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**THE INSTITUTIONAL, ECONOMIC, AND ECOLOGICAL
SUSTAINABILITY OF PLASTICS RECYCLING
IN PAPUA NEW GUINEA**

by

Henry Koi

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ACRONYMS

DEC	Department of Environment and Conservation
FIVE Rs	Reduce, Reuse, Recycle, Recover, and Rethink
NAL	National Analysis Laboratory
NARI	National Agriculture Research Institute
NCD	National Capital District
NCDC	National Capital District Commission
NGO	Non-Government Organisation
NRI	National Research Institute
PET/PETE	Polyethyleneterephthalate
PNG	Papua New Guinea
PNGUOT	Papua New Guinea University of Technology
PVC	Polyvinyl Chloride
UNCED	United Nations Conference on Environmental Development
UN	United Nations
UPNG	University of Papua New Guinea
WCED	World Convention on Environmental Development

CHAPTER 1: DEFINITIONS AND CONCEPTS OF SUSTAINABILITY

Introduction

The deliberate and careless disposal of plastics is a growing concern in Papua New Guinea. Koi (2005) discusses the environmental impacts of plastics, and the different waste management alternatives, including the 5Rs – reduce, reuse, recycle, recover, and rethink.

This discussion paper deliberates on whether the recycling of plastics, as a component of waste management, can be institutionally, economically, socially, and ecologically sustainable in Papua New Guinea.

It focuses on the current sustainable programs, and identifies indicators that can be used to measure the progress, or failure, of the programs towards sustainability. For example, a plastics recycling facility has been established in Lae, Morobe Province, and recently, PNG Recyclers have been buying Coca Cola PET bottles for recycling.

This chapter defines the terms ‘resource’ and ‘sustainability’, and how to measure sustainability. Chapter 2 examines the different recycling processes, looks at problems associated with recycling, and analyses how recycling can be linked to institutional, economical, social, and ecological sustainability. Chapter 3 looks at the current manufacturing, importing, and recycling processes, and the number of plastics disposed of in landfills and dump sites, on a daily and weekly basis.

Chapter 4 discusses what needs to be done to make plastics recycling sustainable in PNG, while Chapter 5 offers some recommendations.

Resource

The word ‘resource’ is defined as ‘useful substances that are obtained from the environment to meet basic human needs and wants’. Although a resource is a basic necessity to sustain life for almost all living organisms, the human perspective of the word has assumed an additional role – to advance material well-being (Robertson, Forbes, and Hollier 1990).

Sources of economic wealth, such as land, minerals, fossil fuel, and labour are considered to be resources. The usefulness of a resource is dependent on contemporary levels of technology. What may be regarded as a resource in a particular place and time, may not be so at a different or corresponding time. If a resource is of no use to humans, it is termed ‘neutral staff or stock’ (Mowbray 2001). Plastics are useful to society, and are categorised as a resource.

Some resources are readily available for direct use, while others can only be used after technology is applied and they are manufactured. Resources can be classified as *perpetual, potentially renewable, or non-renewable*.

2 *Plastics Recycling in PNG*

- **Perpetual:** The ability of a resource to be continually renewable after use. Examples include solar energy, sunlight, freshwater, and fresh air;
- **Potentially Renewable:** The process whereby a resource is naturally replaced over a period of time, on the condition that it is not used faster than it can be replenished. The period of a resource's natural replacement varies. For example, the time it takes to replace trees that have been harvested for timber is longer than the time it takes for nature to replenish grass that was cut to be used as roofing material for a house. Plastics can be a potential renewable resource, if recycling programs are fully implemented; and
- **Non-renewable:** A naturally occurring finite resource that cannot be renewed once it has been consumed. Most non-renewable resources may be renewed over a geological time scale. Most plastics in use today are made from oil, which is a non-renewable resource.

