



UTILIZATION OF PLASTIC MATERIALS IN AGRICULTURAL PRODUCTION AMONG AGRO-ENTERPRISE OWNERS IN CROSS RIVER STATE, NIGERIA

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ABSTRACT

This research assessed the utilization of plastic materials in agricultural production among agro-enterprise owners in Cross River State, Nigeria. It examined the socio-economic characteristics of agro-enterprise owners in the study area, identified plastic materials and the level of usage by enterprise owners in the study area, isolated the most used plastic materials among the selected enterprises in the study area and postulated practical measures as prospects for plastic agricultural development for Cross River State. A simple random and purposive sampling technique was used for the study. Both primary and secondary data were used; a researcher structured questionnaire was used to collect data. Data were obtained from 150 respondents from five selected agro-enterprises which are; processing and packaging enterprises, Vegetable farms/Gardens, Poultry farm enterprise, Nursery/horticultural enterprises, and Agro-marketing enterprises. Result revealed that respondents were educated (f=62, 41.35%), with the highest farming experience between 5 - 10 years (f=67; 44.68%) and monthly income between N21, 000 and N40, 000 (f = 55; 36.68%). Plastic products that are most utilized in the agricultural activities of vegetable farmers included; Plastic Basin ($\bar{x} = 1.92$), Jerry Can ($\bar{x} = 1.72$), Poly-ethyne Bag and Table ($\bar{x} = 1.70$). The use of Tarpauline Bags ($\bar{x} = 1.92$), Poly-ethyne Bags and Chair ($\bar{x} = 1.86$), Cup and Egg Crate ($\bar{x} = 1.80$) among agro-marketers, Egg Crates and Tapolyen Bags ($\bar{x} = 1.94$), Plastic Tanks ($\bar{x} = 1.92$) and Plastic Jerry Cans ($\bar{x} = 1.80$) among poultry enterprises. The study recommended the isolation and implementation of plastic policies that improves the socio-economic characteristics of farmers, as well as a remodeling approach to plastic utilization in agricultural development.

KEYWORDS: plastic products, agro-enterprises, plastic agriculture, prospects in plastic materials,

INTRODUCTION

The use of plastic materials in agricultural production, processing, packaging, and storage unveils an opportunity for economic and rural development. It utilization have improved the standard of life of farmers and enterprise owners who use plastic materials. From increasing farmers income to enhancing social and economic life, the utilization of plastic materials among agro-enterprise owners improves farmer's health through reduced intake of Ferrum Oxides in stored water in iron containers, and reduced corrosion in metals.

It has empowered many micro businesses with packaging and storage input for their products. It is an opportunity for industrialization, creation of employment, job opportunity (Plastic vendors), and government's intervention through a good environmental sanitation policy will further create more opportunities by increasing the number of sanitary workforce due to an increase in waste disposal and the inauguration of an Agricultural and Environmental Safety Awareness and Sanitation Agency (Etim, Effiong, Okoi, and Ntui, (2022); Ntui, Etim, Obhiokhenan, and Ayi, (2022), Effiong, (2012) and Effiong, Ljioma, Effiong, (2016).

