Modernization of fishing gears through recycling plastics

CHAPTER 1

1.0 Introduction

Plastic is a synthetic organic polymer made from petroleum with properties ideally suited for a wide variety of applications including: packaging, building and construction, household and sports equipment, vehicles, electronics and agriculture. Over 300 million tons of plastic are produced every year, half of which is used to create single-use items such as shopping bags, cups and straws. If discarded improperly, plastic waste can harm the environment and biodiversity.**At least 14 million tons of plastic end up in the ocean every year**. Plastic debris is currently the most abundant type of litter in the ocean, making up **80% of all marine debrisfound from surface waters to deep-sea sediments**. Plastic is found on the shorelines of every continent, with more plastic waste found near popular tourist destinations and densely populated areas. The **main sources of plastic debris found in the ocean are land-based**, coming from urban and storm water runoff, sewer overflows, littering, inadequate waste disposal and management, industrial activities, tyre abrasion, construction and illegal dumping. Ocean-based plastic pollution originates primarily from the fishing industry, nautical activities and aquaculture (https://www.iucn.org/resources/issues-briefs/marine-plastic-pollution)-5-4-2022)

Plastic pollution, accumulation in the environment of syntheticplastic products to the point that they create problems for wildlife and their habitats as well as for humanpopulations. In 1907 the invention of Bakelite brought about a revolution in materials by introducing truly synthetic plastic resins into world commerce. By the end of the 20th century, plastics had been found to be persistent polluters of many environmental niches, from Mount Everest to the bottom of the sea. Whether being mistaken for food by animals, flooding low-lying areas by clogging drainage systems, or simply causing significant aestheticblight, plastics have attracted increasing attention as a large-scale pollutant. Since synthetic plastics are largely non-biodegradable, they tend to persist in natural environments. Moreover, many lightweight single-use plastic products and packaging
materials, which account for approximately 50 percent of all plastics produced, are not deposited in containers for subsequent removal to landfills, recycling centres, or incinerators. Instead, they are improperly disposed of at or near the location where they end their usefulness to the consumer.
Indeed, landscapes littered by plastic packaging have become common in many parts of the world. (Illegal dumping of plastic and overflowing of containment structures also play a role.) Studies from around the world have not shown any particular country or demographic group to be most responsible, though population centres generate the

most litter. The causes and effects of plastic pollution are truly worldwide.(https://www.britannica.com/science/plastic-pollution, Mar. 30, 2022, 3:27 PM ET, 5.4.2022)

1.1 Contextual review

Global production of plastic has increased dramatically in the past 70 years, from 1.9 million tons in 1950 to 336 million tons in 2013. (Jones, 2015). It is estimated that 4 percent of the world's annual consumption of petroleum is used as feedstock for plastic , and more than one third of plastic are consumed as packaging that is discarded quickly (Thompson, Moore, Vom Saal, & Swan, 2009). Production of plastic around the world has grown by an average of 8.7 percent per year from 1950 to 2012; and since the 1970s, plastic has been replacing glass metals and paper in automotive and packaging applications (Johnson, 2015). As size of the global middle class continues to expand, consumption of plastic will also grow. It was estimated that consumption of nine major thermoplastic would grow by 4.5 percent annually from 2013 to 2017 or by more than 40 million tons (Galie & Trabucchi, 2013).

According to FAO report (2020), Uganda had only 30% of the forestland or about 1.5 million hectares or 7% of the total land area. With deforestation estimated at**1% per annum**, this area was estimated to reduce to about 1.2 million hectares in 2020. The constant encroachment on forest land raises risks of climate change, and distortion of aquatic environments due to the significant contribution of forests to the water cycle and key roles as acclimate buffer.

The fisheries sector strongly characterized by subsistence fishery levels has a high demand for wood as the major raw material for boat building. Almost all of the processed and exported fish from Uganda is from Lake Victoria. Primary production of fish is generally done on a relatively small-scale, as most of the fishing is carried out using small, wooden (plank-built) boats about six to eight meters in length propelled by oars or, in an increasing number of cases, a petrol engine fastened to the back of the boat. These simple boats are sufficient to carry fishermen to and from the fishing grounds with full loads of fish. There are an estimated 250,000 artisan fishermen (136,000 on Lake Victoria), while nearly a million people (700,000 around Lake Victoria) benefit from fishery-related activities like local fish-processing, fish trade, boat-building, industrial fish-processing, net-making, trade in fishing equipment, fisheries research, extension services and administration (USAID, 2002). The latest PEAP (2004-7) estimates indicate that 1.2 million Ugandans depend on fishery-related activities (PEAP, 2004: 78).