Sustainability

'Sustainability' is derived from the word 'sustain', which means 'to be able to support, or continually use (a resource) without exhausting it'. According to Diesendorf and Hamilton (1997), the action of careful, deliberate, and considerate resource calculation for present use, with the intent of preserving for continual future use. Terms such as institutional, economical, social, and ecological sustainability are also defined.

Institutional Sustainability

The word 'institute' is often used to describe a society or an organisation that promotes scientific, educational, social, or commercial activities. The terms 'institution', 'institutionally', and 'institutional' are derived from institute.

The term 'institutional sustainability' describes the mechanisms that are available through government institutions, the private sector, and civic society to implement economic, social, and ecological sustainability. Relevant government agencies include the Department of Environment and Conservation (DEC), the Department of National Planning and Monitoring, non-government organisations (NGOs), the private sector, and civic society. The term is also used to assess capacity, or means to continuously implement recycling programs, to ensure economic, social, and ecological sustainability.

Economic Sustainability

The word 'economic' is derived from 'economics'. Economics is the science concerned with the production and consumption of goods and services. It also refers to the sufficiency in getting a good return for money spent.

'Economic sustainability' is the ability to continuously produce wealth by using other wealth. The wealth that is produced is known as 'total stock' or 'capital'. Other forms of wealth that are used to produce total stock or capital are natural capital (environment or natural resources), manmade or physical capital (infrastructure),

human capital (knowledge and skills), and social capital (cultural aspects, and social networks such as the *wantok* system). For sustainability, the aggregate or capital stock should not decline.

The term 'economically sustainable plastics recycling' is used to ascertain how much money is generated through the recycling of plastics, and whether other centres can engage in recycling, apart from Port Moresby and Lae. Institutional (physical and human capital), social (social capital), and ecologically (natural capital) sustainable measures that encourage or discourage economic sustainability are also discussed.

Social Sustainability

'Social' is a term that is used to describe an organised community of people. The word 'socially' is derived from social.

The term 'social sustainability' describes how a society lives or practices their way of life over a period of time, through institutional, economic, and ecological changes. It also refers to practices that are accepted by a society, and passed on through generations. In order for a society to be sustainable, their practices or ways of doing things must be maintained. A good example is the *wantok* system in Papua New Guinea.

The term is used in this paper to analyse whether the different societies that coexist in the country will benefit from the recycling of plastics. It also explores the existing arrangements of the various societies, and their relationships with each other, the government, and other organisations, to determine whether there will be cooperation in sustaining a plastics recycling program in Papua New Guinea.

Ecological Sustainability

The word 'ecological' is derived from the word 'ecology' which refers to the study of living things, and their relationship to one another, and their physical environment (Mowbray 2001). In the broadest sense, 'ecology' is the study of living things and how they exist in their natural environment.

The term 'ecological sustainability' refers to the continuous existence of living things, and their relationship with one another, and their non-living surroundings, over a period of time. Ecological sustainability also refers to the environment, with emphasis on biodiversity and environmental quality. Economic sustainability emphasises the allocation of resources, and levels of consumption, where financial value is the key element (total capital). On the other hand, ecological sustainability places emphasis on maintaining the natural or physical capital, and ecological integrity, through institutional, economic, and social sustainability. The careless disposal of plastics is a threat to ecological sustainability.

Box 1: Conceptual Background: How the Concept of Sustainability Emerged

The concept of sustainability became known as a result of publications such as 'Silent Spring' (Carson 1962), and other authors such as Mishan (1967). These books raised public, political, scientific, and economic concern about the environment. This led to the UN Conference on the Human Environment in Stockholm 1972.

During 1972, a book titled 'The Limits of Growth' (Meadows 1972) created controversy when it revealed that resource and environmental growth in the future would be limited, if the current patterns of population growth, food production, and resource depletion continued unchanged. A world model that was created by Meadows suggested that industrial capital would start to depreciate faster than new investment would rebuild, and as a result, ecological and economic collapse was imminent.

In the 1970s and 1980s, the number of community-based environmental organisations rapidly increased, and to an extent, they influenced government decisions. These organisations also succeeded in arousing public concern, and gained political recognition.

