1.8$ ), present an opportunity for farm expansion ( $\bar{x}= 2.0$ ), increase profit due to low cost of plastic bags ( $\bar{x}= 1.8$ ) and reduce credit risk ( $\bar{x}= 1.8$ ). This implied that plastic bag is a very important production resource in the Nursery and Horticultural enterprises for enhancing the well being of plants and seedling. To support the fact that plastic bag use is not hazardous to agricultural production in Nursery and Horticultural enterprises, William (2015) opined that there appears to be some reduction in disease pressure with crops grown on specific mulch colours.

## 2. Benefits of Utilization of Non-Flexible Plastic Products (Plastic Containers) by Agro-Firm Owners

Table 7 – Distribution of Respondents Based on their ratings of benefits Derived from the utilization of Non-Flexible Plastic Products in Agro-Marketing Enterprises

S/N	BENEFITS OF PLASTIC IN AGRO MARKET	YES	NO	MEAN	REMARK
1.	Improves the efficiency of my market/business	27	3	1.9	Beneficial
2.	Best storage for liquid products	26	4	1.8	Beneficial
3.	Transparent plastic container attracts customers to the product	21	9	1.7	Beneficial
4.	It can be used for measurement of produce	26	4	1.8	Beneficial



5	It enables haulage and transportation of goods	27	3	1.9	Beneficial
6	Improve the retailing of liquid produce	28	2	1.9	Beneficial
7	Adds value to agricultural marketing of produce	25	5	1.8	Beneficial
8	Hazardous to my market produce	5	25	1.1	Not Beneficial
9	Increase my income	28	2	1.9	Beneficial
Field survey, 2022		<i>Benchmark mean <math>\geq 1.5</math> implies beneficial</i>			

Table 7 shows the distribution of respondents based on their ratings of benefits derived from the utilization of non - flexible plastic products in agro-marketing enterprises. The use of non-flexible Plastics is not hazardous to market produce as indicated with a mean of 1.1. This implies that all the variables are beneficial in relation to the use of non-flexible plastic products.

The following were also observed in Table 7; the use of non-flexible plastic container improves the efficiency of my market and business ( $\bar{x} = 1.9$ ), provides the best storage for liquid product ( $\bar{x} = 1.8$ ), transparent plastic container attracts customers to the product ( $\bar{x} = 1.7$ ), it can be used to measure produce ( $\bar{x} = 1.8$ ), it enables haulage and transportation of goods ( $\bar{x} = 1.9$ ), improve the retailing of liquid produce ( $\bar{x} = 1.9$ ), add value to agricultural marketing of produce ( $\bar{x} = 1.8$ ), is not hazardous to agro-products or market products ( $\bar{x} = 1.1$ ) and it increase the income of agro-firm owners ( $\bar{x} = 1.9$ ). This is most sustainable through quantification of a large volume of a product which requires a large amount of money, into smaller quantity (to encourage retailing and availability in small quantities or units which is easily marketed and enhance large number of small scale enterprises. To support this findings, Michel, (2010) asserted that plastic products help to avoid losses during difficult climate conditions (rain) that can generate important fodder losses due to rot and in handling for stock and transport, reducing losses. This makes plastic packaged market produce last longer.

Table 8 - Distribution of Respondents Based on their Ratings of the Benefits Derived from the Utilization of Non-Flexible Plastic Products by Poultry Enterprises

S/N	BENEFITS OF PLASTIC IN POULTRY	YES	NO	MEAN	REMARK
1.	Reduce credit risk due to low cost and durability	36	4	1.9	Beneficial
2.	Increase my income	35	5	1.8	Beneficial
3.	Hazardous to my farm	8	32	1.2	Not Beneficial
4.	Plastic containers are very easy to use	35	5	1.8	Beneficial
5.	Best for carrying water in the farm	36	4	1.9	Beneficial

6	Used to store farm vaccines	35	5	1.8	Beneficial
Field survey, 2022.		<i>Benchmark mean <math>\geq 1.5</math> implies beneficial</i>			

Table 8 shows the distribution of respondents based on their ratings of benefits derived from the utilization of non-flexible plastic products in Poultry enterprises. The result indicated that the use of non-flexible plastic products in Poultry enterprises constitutes no hazard ( $f=32$ ,  $\bar{x}=1.2$ ), whereas all other benefits have a mean greater than 1.5 which implies beneficial.