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In Africa, Nigeria is Africa's largest importer of plastics in primary forms (Fairtrade, 2019). With about 70% of raw materials imported (mainly from the Middle East, Europe and Asia) and only 30% produced locally, the Nigerian market has great prospect for export of plastics in primary forms. In the years 2008 to 2015, imports of plastic raw materials improved annually by 7.2% from 464 kt to 754 kt, +62.5% (Fairtrade, 2019). This makes Nigeria and Algeria, Africa's largest importers of plastics in primary forms. According to World Wide Fund for nature (2018), Plastics packaging has become very popular in Nigeria's agriculture and is increasingly being preferred than glass, even in the pharmaceutical and cosmetics industries. Most ECOWAS (Economic Community of West African States) countries depend on Nigeria for their plastic needs, given the country's competitive advantage in the area of sourcing raw materials. The demand for plastics products continues to outpace supply and consumption is expected to grow significantly (Giuliano, Rosa, Ileana, Giacomo, and Evelia, 2015). Plastic South Africa in a National Plastic Recycling Survey, 2017 indicated that the industry recycled 334, 727 tons or 43.7% of all plastics. This recycling industry in South Africa supports 5, 837 formal jobs (WWF, 2018). Being the second largest importer of packaging technology in Sub-Sahara Africa, Nigeria invests heavily in its packaging industry. Nigeria's imports of packaging technology increased by 34% in 2017, from 113 to 152 million Euro, (Fairtrade, 2019). Nigeria's plastics consumption by application in 2017 posited that 53.8% of consumption is accounted for by packaging, 16.3% by construction, 5.7 for automotive, electrical technology 3.3% and others 21%, while Nigeria's plastics consumption by processing method in 2017 showed that in plastics processing, extrusion is in the lead with 52.0%, followed by injection molding with 23.4%, blow molding with 8.6% and PET (Polyethylene terephthalate) with 8.1% (Fairtrade, 2019; Effiong, and Asikong, (2013); Etim, Effiong, Okoi, and Ntui, (2022) and Effiong and Aboh, (2018)). Biodegradable plastics may not be the best for our agricultural machines, tractors, farm shed and other plastic farm assets which are expected to last for a long time. This is because biodegradable plastics are not durable. Bio-plastic are produced from renewable biomass sources such as vegetable fats and oil, corn starch, straw, woodchips, and food waste, they are made from agricultural by-products. Most are produced from plant sugars, starches and oils.

However, it is expensive to use bio-plastics. Synthetic plastic materials have a wide application in agriculture such as in plastic pond, seed nursery shed, watering cans for poultry, plastic tanks, plastic pipes as used in poultry battery cage system and so on. Metallic pipes are known to increase oxidation to produce a brown hydrated ion called rust which will increase the level of ferrous oxides due to internal corrosion (Effiong and Aboh, (2024) and Effiong, and Aboh, (2019)).

Plastic drinkers are ideal for poultry and animals to reduce the level of contamination. This is why plastic enclosed drinkers reduce airborne disease, chemical and faecal contamination. Agricultural production is highly encouraged by the low cost of input and subsidies, therefore any innovation that reduces farmer's capital or input cost and which increases profit will be highly adopted. This is what plastic installations in the farm have been able to achieve; being incorporated into some sections or parts of farmsteads or farms houses, fish ponds, market materials for display, spraying/drying, preserving, packaging, haulage, and so on ((Etim, and Effiong, (2022); Ntui, Effiong, Etim, and Okoi, (2022) and Ntui, Etim, Obhiokhenan, and Ayi, (2022)). The Cross River State government in 2018 placed a huge tax burden on Scrap collection and scrap sites since they have come to the awareness of the high level of income generation from dealers. Collection of scraps was down by the street children who are homeless and who always have their routine collecting scraps, tins or can, plastic bottles from various waste bins at all the waste locations in the state. The sales of these materials can afford them money for food. The Hausa Community in Calabar residing at 'Gbogobri' has traded extensively in the whole city gathering the scrap materials. These materials are weighed at a collection point where payments are made while the bulk of the materials are then transported to the recycling plant outside the state. Such is ongoing for plastic too (Effiong, Aboh, and Aya, (2021); and Ijioma, Effiong, Ogbonna, and Okolies, (2024)).

Plastic containers have displaced the use of bottles in drinks and glass packaged products. Glass packages can lose their content when broken by accident. Glass or bottle containers are known to have a high probability to cause injury in case of accident, and can serve as a weapon in public restaurants or bar. Bottles if disposed on farmlands cause injury to the farmer and are mostly unsafe.