Other causes of increased forest land encroachment include but not limited to; high demand for wood fuel and charcoal, and furniture subsector (UBOS Report-2020, Uganda Wood and Forest Resources Accounts.indd).

Plastic consumption with poor waste management has contributed great to pollution and modification of aquatic ecosystems informs of micro plastics, debris, floating plastic whish are distributed across the water zones from top surface to benthic zone. Plastics are largely derived from fossil fuels and continue to emit greenhouse gases (GHGs) at each stage of their life cycle, from extraction up to and including their EOL (Zheng and Suh, 2019). Plastic production increased from two million metric tons (Mt) in 1950 to an estimated 380 million Mt in 2015, a compound annual growth rate of 8.4% (Geyer et al., 2017). The demand for plastics illustrates the need for cheap, lightweight materials in our day to day lives. However, global growth in demand for plastics is set to continue as economies develop further. (Hamilton et al., 2019). The contribution of plastic to climate change can be categorized in three ways: 1) plastic production, transport and use; 2) plastic disposal, mis-managed waste and degradation; and 3) bio-based plastics.

1.1.1 Legal framework for water resources management in Uganda

According to Echookit Akello., *2007,* the Government of Uganda developed a National Environment Action Plan (NEAP) between 1991 to 1994. The NEAP provided a framework for addressing gaps in environment management as well as a strategy for integrating environment into the national socio-economic development. One of the outcomes of the NEAP was the formulation of the National Environment Management Policy (NEMP) of 1994. The overall Goal of the NEMP is sustainable social and economic development which maintains or enhances environmental quality and resource productivity on a long term-basis that meets the needs of the present generations without compromising the ability of future generations to meet their own needs. This policy goal has informed subsequent policies such as the 2004/5- 2007/8 Poverty Eradication Action Plan (PEAP) and the Plan for the Modernisation of Agriculture (PMA). As a result, environmental management is now a key criterion for national socio-economic development decisions.

1.1.2 The constitution of the republic of Uganda (1995)

The constitution of Republic of Uganda is the supreme ruling that lays the foundation for all the laws that have a bearing on water and environment and provides for environmental protection and conservation. The constitution (Article 39 and 17) further provides for the right to a clean and healthy environment, but states that it is the duty for every citizen of Uganda to create, protect and maintain the environment. To promote sustainable development and public awareness of the need to manage water resources

in a balanced and sustainable manner and utilization of water resources in a way that would meet the development and environmental needs of present and future generations are also stipulated in the constitution.

1.1.3 The National Environmental Management Policy, (1994)

The overall goal of the National Environmental Management Policy is to promote sustainable economic and social development that will meet the needs of the present generation while being mindful of the needs of future generations. The specific policy objectives are to introduce; Sound environment management; Environmental planning; Ecosystem conservation; Sustainable resource consumption and; Environmental awareness and community participation.

1.2 Conceptual perspective

The project aims to raise awareness on how much plastic ends up in the aquatic zones and how plastic pollution affects us all, share the value of repurposing plastic waste and bring an end to single-use plastic, in line with SDG 9 (industry, innovation and infrastructure), SDG 12 (responsible consumption and production), SDG 14 (life below water) and SDG 15 (life on land). The boat created using locally available resources and low-tech solutions, underscoring the potential for its ideas and techniques to be easily emulated. According to the UN Environment Programme (UNEP, or UN Environment), only 9 percent of the 9 billion tonnes of plastic the world has produced has ever been recycled. The majority of plastics are thrown away after a single use, resulting in billions of tonnes of plastic that ends up in landfills and in the environment. This aquatic debris threatens ecosystem viability, economic development and food security. UNEP's Clean Seas Campaign engages governments, the public and private sector in the fight against marine pollution. The project is focusing on 'Innovative Solutions for Environmental Challenges and Sustainable Consumption and Production.

Vergara & Tchobanoglous (2012) reported that proper planning and control is required in other to prevent the negative impact of waste on the environment as per **fig 1.** As a result, Ghiani et al. (2014) added that, a proper organization of solid waste management has become an essential task needed to safeguard the environment. Demirbas (2011) suggested that the main reason for managing waste is to ensure a safe environment.

Figure 1; waste management levels

A green and blue economy is characterized where economic value and growth is maximized while managing all natural assets sustainably. Achieving a green economy means the transformation of the whole economy in terms to what is produced and used, who produces and uses it, and how it is disposed off.