For poultry enterprise, Table 8, showed that plastic container reduces credit risk due to low cost and durability ( $\bar{x}= 1.9$ ), increase farmers income ( $\bar{x}= 1.8$ ), is not hazardous to the farm enterprise ( $\bar{x}= 1.2$ ), are very easy to use ( $\bar{x}=1.8$ ), are best for carrying water in the farm ( $\bar{x}= 1.9$ ) and are used to store vaccine ( $\bar{x}= 1.8$ ). This implied that plastic containers which come in various forms such as bucket, plate, net, basin, Jerry Can, Bottle, and so on, are essential for farm operation or activities, with its numerous benefits.

Michel, (2010) has opined that plastics reduce investments for the farmers. In many ways, plastic is a must for cattle farming, without plastic, meat and milk production would be reduced by 60% in developed countries. This assertion also imply for poultry as most of the materials used in the farm are plastic products.

**Table 9** - Distribution of Respondents Based on their Ratings of Benefits Derived from the Utilization of Non-Flexible Plastic Products in Vegetable/Garden Enterprise

S/N	BENEFITS OF PLASTIC IN VEGETABLE AND GARDEN ENTERPRISES	YES	NO	MEAN	REMARK
1.	Improve the physical condition of my vegetable to avoid bruise, injury or damage	35	5	1.8	Beneficial
2.	Improves my income	29	11	1.7	Beneficial
3.	Is hazardous to my crops	5	35	1.1	Not Beneficial
4.	Enhance easy collection of harvested crops	36	4	1.9	Beneficial
5.	Enhance easy carriage and transport of harvested produce	37	3	1.9	Beneficial
6.	Used to store garden produce over time	37	3	1.9	Beneficial
7.	Use to measure or gather garden produce at the farm market stand	37	3	1.9	Beneficial
Field survey, 2022		<i>Benchmark mean <math>\geq 1.5</math> implies beneficial</i>			

Table 9 shows the distribution of respondents based on their ratings of benefits derived from the utilization of non-flexible plastic products by vegetable/garden enterprises. With a mean of 1.1, the utilization of non-flexible plastic products is not hazardous to processing and packaging enterprises. This implies that all the variables are beneficial with a mean ratings greater than the

bench mark mean.

The benefits of the use of plastic containers in Vegetable and Garden enterprises on Table 12, reveal the following; that plastic containers improves the physical condition of vegetable to avoid bruises, injury or damage ( $\bar{x} = 1.8$ ), improves farmers or traders income ( $\bar{x} = 1.7$ ), is not hazardous to my crops ( $\bar{x} = 1.1$ ), enhance easy collection of harvested crops ( $\bar{x} = 1.9$ ), enhance easy carriage and transport of harvested produce ( $\bar{x} = 1.9$ ), used to store garden produce over time ( $\bar{x} = 1.9$ ), and it is used to measure/gather garden produce at the farm market stand ( $\bar{x} = 1.9$ ). Plastic products are able to enhance these benefits because of their form. It is a good insulator, can absorb a certain amount of heat, it is not subject to corrosion, it is light, easily affordable and readily available in marketable quantities, and comes in different shapes, colours and designs that can attract ones attention easily.

According to Michel, (2010) Plastics' impacts on fruit and vegetable production included allowing for better control of climatic conditions for the root systems, leaves and fruit, photosynthesis and temperature. It also encourages the mulching effect, capturing of CO<sub>2</sub>, heating the soil and preserving soil humidity.