Publications by Brandt (1980) and Palme caused the United Nations to set up the World Commission on Sustainable Development in 1983. After the publication of its report, 'Our Common Future' (the Brundtland Report, named after its chairperson Gro Harlem Brundtland), the concept of sustainable development was further boosted (WCED 1987).

The report described sustainable development in a number of ways, with the popular quote being:

Sustainable development is development that meets the needs of the present, without compromising the needs of the future generations to meet their own needs.

As a result of the United Nations Conference on Environmental Development (UNCED), the following non-binding agreements were declared by all member countries:

1. The Rio Declaration on Environment and Development which was initially known as the Earth Charter or Global Strategy for Sustainable Development in the Twenty-first Century.
2. Agenda 2, which is a large detailed action plan, that is not legally binding, but is a strategy for global sustainable development in the Twenty-first Century.

Box 1 (continued)

3. The Framework on Climate Change, which is legally binding and has strong ultimate objectives, but contains no legally binding targets for greenhouse gas emissions
4. The Convention on Biological Diversity, which recognises the sovereign right for States to exploit their own natural resources, while ensuring that they do not exploit the environment of other states. It is also legally binding
5. Statement of Forest Principle, which looks into a standard or code of acceptable practice for the logging industry
6. Establishment of the Commission on Sustainable Development
7. Initiation of the National or Local Sustainable Development Strategies
8. Initiation of actions (international and local) resulting from the implementation of Agenda 21 (Diesendorf and Hamilton 1997)

Measuring Sustainability

According to Morse and Bell (1999), two questions must be answered to achieve sustainability:

- over what space can sustainability be achieved; and
- over what time can sustainability be achieved.

Space

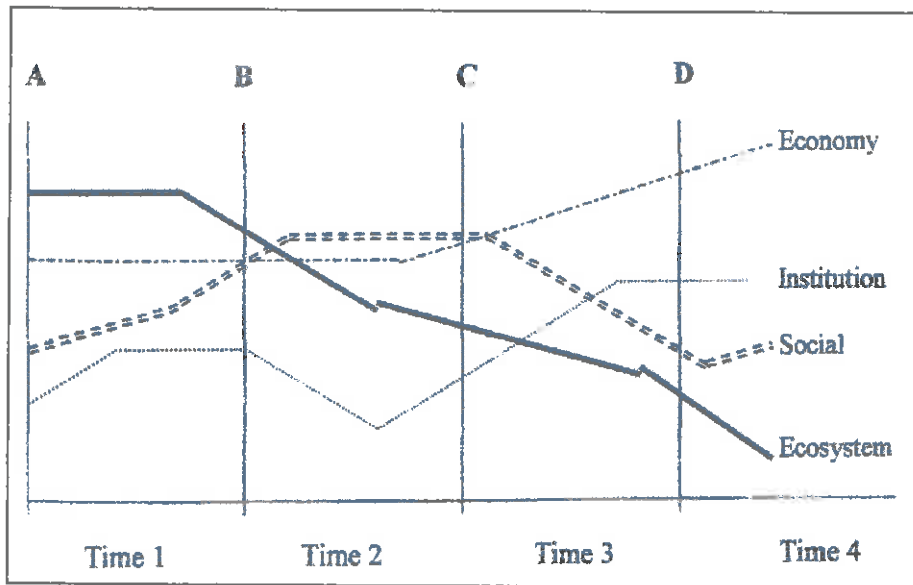
The space scale of plastics recycling in Papua New Guinea would most likely be concentrated in urban centres such as Port Moresby, Lae, and Mount Hagen because of demographic and economic factors. A branching out of operations into other urban centres will depend on the sustainability of the institutional, economic, social, and ecological components of plastics recycling.

There is no definite space between the urban and rural areas, because what happens in the rural areas affects what happens in the urban areas, and vice versa.