The recycle concept is adopted in the concept which works on principles of a circular economy where something seen as waste and turning it into something of Value. By helping to clean up the local environment and improving living conditions for communities – local businesses can also make money – it's a win-win situation for everyone involved.

The circular economy is a production and consumption model that seeks to ensure that materials remain in the economy longer, reducing the use of virgin raw materials and the generation of waste and consequently reducing damage to society and the environment. The circular economy is based on the durable design, maintenance, repair, reuse, remanufacturing, restoration and recycling of products.

The proposal of adoption of plastic recycling in boat making is looking at balancing the livelihood incomes, environmental protection and economic development through SMART technologies in the fisheries sector.

Wooden boats that are greatly used in the artisanal fishery are exposed to various disadvantages as follows; -

- Some wooden boats have issues with wood rot.
- Wooden boats overall require a high level of maintenance.
- Damage to the caulk between seams on the hull of wooden boats is common.
- Metal fasteners that hold wooden boats together can rust and fail.
- Hazards and poor maintenance can damage the hulls of wooden boats.

Adoption of SMART technology using plastic boats will greatly; -

- Reduce on maintenance costs by fisher folk
- Loss of boats due to rot and soft wood breakage
- Contribute to environmental protection through plastic monetary driven collection strategy
- Contribute to Climate change mitigation as a result of greenhouse gasses from plastic
- Reduceafforestation for sources of timber and mitigate climate change and its effects resulting from vegetation loss

1.3 Problem statement

High operational costs greatly influence the profit margin of fisheries SME businesses in the fisheries sector. Specifically the costs are attributed to poor fishing gears and high maintenance costs of the operational gears (boats). These cost are derived from closing of boat holes, breakage of boat wood due to old age, infestation by termite, and strong waves that weaken the boat wood. This generally grants the wooden boats being expensive in the long run.

Improper handling of plastic waste and indiscriminate disposal in open spaces, and aquatic zones, gives rise to numerous potential risks to the environment. For the public, the main risks to health are indirect and related to poor water, land, and air quality. In addition, infrequent collection of waste provides an attractive breeding ground for flies and mosquitoes in fishing communities

In the fishery, the most visible impacts of plastic debris pollution are the ingestion, suffocation and entanglement of hundreds of water species. Aquatic wildlife such as fish mistake plastic waste for prey; most then die of starvation as their stomachs become filled with plastic. Micro plastic pollution results after the exposure of the wastes to pressure forces from sunlight, wind, and wave action that break down plastic waste into small particles, often less than one-fifth of an inch across. These so-called micro plastics are spread throughout the water column and have been found in every corner of the globe. Gradually the micro-plastics end up into human consumption through bio-accumulation and magnification and their related effects.

Some key facts:

- Half of all plastics ever manufactured have been made in the last 15 years.
- Production increased exponentially, from 2.3 million tons in 1950 to 448 million tons by 2015. Production is expected to double by 2050.

- Every year, about 8 million tons of plastic waste escapes into the oceans from coastal nations. That's the equivalent of setting five garbage bags full of trash on every foot of coastline around the world.
- Plastics often contain additives making them stronger, more flexible, and durable. But many of these additives can extend the life of products if they become litter, with some estimates ranging to at least 400 years to break down.

1.4 Justification and significance

The creation of easily manageable, and low costed boats with minimal maintenance costs will greatly reduce on costs incurred by boat owners.

Post-Consumer Plastic Waste causes severe environmental impact is much greater than any other waste material. This material i.e. 'thin' polythene when discarded after use (20 and less micron thickness) will remain in the soil for at least 100 years (Dangalla, Chandrasena, Semasingha, & Amarasingha, 2013). The problems they create are numerous According to world surveys by every ten years the plastic consumption increases by three times. This poses a great challenge as well as a threat to the environment.
Life-cycle analysis can be a toolin creating potential benefits through recycle programs. If recycled plastics are used to produce goods that would otherwise have been made from new (virgin) polymer, this will directly reduce oil usage and emissions of greenhouse gases associated with the production of the virgin polymer (less the emissions owing to the recycling activities themselves).

Uganda's fishing sector strongly relies on wooden boats which puts forested areas/vegetation at a constant risk of deforestation for sources of timber despite the less efforts in regenerating the vegetation cover. FFOU therefore believes that development of modern technologies from the potential waste pollutants in the sector will help reduce aquatic environment pollution and its associated impacts of modification of ecological zones, environmental degradation andclimate change. The project will further reduce on high costs by fisher folk on boat purchase and maintenance.