This is why the use of plastic in agriculture has gained prominence than alternative materials (Effiong, (2013); Nkang and Effiong, (2015)).

PLASTIC PRODUCTS IN AGRICULTURAL PRODUCTION

Plastic products cover a wide group of materials depending on the purpose of use. Some plastic products falls into the sub category of plastic bags and plastic containers which also varies based on method of practical application. They are;

A. Plastic Films

Plastic film can be used to aid crop production in many ways. Polyethylene and other materials can be formulated to control or utilize more effectively the heat and light energy from the sun, and also heat energy radiated from the soil. Plastic film can be used in crop production as covers for greenhouses and low tunnels, or as direct covers. The film entirely covers the crop and so has an influence on the total plant environment (Effiong, Aboh, and Aya, 2021).

B. Polyethylene

This is the plastic film or flexible plastic product called Tarpauline which is used by farmers in growing their crops in order to suppress weed growth, regulate the temperature and humidity, increase uptake of fertilizer as well as protect the plant from bad weather. It varies in thickness such as low density (LDPE) and linear low density form (LLDPE).

Farmers benefits from polyethylene in growing their maize, potatoes, carrot, among others, which provide warm needed for early germination of seeds. It also increased the yields of a number of crops and extended the growing period (Hancock 1988).

C. Ethylene Vinyl Acetate

Films based on Ethylene Vinyl Acetate (EVA) copolymers contain 14-18% vinyl acetate, and have been widely used as an alternative to polyethylene, both unmodified and with the addition of heat absorbing fillers. EVA copolymers are transparent to visible light, and allow all those wavelengths essential for photosynthesis to pass through (Desriac 1988). In addition, they have good heat retaining characteristics to an extent which depends on the vinyl acetate content (Desriac 1988).

D. Greenhouse Structures

Plastic covered structures were developed initially as a cheap substitute for glasshouses, Rapid expansion and modification took place in Mediterranean areas, where simple greenhouses helped greatly in the winter production of vegetables. Subsequently, plastic greenhouses have been developed for tropical desert conditions and, more recently, for humid tropical regions. Production under plastic is more expensive than in the open, but is often economically viable because it enables limitations of the climate to be overcome (Desriac 1988).

E. Plastic bags

Agricultural plastics bags have been expanded to include food packaging, agricultural chemical containers, and shipping sacks for agricultural products and inputs. 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. Plastics seem destined to play an ever-greater role in horticulture (Science Direct, 2015).

F. Agricultural films

Agricultural films' largest market is mulching film used by vegetable growers. Plastic mulch's first advantage to the horticulturist is that film increases the soil temperature, promoting increased and earlier yields of fruits and vegetables. Mulches are also used to discourage weed growth and to conserve water and fertilizer, (Aboh and Effiong, 2019). Some mulch is light selective and allows only certain parts of the spectrum to pass through. It has been demonstrated that in some areas, plastic mulch acts as a deterrent to fungus infections and insect infestations, allowing reduction in chemical pesticide applications. Low Density Polyethylene (LDPE) plastic is used extensively by flower and foliage growers for covering greenhouses. Because of cost and ease of installation, plastic has replaced glass as the dominant glazing in North America. Nursery growers use Low Density Polyethylene (LDPE) plastic film for overwintering protection of shrubs and plants, both in open fields and in "hoop house" settings. Hoop houses, unlike greenhouses, have no artificial heat sources (Effiong, Ijioma, and Effiong, 2016). When used on hoop houses or in the fields directly over the plants themselves, the film protects plants and shrubs from the cold and wind chill. The film also helps conserve ground warmth, reducing winter injury. Overwintering film is often white and reflects light, keeping the inside temperatures lower throughout the day to maintain the plants' dormancy (Trucost, 2016)

G. Silage bags

As alternatives to vertical silos, silage bags are used by cattle ranchers and dairy farmers to produce corn silage and to protect it from spoiling. Haylage tubes and hay bale stretch wrap are used to protect hay from the elements.