Table 10 - Distribution of Respondents Based on their Ratings of Benefits Derived from the Utilization of Non-Flexible Plastic Products in Packaging and Processing Enterprises

BENEFITS OF PLASTIC IN PROCESSING AND PACKAGING ENTERPRISE	YES	NO	MEAN	REMARK
1. Improves my product storage	15	2	1.8	Beneficial
2. Increase my income	13	4	1.7	Beneficial
3. Is best for my product packaging	14	3	1.8	Beneficial
4. Reduce my credit risk	10	7	1.5	Beneficial
5. Easy haulage of processed farm produce	13	4	1.7	Beneficial
6. Helps me to stores products in airtight containers	13	4	1.7	Beneficial
7. provide easy means for turning, steering, mixing and milling agro-products	15	2	1.8	Beneficial
8. it is hazardous to my processing and packaging enterprise	2	15	1.1	Not Beneficial
9. processed liquid products can be stored in small plastic bottles for marketing	15	2	1.8	Beneficial

Field survey, 2022

*Benchmark mean  $\geq 1.5$  implies beneficial*

Table 10 shows the distribution of respondents based on their ratings of benefits derived from the utilization of non-flexible plastic products by processing/packaging enterprises. The result indicated a negative response to hazardous effect on crops with a mean of 1.1. This implies that

all the variables are beneficial with a mean ratings greater than the bench mark mean.

The result from Table 10, showed that the benefits of the use of plastic containers in the processing and packaging enterprises included the following; that plastic container improves product storage ( $\bar{x} = 1.8$ ), increases the income of farmers and Agro-marketers ( $\bar{x} = 1.7$ ), is best for product packaging ( $\bar{x} = 1.8$ ), Reduce credit risk ( $\bar{x} = 1.5$ ), ensure easy haulage of processed farm produce ( $\bar{x} = 1.7$ ), help to store products in airtight containers ( $\bar{x} = 1.7$ ), provide easy means for turning, steering, mixing and milling of agro-products ( $\bar{x} = 1.8$ ), and it is not hazardous to processing and packaging enterprise activities ( $\bar{x} = 1.1$ ), as processed liquid products can be stored in small bottles for marketing ( $\bar{x} = 1.8$ ). This implied a positive relationship between the use of flexible plastic products and processing and packaging enterprise. In support of the findings of this study, Bernard (2015), has asserted that the usefulness of plastic in agriculture cannot be easily replaced.

Table 11 - Distribution of Respondents Based on their Ratings of Benefits Derived from the Utilization of Non-Flexible Plastic Products by Nursery and Horticultural Enterprises

BENEFITS OF PLASTIC IN NURSERY/HORTICULTURAL ENTERPRISES		YES	NO	MEAN	REMARK
1.	Plastic container/bucket improve my labour efficiency	23	3	1.8	Beneficial
2.	Bears flowers or plants for a longer time	23	3	1.8	Beneficial
3.	Reduce cost over cement or metal pots	4	22	1.1	Not Beneficial
4.	Increase my profit due to low cost	21	5	1.8	Beneficial
5.	Best for watering the garden	21	5	1.8	Beneficial
6.	Best material for flower pots	8	18	1.3	Not Beneficial
7.	Best vessel for water collection	26	0	2.0	Beneficial
8.	Best for carrying seeds, materials and garden soils	26	0	2.0	Beneficial
9.	Less risk of injury to farmer/horticulturist	23	3	1.8	Beneficial
10.	Low weight reduce load and stress during haulage	23	3	1.8	Beneficial
11.	Promote easy movement of items, flowers or plants	22	4	1.8	Beneficial
12.	Flowers can be rented out for events easily with plastic pots	23	3	1.8	Beneficial
13.	It increases my income	23	3	1.8	Beneficial
14.	Reduce credit risk	21	5	1.8	Beneficial
15.	It is hazardous to my nursery farm	0	26	2.0	Beneficial

Table 11 shows the distribution of respondents based on their ratings of benefits derived from the utilization of non-flexible plastic products by nursery/horticultural enterprises. According to the findings, the use of non-flexible plastic products in nursery and horticultural enterprises does not reduce cost over cement not metal pots ( $\bar{x}=1.1$ ) and is not the best material for flower pots ( $\bar{x}= 1.3$ ). This is because certain features made plastic more desirable than cement and metal pots. There are; light weight, portability, mobility, easy transplanting, and unique design. Respondents had through interviews opined that plastic products are more expensive. This also may be due to the increasing level of patronage of plastic products over alternatives.