1.5 Objectives

1.5.1 Main Objectives

To develop SMART environmental friendly fishing technology

1.5.2 Specific objectives

- To manufacture 500low cost plastic boats for fishing communities

- To train 1000 fisher folk on aquatic environmental governance and management
- To train 1000 fisher folk on SMART fisheries production technology
- To plant 2,000,000 trees across the 15 districts of L.Victoria

1.5.3 Expected Key outputs

- 500 model boats manufactured and distributed across districts of L.Victoria by end of 2023
- 1000 fisher folk trained on SMART fisheries production technology
- 1000 fisher folk trained on aquatic environmental governance and management
- 2,000,000 trees planted across districts of L.Victoria by end of 2023.
- Reduced plastic pollution among landing sites by 50%
- 30% reduction in use of wooden boats by end of 2023.
- 50% reduction in boats maintenance costs among 500 model fisher folk.

1.6 Scope

1.6.1 Technical

The project will address three areas as follows; -

I. Theoretical knowledge delivery on SMART fisheries production technology and aquatic environmental governance and management
II. Low cost plastic boats (LCPB) production and distribution among the fisher folk
III. Environmental restoration through re-afforestation of lake buffer zones
IV. Sensitization on environmental protection

The project will embrace a multi discipline holistic approach

1.6.2 Geographical

The project phase is to be implemented across the 15 districts of L.Victoria. This includes the Eastern, Central and Western region across the Lake.

1.6.3 Time

The project will be implemented for a period of 2 years. This will include a 3 phased approach on implementation.
The first phase will include development of the designs with appropriate modifications that suite the fishing activities and actual manufacture of first models for testing on the Lake. The phase will also involve trainings to fisher folk on smart technology adoption across the fisheries value change.

The second phase will involve the mass production and distribution of the boats across the districts of L.Victoria. This will also include trainings on clean production energy in the fisheries sector.

The third phase will involve various activities of increased awareness creation and marketing of the technology. This will involve forestation activities which may be distributed across the project phases.

1.7 Target groups and beneficiaries

1.7.1 Fisher folk

The project is targeting mainly the fisher folk and their communities. These are potential buyers for the plastic boats and community members that operate in the water transport sector.
The group will further receive trainings in the various areas of SMART technology and energy consumption and use.

1.7.2 Aquaculture farmers

The project also targets the aquaculture subsector as a potential market where the boats can be used on fish farms.

1.7.3 Plastic recycling plants

The group will benefit through increased market for their recycled plastic raw material thus increased revenue.

1.7.4 Plastic collectors

These are indirect beneficiaries to the project. The group involve in the plastic collection and cleaning thus earn directly from plastic collected and supplied to the recycling factories.

1.8Implementation Approaches

The concept of Blue Economy (BE) which is recognized as central for sustainable development. The BE incorporates socio-economic benefits and ecological conservation. The BE initiative in Africa accentuate the involvement of local communities and promote sustenance of the natural ecosystem in terms of the sustainability balance among ecological, social and economic aspects.

Co-management approaches, where key stakeholders will be involved in the project implementation levels.Stakeholder participation is widely considered aprecondition for sustainable processes (Bossel, 1999; Empacher and Wehling, 2002). It attenuates conflicts and taps the potentials of ecosystem user knowledge to contribute to sustainable solutions.

The project is a multi-discipline project that will ensure fisher folk are introduced to the concepts of building SMART fisheries technologies that eco-friendly balancing the two aspects with social economic demands. This will help promote efficiency and effectiveness in production.

CHAPTER 2

2.1 Boat manufacture and molding

2.1.1 Development of boat designs

The designs will be developed to suite market and sectoral demands as allowed to carry out fishing activities the Lakes of Uganda. This will also involve determining the appropriate buoyancy for the products, carrying capacity, length and width as deemed appropriate for the sector.

The process will also involve stakeholder involvement (fisher folk) to analyze the key challenges of using wooden boats to enable designing of boats with better flexibility, fish storage facilities, lighting abilities, and any other recommended features.

The designs will be developed by a consultant with experience in marine navigation

2.1.2 Moulding container manufacture

A moulding container gives shape to the plastic pellet that is moulded under exposure to heat. This will be made of a metallic material with the specified measurements of the required boat.

2.1.3Processing of New Life (Extrusion Processing) – Plastic Boat

Here is the model that is proposed for boat reprocessing:

i. Acquisition of new plastic pellets/shreds from recycling plants; These area crushed or shredded pieces of plastic that can be molded to any shape as deemed required.
ii. Moulding of the boat; The plastic will be moulded by aid of a moulding container with the shape of the intended boat design.Moulding is another process to get it the plastic material scaled-up.