TYPES OF AGRICULTURAL PLASTIC USED BY VARIOUS AGRO-FARMS

Another study by the American Chemistry Council in 2017 depicts the use of plastics by the agricultural community, by estimating the quantities of Agricultural plastic used (million lbs). Greenhouse and Nursery films were highest. They are listed thus;

A. Agricultural film such as; Greenhouse & Nursery Film, Low Density Polyethylene Mulch Film, Fumigation Film, Degradable Mulch Film, Irrigation Tubing, Silage Bags, Hay & Silage Bale Stretch Wrap, Hay sleeve Covers and High Density Polyethylene Mulch Film

B. Nursery plastics such as; Nursery Containers, Blow-Molded HDPE Pots, Injection-Molded HDPE Pots, Polystyrene Nursery Pots, Packs and Flats

C. Pesticides; Different farm enterprises uses different plastic materials which share unique characteristics **between the same enterprises. Such are listed thus;**

a. Fish farm (plastic ponds, tank, pipes, bucket, plate, nets and so on)

b. Vegetable/garden enterprise (plastic bags, plastic pesticide bottles, water bottles, gloves, boots, shoes/slippers, waterproof (poly-ethene bags) and so on)

c. Poultry enterprise (drinker, feeders or troughs, buckets, nets, farm stead, roofs, crates, among others).

d. Nursery/seedling enterprise (cans, poly-ethene bags, special plastic designed cups, buckets, tanks, among others)

e. Agro-marketing enterprise (plastic bottles, poly-ethene bags, plastic buckets, basins, plates, cups, among others).

f. Agro-packaging and processing (Plastic buckets, plastic bags, plastic rod stirrer, cup, spoon, plates etc.)

RESEARCH METHODOLOGY

The research was conducted in the Southern 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). Cross River State is bounded in the North by Benue State, in the South West by Akwalbom State, in the west by Ebonyi and Abia States (CRS LEEDS 2 (2016)).

The Southern Agricultural Zone has seven blocks which are; Calabar South, Akampka, Calabar Municipality, Biase, Akpabuyo, Bakassi, and Odukpani. The vegetation are; Mangrove, Swamp, and Rainforest. Major crops produced in the area includes; Cocoa, Rice, Cassava, Oil Palm, Rubber, Banana and Pineapple among others. Occupation is mostly farming, marketing and civil services. The population of study included owners of agricultural enterprises that use plastic for their production,

processing, packaging, marketing or storage needs in the southern agricultural zone of Cross River State. Enterprise category measured in this study included; processing and packaging agricultural enterprises, Vegetable farms/gardens, Poultry enterprises, nursery/horticultural enterprises and agro-marketing enterprise.

Table 1 showed the sampling procedure and sample size for the study. A simple random sampling technique was used in the selection of five 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 plastic. The population of the study involves owners of agricultural enterprises. Data was presented using descriptive statistics such as frequency count, percentage and mean. A purposive sampling technique was used in the selection of five agricultural enterprises that makes use of plastic materials in their agricultural production in the five blocks. They are; processing and packaging enterprises, Vegetable farms/Gardens, Poultry farms, Nursery/horticultural enterprises, and Agro-marketing enterprises. The study also used a disproportionate sampling method to purposively select; 35 poultry enterprises, 25 Nursey/Horticultural enterprises, 25 Processing and Packaging enterprises, 30 vegetable/Garden enterprises and 35 Agro-marketing enterprises based on; ease of accessibility and spread in the study area. This gave a sample size of 150 respondents. Socioeconomic characteristics of respondents such as; sex, age, marital status, level of education, among others, was measured using frequency count and percentage. While the utilization of plastic products such as; plastic cup, tables, bottle, jerry can, among others, across the various enterprises was measured using frequency count and mean. A benchmark mean of 1.5 (2+1/2) was used to identify significant variables. Means equal to or greater than 1.5 implies that the variable measured is beneficial or significant.