The result also revealed that plastic container/buckets improves labour efficiency ( $\bar{x}= 1.8$ ), bears flowers or plants for a longer time longer ( $\bar{x}= 1.8$ ), does not reduce cost over cement or metal pots ( $\bar{x}= 1.1$ ), increase profit due to low cost ( $\bar{x}= 1.8$ ), is best for watering the garden ( $\bar{x}= 1.8$ ), and is not the best material for flower pots ( $\bar{x}= 1.3$ ) because it can absorb heat when left under the sun for a long time, whereas, clay or cement pots are the best because of their ability to conserve moisture and maintain a humid temperature for flowers. Furthermore, it is the best vessel for water collection ( $\bar{x}= 2.0$ ). It is also the best material for carrying seeds, farm materials and Garden soils ( $\bar{x}= 2.0$ ), it reduce the risk of injury to farmers or horticulturist ( $\bar{x}= 1.8$ ) as it low weight reduces load and stress during haulage ( $\bar{x}= 1.8$ ). It promotes easy movement of items, flowers or plants ( $\bar{x}= 1.8$ ), flowers can be rented out for events easily with plastic pots ( $\bar{x}= 1.8$ ), it use increases farmers income ( $\bar{x}= 1.8$ ), Reduce credit risk ( $\bar{x}= 1.8$ ) and is not hazardous to nursery farm ( $\bar{x}= 2.0$ ). From the results, it is clear that plastic container has a positive relationship to enhancing the efficiency of nursery and horticultural farmers. Also, the use of plastic containers in nursery and horticultural enterprise does not amount to a reduction in the cost of the material over plastic or metal pots. On why the use of plastic containers does not reduce cost, it was discovered that clay pots made from cement are cheaper and preferred by horticultural farmers or florists but they are bulky and difficult to carry whereas customers only prefers plastic pots or buckets which comes in designs and is very easy and light to be conveyed and even in large quantity. Science Direct, (2015) have stated that agricultural plastics are appropriate components of reduced-input horticultural systems, as agricultural plastics may reduce the need for pesticides, water, and nitrogen fertilizers while increasing crop yield.

## SUMMARY

The benefits of the utilization of flexible plastic products in the study area had aided agro-firm activities such as improvement in income, increase sales, product storage, hygienic packaging, less expense, among others. It however does not increase the profit of processing and packaging enterprises due to low cost even when it proves sales, income and storage. It is also not hazardous to products.

The benefits of the utilization of non-flexible plastic products by agro-firm owners in the study area indicated that; the use of non-flexible plastic products improve the efficiency of their market, storage, movement of produce, retailing in smaller units, value addition, improve the physical condition of produce, among others. It however, do not reduce the cost over cement or metal pots since it is me re expensive in the nursery/horticultural enterprise but most preferable because of it mobility, light weight and ease during transplanting. It does not attach any form of hazard to the agro-firm's activities

## **CONCLUSION**

From the findings, it is therefore evident that the utilization of plastic materials such as flexible and non-flexible plastic products (plastic bags and plastic containers) is beneficial and crucial to agricultural development among agro-firms in the study area. In the various enterprises surveyed, plastic materials have been used at different levels. For example, it has been used at the stages of production, processing, packaging and marketing which connote that it constitutes no hazard to agro-firm activities. The study has also shown that plastic materials such as bags and container are rather beneficial than being a problem in agricultural production processes since it has a comparative advantage over the use of its alternatives such as paper, steel, iron, glass and aluminum hence its wide range of adoption by agro-firm owners.

## **RECOMMENDATION**

Based on the findings of this study, the following recommendations are put forward.

Respondents had opined that the benefits associated with the utilization of flexible plastic products in their farm activities do not constitute any hazard. This study recommends that the production of plastic products for agricultural use be void of toxic chemical. The non-toxic plastic produced for agricultural purposes should be branded “Agricultural Plastic” in order to enhance safety and reduce health insecurity among users.

Non-flexible plastic products have been beneficial to agro-firm owners, as a way of reducing cost of agriculture investment, this study recommend that small scale enterprises of any sought should be encouraged to utilize the benefits of plastic in this study to enhance their business start-up, rather than going for plastic alternatives which may be very expensive. By this, a plastic tank can serve the same purpose of an iron tank for an emerging business at startup to reduce the cost of capital acquisition.