2.1.4 Boat testing

The final boats will be tested to define and asses the pressure containment, floating buoyancy, and weight capacity.

The tests will be carried out for all boats produced to ensure stability on water, and no leakages.

2.1.5Types of plastics to be used

The 2 types of plastics to be used will include; Polyethylene terephthalate (PET/PETE) and High density polyethylene (HDPE). The plastics industry has voluntarily devised a coding system which makes recycling plastics easier. Table 1 shows these 6 types of plastics with their identification code, general properties and common uses.

Table 1: Plastic types, identification codes, general properties and common uses

Type of plastic	Identification code	General properties	Common uses
Polyethylene terephthalate (PET/PETE)	PET	Clear Hard Tough Barrier to gas and water Resistance to heat Resistance to grease/oil	Mineral water bottles 2 liter soda bottles Cooking oil bottles Powder detergent jars Fibre for clothing Fibre for carpets Strapping Peanut butter jars
High density polyethylene (HDPE)	HDPE	Barrier to water Chemical resistance Hard to semi-flexible Strong Soft waxy surface Low cost Permeable to gas Natural milky white colour	Jerry cans “Crinkly” shopping bags Film Milk packaging Toys Buckets Rigid pipes Crates Bottle caps

Sample Models for First Production-Ongoing

Figure 2; Small size vessel for fish farms

Figure 3; Proposed look of a plastic fishing boat

2.2 Trainings on SMART fisheries technology and Environmental governance and management

Recently, most fisher communities have been using rudimental methods of fisheries production. This lies strongly in the SMESs that majorly engage in activities like fish smoking, and forest encroachments. The technologies used promote less efficiency and effectiveness.

Therefore, this projects looks at introducing basic technological skills to the fisher groups and why they are important in the areas of improving production efficiency with reduced production costs, minimal energy consumptions, and eco-logical conservation.

The content of delivery will be developed by a consultant hired to produce a guiding document for the trainers.

2.2.1 SMART fisheries technology;

This will involve 1000 fisher folk trained on SMART fisheries technologies. The technologies will target thematic areas of 1) Energy consumptions 2) Processing and preservation 3) Artisanal fisheries

Each thematic area will be trained for a period of 4 days in every community of delivery. Each region along L.Victoria having 11 groups of 30 people per training. A total of 33 groups will be made across the three region. Atotal of 132 days will be used to deliver the training across the 3 regions.

The trainings will be delivered at the operational areas of the fisher folk.

2.2.2 Environmental governance and management

Most programs fail in various geographical scopes due to inadequate co-management approaches. The module will look at introducing health business environmental operation with sustainability in the fisheries sector. Additionally the trainings will involve basic introduction to climate change to all fisher folk.

The trainings will be delivered to all the 1000 fisher folk with 11 groups of 30 people per training. A total of 33 groups will be made across the three region. A total of 132 days will be used to deliver the training across the 3 regions.

2.2.3 Tree planting activities

Approximately 2,000,000 tree seedlings will be planted along L.Victoria. The trees will be planted across the three phases of the project. 666,666 trees will be planted per phase across all regions.

Seedlings will be procured from certified tree producers.

Additionally 2,000,000 T-Shirts will be distributed across fisher folk in the sector as an information dissemination strategy.

CHAPTER 3

3.1 Sustainability plan

The project will be self-sustaining in various aspects; -

- Constant demand of boats by fishing communities will contribute to the potential existing market for the boats.
- Revolving funds by boat sales which is estimated to be lower than the price of a wooden boat. The boats will be slightly cheaper than the wooden boats and in case of old aging of the boats, these will be recollected and recycled at top up rates rather than wholesome payments of the new boat.

- Potential supply of plastic material due to constant residue from municipal waste and fuel bi-products.

3.2 Waste management plan

- Plastic has a longer life span as compared to the wooden boats and in case of old age for the boats, these will be resupplied to recycling plants for remodeling and remanufacture

A reuse and recycle plan will be adopted for the project as a control strategy for the potential wastes from the boat production and old used boats, where an old boat is brought back to the company by a fisher folk, sold at a subsidized cost and top up for a new boat.

Attached financial fee on the plastic waste will greatly lure fishing communities and general public onto co-management approaches of ensuring collective action towards collection and management of plastic waste.

3.3 Monitoring and evaluation

The project will be monitored at all levels of implementation by the Federation and GIZ-RFBCP. This will enable promotion of more efficiency and effectiveness of the implementations.