Table 1. Number of Registered Agricultural Enterprises in the Southern Agricultural Zone

Enterprises	Calabar South	Calabar Municipality	Akamkpa	Akpabuyo	Odukpani	Total	Total Sample
Poultry	27	30	71	39	60	227	35
Nursery/Horticulture	21	26	27	40	30	144	25
Processing/Packaging	20	25	12	13	27	97	25
Vegetable/Garden	79	40	15	10	80	224	30
Agro-marketing	40	50	27	23	31	171	35
Total	187	171	152	125	228	863	150

Source: Field Survey, 2024

RESULTS AND DISCUSSIONS**Socioeconomic Characteristics of Respondents**

Table 2 – Distribution of Respondents Based on their Socioeconomic Characteristics

Variables	Category	Frequency (f)	Percentage (%)
Age (years)	<21	19	12.67
	21 – 30	58	38.68
	31 – 40	36	24.01
	41 – 50	25	16.67
	50 >	12	8.00
		150	100
Sex	Male	67	44.68
	Female	83	55.36
		150	100
Marital Status	Singles	59	39.35
	Married	78	52.02
	Widow	11	7.33
	Widower	1	0.667
	Divorcéd	1	0.667
		150	100
Primary Occupation	Farming	88	58.69
	Trading	38	25.43
	Civil service	24	16.00
		150	100
Level of education	Primary	28	18.67
	Secondary	58	38.68
	Tertiary	62	41.35
	None	2	1.33
		150	100
Farming experience	Below 5	46	30.68
	5 – 10	67	44.68
	11 – 15	24	16.00
	16 – 20	8	5.33
	20>	5	3.33
		150	100
Income	< N 21, 000	44	29.34
	N 21, 000 – N 40, 000	55	36.68
	N 41, 000 – N 60, 000	25	16.67
	N 61, 000 – N 80, 000	16	10.67
	N 81, 000 – N 100, 000	9	6.00
	N 100, 000>	1	0.66
		150	100

Source: Field Survey, 2024

The socioeconomic characteristics of plastic users indicated that; respondents were mostly between the age of 21 – 30 with a frequency of 58 (38.68%), followed by those between 31 – 40 years of age with a frequency of 36 (24.01%). This implied that majority of farmers who use plastic in their farms or agrobusinesses are mostly young adults who have registered their agrobusinesses with the Cross River State Ministry of Agriculture. Results on the sex of the respondents, showed that most enterprises covered by this study are driven by females with a frequency of 83 (55.36%) over males 67 (44.68%). This proof supports research that women play a vital role in Agricultural development in Africa (FAO, 2011). The result also showed that most of the respondents were married (f= 78; 52.02%). This is followed by single respondents at a frequency of 59 (39.35%). This implied that farm families/households are dominantly involved in agricultural production and the use of plastic materials since the couples do their farm businesses alongside members of their families. Farming occurred to be the dominant occupation of respondents with a frequency of 88 (58.69%), while trading has a frequency of 38 (25.34%) and civil service 24 (16%). The high rate of farmers is because many families in Cross River State are involved in one agricultural or agro-marketing activities or the other.

This corroborates the findings of the Agricultural Plastic Recycling and Producers Survey Final Report, (2012), which posit that a significant higher percentage of plastic users than non-users cited livestock as their main source of revenue which implied farming.