## REFERENCES

- Abdul, J., Nannu, M., & Muhammad, K. R. (2014). "Using plastic bags and its damaging impact on environment and agriculture: An Alternative Proposal". *International Journal of Learning & Development*. 3(4):2-14.
- American Chemistry Council (2017). "Study examines production, use and disposal of plastics". [www.recyclingtoday.com/article/plastic](http://www.recyclingtoday.com/article/plastic)
- Atuanya, I., Aborisade, W. T., & Nwogu, N. A., (2012). "Impact of plastic enriched composting on soil structure, fertility and growth of maize lands." *European Journal of Applied Sciences*. 2012;4(3):105-109. Accessed on 23 February, 2020
- Bernard, L. M. (2015). "Plastics in agriculture: a contribution to Intensive Ecological Agriculture (IEA)". CPA: French Committee for Plastics in Agriculture and APE Europe: European Association of Plastics Converters for Agriculture. Saltillo, Coahuila, México.
- California Integrated Waste Management Board (2008). "Postconsumer Agricultural Plastic Report." Produced Under Contract by: Sean Hurley, California Polytechnic State University. Publication #IWMB-2008-019
- Etim, O. U. (2018). "Beat Plastic Pollution." Live Broadcast from Radio Nigeria - Canaan City FM (95.5Mhz) during the observance of the World Environment Day June 5, 2018 in Beat plastic pollution by Safety Awareness and Environmental Support Initiative – SAESI Nigeria, in collaboration with Miss Africa 2018, and the Cross River State Ministry of Environment, Calabar, Cross River State.
- Europe's Association for Plastic and Rubber Machinery Manufacturers (EUROMAP) (2017). "Nigeria's plastic industry is fast growing – plasticprintpack Nigeria." Land Mark Centre, Victoria Island Lagos, Nigeria. Available at: [www.ppp-nigeria.com/nigeria - plasticprintpack-nigeria-event2.html](http://www.ppp-nigeria.com/nigeria-plasticprintpack-nigeria-event2.html)
- Franklin Associates (2013). "Impact of Plastics Packaging on Life Cycle Energy Consumption and Greenhouse Gas Emissions in the United States and Canada." Available: <https://plastics.americanchemistry.com/Education-esources/Publications/Impact-of-Plastics-Packaging.pdf>
- Giuliano, V., Rosa, V., Ileana, B., Giacomo, S., & Mugnozza, E., (2015). "Sustainability of Well-Being International Forum". 2015: Food for Sustainability and not just food, FlorenceSWIF2015. Amendola 165/A, 70126 Bari, Italy Available online at [www.sciencedirect.com](http://www.sciencedirect.com). Assessed on 25<sup>th</sup> June, 2018.
- Giuliano, V., Rosa, V. L., Ileana, B., Giacomo, S. M., & Evelia, S. (2015). "Mapping of Agricultural plastic waste". Florence "Sustainability of Well-Being International Forum". 2015: Food for Sustainability and not just food, FlorenceSWIF2015. Amendola 165/A, 70126 Bari, Italy. Assessed on 25<sup>th</sup> June, 2018.

- Marsh, K., & Bugusu, B. (2007). "Food Packaging—Roles, Materials, and Environmental Issues" Institute of Food Technologists Vol. 72, Nr. 3, 2007—JOURNAL OF FOOD SCIENCE R39 doi: 10.1111/j.1750-3841.2007.00301.x. Accessed on 23 February, 2020
- Michel, G., (2010). "Plastics in agriculture: a contribution to Intensive Ecological Agriculture (IEA)." Saltillo, Coahuila, México
- Muhammad, K . R., (2014). "Using Plastic Bags and Its Damaging Impact on Environment and Agriculture: An Alternative Proposal." *International Journal of Learning &Development* ISSN 2164-4063 2013, Vol. 3, No. 4. Accessed on 23 February, 2020.
- Robinson, D.W. (1991). "Developments in Plastic Structures and Materials for Horticultural Crops." Baron's Brae, Baily, County Dublin, Ireland, 1991-06-01.
- Science Direct (2015). "*Plastic Waste: Ecological and Human Health Impacts.*" *Science for Environment Policy*| In-depth Reports. www.sciencedirect.com/science/artic/Science for Environment Policy (2011). Accessed on 25 June, 2018.
- Trucost (2016). "Plastics and Sustainability: A Valuation of Environmental Benefits, Costs and Opportunities for Continuous Improvement." Plastic and sustainability