Time

The time scale is another factor in achieving sustainability. Different components of sustainability require different time scales. The plastics recycling time scale is complicated because it has different components of sustainability (institutional, economic, social, and ecological), which are measured in different timeframes. For example, the time it takes to measure economic impacts as a result of recycling may be quarterly over Phase 1, while social impacts may be measured over a period of five years. The Phase 1 period may extend over a period of 10 years.

Figure 1: Measurement of Space and Time in Sustainability



One cannot determine the quality of life in Papua New Guinea using plastics recycling alone. As much as plastics recycling is one component of institutional, economical, social, and ecological sustainability, it is also an important component of the quality of the environment.

Sustainability can be measured, over space and time, by using indicators on institutional, economic, social, and ecological concepts (see Box 2). Attempts to measure any physical, biological, chemical, and socioeconomic characteristics of a system can be thought of as an indicator (Forner 1998).

Box 2: Measuring Sustainability

Institutional Indicators

Institutional indicators of a society that are considered to be effective are shown by the political power used to develop, implement, and enforce policies that facilitate environmental, economic, ecological, and social stability. It will also have the capacity to employ legal sanctions to induce industrial, agricultural, and natural resource development.

The availability and increase in the number of highways, vehicles per province, airlines, airstrips, airports, wharves, and main ports also indicate the sustainability of an institution.

Box 2 (continued)

Economic Indicators

Economic indicators may show high employment in the formal and informal sectors, low inflation rate, and minimal differences in income. Political stability and an increase in foreign investments are also indicators of economic sustainability.

The recycling of plastics in Papua New Guinea will generate employment opportunities in the formal and informal sectors. In the formal sector, people will be employed by the companies, and the government, while in the informal sector, the unemployed are given the alternative of earning an honest living.

Social Indicators

Social indicators may show a low crime rate, low prison population, no death penalties, high cultural diversity, high literacy rate, fewer homeless people, high life expectancy rates, and low mortality rates. There should also be equal gender participation.

Plastics recycling, as an economic incentive, will give rise to social standards or an improvement in the standard of living. People will be able to afford basic education and health services by selling plastics that have otherwise been disposed of. The government would be able to provide new services, or improve existing services which will benefit civil society.

Ecological Sustainability

Ecological indicators of a society include clean air, water, productive soil, high biological diversity, and ecosystem integrity.

Plastics recycling would reduce intentional and unintentional disposal practices, hence leading to a cleaner environment.

CHAPTER 2: CONCEPTS OF PLASTICS RECYCLING

Introduction

This chapter discusses plastics recycling and sustainability and also covers issues that were discussed in 'Plastics and Their Environmental Impacts' (Koi 2005).

Plastics recycling is defined as the process involving the collection, sorting, and reprocessing of plastics through chemical or mechanical means, in order to make new plastics (Arms 1990).

The Recycling Process

Plastics go through four stages in the recycling process – *primary*, *secondary*, *tertiary*, and *quaternary*. There are three processes in which plastics can be recycled – *mechanical recycling*, *feed stock recycling*, and *chemical recycling*.

Mechanical Recycling

Mechanical recycling is a process that recovers clean plastics for reuse in the manufacture of new plastic products. However, the mechanical recycling of plastics is not always practical.

The steps involved in the mechanical recycling process are:

- (a) the plastic that is destined for recycling is collected from a manufacturing site, a commercial operation seeking to dispose of bulk packaging such as pallet wrap, 'drop off' points such as schools, from residents, or via curbside collections;
- (b) it is transported to a recycling plant;
- (c) at the plant, plastics are sorted into the different types, ready for reprocessing;
- (d) the plastics are cut into flakes through a washing and drying process to remove dirt and other contaminants;
- (e) the flakes are then converted into reusable granules; and
- (f) the granules, or pellets, are used to make new plastic products.