The result in Table 2, also showed that respondents are educated (f=62, 41.35%). The highest farming experience occurred among respondents who are between 5 - 10 years (f=67; 44.68%) in their agribusinesses. This is followed by respondents with farming experience below 5 years with frequency of 46 (30.68%), 11 - 15 years (f = 24; 16%), 16 - 20 (f = 8; 5.33%) and greater than 21 (>21) at 5 (3.33%). Most of the respondents have a monthly income between N21, 000 and N40, 000 (f = 55; 36.68%). The next range of income falls below N20, 000 with a frequency of 44 (29.34), while respondents in N41, 000 - N60, 000 category are at 25 (16.67%) N81, 000 - N100, 000 (f = 9; 6%) and 100 and above. (f = 1; 0.66%). This implied that respondents are mostly low to average income earners in the farm or agrobusiness enterprises who make monthly revenue below N40, 000. This does not tally with the findings of the Agricultural Plastic Recycling and Producers Survey Final Report (2012), which in their study, the use of agricultural plastic is higher on larger operations. The low to average income level may be due to lack of large agricultural investments among respondents in this study.

Plastic Products Used by Respondents in the Study Area.

Table 3 – Distribution of Respondents Based on their Ratings on plastic products used in Vegetable enterprises

S/No.	Plastic Materials	Frequency		Mean (\bar{x})	Rank
		used	Not used		
1.	Cup	91	59	1.60	5 th
2.	Chair	86	64	1.57	6 th
3.	Table	106	44	1.70	3 rd
4.	Egg Crate	0	150	1.0	10 th
5.	Net	15	135	1.1	9 th
6.	Roof	5	145	1.03	11 th
7.	Plate	25	125	1.16	7 th
8.	Bucket	103	47	1.68	4 th
9.	Bottle	21	129	1.14	8 th
10.	Jerry Can	109	41	1.72	2 nd
11.	Basin	139	11	1.92	1 st
12.	Tank	25	125	1.16	7 th
13.	Tarpaulin Bag	103	47	1.68	4 th
14.	Poly-ethyne bag	106	44	1.70	3 rd

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. Table 3 showed the distribution of respondents based on their ratings on plastic products used 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. Plastic products that are most utilized in the agricultural activities of vegetable farmers

included; Plastic Basin ($\bar{x}=1.92$), Jerry Can ($\bar{x}=1.72$), Poly-ethyne Bag and Table ($\bar{x}=1.70$). These have ranked 1st, 2nd and 3rd respectively. Products with very low mean values are less beneficial/significant in vegetable/garden enterprise. They include; Plastic Net ($\bar{x}=1.1$), Egg Crate ($\bar{x}=1.0$), Plastic roof ($\bar{x}=1.03$). Findings in Table 3 imply a huge prospect for agricultural development in the study area due to the high relevance of plastic products/materials in the production efficiency of vegetable or garden farmers. Bernard (2015) had reiterated that plastic materials in agriculture has a massive impact on increasing agricultural investment and productivity necessary to feed the growing human population. That without plastics, 60% of fruit, vegetable and dairy production would be endangered.

Table 4. Distribution of Respondents Based on their Ratings on plastic products used in Agro-Marketing enterprises

S/No.	Plastic Materials	Frequency		Mean (\bar{x})	Rank
		Use	Not used		
1.	Cup	120	30	1.80	3 rd
2.	Chair	130	20	1.86	2 nd
3.	Table	119	31	1.79	4 th
4.	Egg Crate	120	30	1.80	3 rd
5.	Net	31	119	1.20	11 th
6.	Roof	72	78	1.48	8 th
7.	Plate	69	81	1.46	9 th
8.	Bucket	89	61	1.59	7 th
9.	Bottle	118	32	1.78	5 th
10.	Jerry Can	110	40	1.73	6 th
11.	Basin	119	31	1.79	4 th
12.	Tank	49	101	1.32	10 th
13.	Tarpauline Bag	138	12	1.92	1 st
14.	Poly-ethyne bag	130	20	1.86	2 nd

Field Survey, 2024

Benchmark mean ≥ 1.5 implies beneficial

Table 4 showed the distribution of respondents based on the ratings of plastic products used in agro-marketing enterprise. According to the findings, highly incorporated plastic materials/products among agro-marketers and their marketing enterprises includes; the use of Tarpauline Bags ($\bar{x}=1.92$), Poly-ethyne Bags and Chair ($\bar{x}=1.86$), Cup and Egg Crate ($\bar{x}=1.80$) which are observed as 1st, 2nd and 3rd respectively. Low ranked plastic products include; plastic plate ($\bar{x}=1.46$), Plastic Tank ($\bar{x}=1.32$), Plastic Net ($\bar{x}=1.20$) which ranked 9th, 10th and 11th respectively. They are scarcely used by agro-marketers. Highly used products identified in Table 4 is a prospect that improvement in the utilization of

plastic materials in agriculture can ensue expansion and development in agro-markets in the study area. Marsh and Bugusu (2007) highlighted that the high level incorporation of plastic materials among agro-marketers is based on its ability to retard product deterioration and improved packaging needs.

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.

Table 5 - Distribution of Respondents Based on their Ratings on plastic products used in Nursery/Horticultural Enterprises

S/No.	Plastic Materials	Frequency		Mean	Rank
		Use	Not used	\bar{x}	R
1.	Cup	106	44	1.70	4 th
2.	Chair	91	59	1.60	6 th
3.	Table	21	129	1.14	10 th
4.	Egg Crate	0	150	1.0	11 th
5.	Net	56	94	1.37	8 th
6.	Roof	49	101	1.32	9 th
7.	Plate	49	101	1.32	9 th
8.	Bucket	118	32	1.78	3 rd
9.	Bottle	106	44	1.70	4 th
10.	Jerry Can	118	32	1.78	3 rd
11.	Basin	99	51	1.66	5 th
12.	Tank	86	64	1.57	7 th
13.	Tarpauline Bag	130	20	1.86	2 nd
14.	Poly-ethyne bag	141	9	1.94	1 st

Field Survey, 2024

Benchmark mean ≥ 1.5 implies beneficial

The utilization of plastic materials such as; Poly-ethyne Bag ($\bar{x} = 1.94$), Tarpauline Bag ($\bar{x} = 1.86$), Plastic Bucket and Jerry Can ($\bar{x} = 1.78$) showed a huge prospect in horticultural enterprises as indicated in Table 5. Horticultural Farmers find these materials most useful in their nursery operation since plants/flowers are better put in a polybag for ease in transplanting. Low ranking plastic materials such as;

Plastic plates and plastic roof ($\bar{x} = 1.32$), Plastic Table ($\bar{x} = 1.14$) and Plastic Egg Crate ($\bar{x} = 1.0$) which ranked 9th, 10th, and 11th respectively, are less likely used in horticultural farmers. Science Direct, (2015) stated that agricultural plastics are appropriate components of reduced-input in horticultural systems, as it also reduce the need for pesticides, water, and nitrogen fertilizers, as it also increasing crop yield due to its ability to retain moisture, plant root and heat.

Table 6 - Distribution of Respondents Based on their Ratings on plastic products used in Poultry enterprises

S/No.	Plastic Materials	Frequency		Mean	Rank
		Use	Not used	(\bar{x})	R
1.	Cup	60	90	1.40	9 th
2.	Chair	21	129	1.14	11 th
3.	Table	31	119	1.20	10 th
4.	Egg Crate	141	9	1.94	1 st
5.	Net	107	43	1.71	5 th
6.	Roof	99	51	1.66	6 th
7.	Plate	62	88	1.41	8 th
8.	Bucket	118	32	1.78	4 th
9.	Bottle	99	51	1.66	6 th
10.	Jerry Can	120	30	1.80	3 rd
11.	Basin	99	51	1.66	6 th
12.	Tank	139	11	1.92	2 nd
13.	Tarpauline Bag	141	9	1.94	1 st
14.	Poly-ethyne bag	86	64	1.57	7 th

Field Survey, 2024 Benchmark mean ≥ 1.5 implies beneficial

Poultry Enterprises:

This includes enterprises that raise 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. Table 6 indicated that poultry enterprises mostly utilizes plastic materials such as; Egg Crates and Tapolyen Bags ($\bar{x} = 1.94$), Plastic Tanks ($\bar{x} = 1.92$) and Plastic Jerry Cans ($\bar{x} = 1.80$) which ranked 1st, 2nd and 3rd respectively. This showed that these plastic materials are crucial in the development of this enterprise due

to high level inclusion in poultry farming based on how it is affordable, assessable, and how it improves the profit of poultry enterprises. However; Plastic Cup ($\bar{x} = 1.40$), Plastic Table ($\bar{x} = 1.20$) and Plastic Chair ($\bar{x} = 1.14$), were ranked low with 9th, 10th and 11th respectively due to their low level utilization and prospect in poultry farming in the study area. 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 7 - Distribution of Respondents Based on their Ratings on plastic products used in Processing/packaging Enterprises

S/No.	Plastic Materials	Frequency		Mean (\bar{x})	Rank R
		Use	Not used		
1.	Cup	89	61	1.59	7 th
2.	Chair	69	81	1.46	9 th
3.	Table	91	59	1.60	6 th
4.	Egg Crate	99	51	1.66	4 th
5.	Net	94	56	1.62	5 th
6.	Roof	69	81	1.46	9 th
7.	Plate	75	75	1.50	8 th
8.	Bucket	91	59	1.60	6 th
9.	Bottle	130	20	1.86	2 nd
10.	Jerry Can	122	28	1.81	3 rd
11.	Basin	122	28	1.81	3 rd
12.	Tank	122	28	1.81	3 rd
13.	Tarpauline Bag	141	9	1.94	1 st
14.	Poly-ethyne Bag	94	56	1.62	5 th

Field Survey, 2024 *Benchmark mean ≥ 1.5 implies beneficial*

Packaging and Processing Enterprises:

These 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, and promote an agricultural product, thus improving its market value and keeps it clean.

Table 7 revealed that plastic materials mostly used by agricultural processors for packaging includes; Tarpauline Bags ($\bar{x} = 1.94$), Plastic Bottles ($\bar{x} = 1.86$), Jerry Cans, Plastic Basins, and Plastic Tanks ($\bar{x} = 1.81$) ranked 1st, 2nd and 3rd respectively. The use of these materials shows a high prospect for agricultural development through Plasticulture which can improve the standard of living of the farmers. Low ranked plastic materials included; Plastic chair and Plastic Roof ($\bar{x} = 1.46$) which falls below the benchmark mean do not have the propensity to transform the processing and packaging agricultural sector in the study area as indicated in Table 7. To support this findings, Marsh and Bugusu (2007) revealed that 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. According to Marsh and Bugusu (2007), 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. Packaging provides protection from chemical, biological, and physical influence on food.

CONCLUSION

The study therefore concludes that the use of plastic materials among agricultural enterprises in the study area is of immense importance to production, processing, storage, marketing and packaging activities. This study shows the beneficial relationship of selected plastic materials among agricultural enterprises in the study area.

Plastic material has multi-varied usage across different enterprises. Some plastic materials may have immense usage in one enterprise and be of no importance to another. This study therefore concludes that the utilization of plastic materials in agricultural production among agro-enterprise owners in Cross River State, Nigeria is mostly beneficial.

RECOMMENDATIONS

From the findings of the study, the following recommendations were made;

1. Policymakers should implement regulations and incentives for sustainable plastic use to improve the income of enterprise owners through the isolation of plastic materials mostly used by farmers and implementation of the policy strategy on sustainable use.

2. Government, investors, entrepreneur should study the trend in plastic materials usage among these agro-enterprises and seek out ways to model, re-invent and invest in these materials to modernize the agricultural plastic industry. Government should provide subsidies for eco-friendly alternatives for farmers to adopt sustainable plastic alternatives.

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