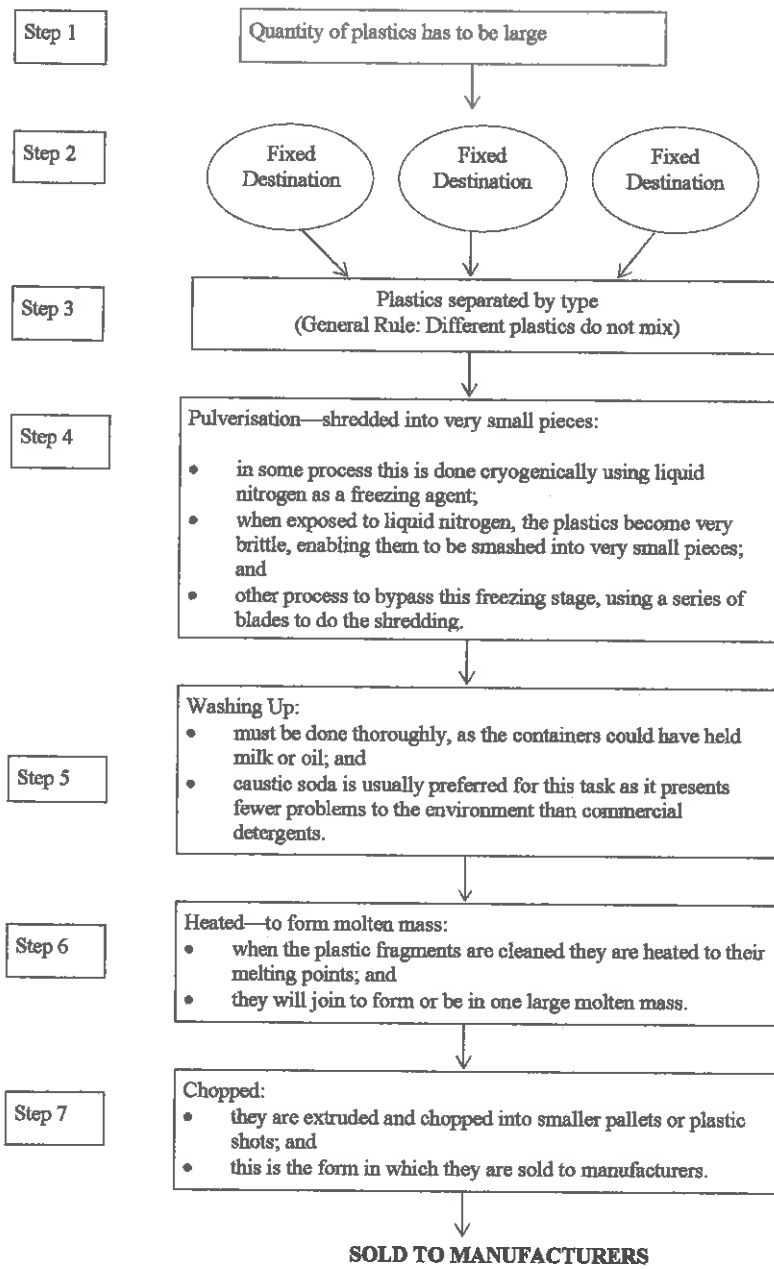
The chemical and feed stock recycling of plastics are advanced recycling technologies. Solid plastic materials are converted into smaller molecules using heat. These molecules are usually liquids or gases, or sometimes solids or waxes, and are suitable for use as feed stock for the production of new petrochemicals, and plastics.

These processes can be likened to separating a long freight train into individual carriages, and then putting the train back together, in a slightly different form, at a later time.

Technical and economic feasibility, and the commercial viability of advanced recycling methods must be considered in each step of the recycling chain. These technologies remain developmental, and have not been proven to be sustainable in a

competitive market. However, they remain of considerable interest because of their long-term potential.

Figure 2: The Plastics Recycling Process



Feed Stock Recycling

The term 'feed stock recycling' includes chemical recycling, and is often applied to the thermal depolymerisation of polyolefins, and substituted polyolefins (large molecules made up of the elements carbon and hydrogen, such as polyethylene) into a variety of smaller hydrocarbon molecules (intermediates).

These hydrocarbon intermediates are not like the chemicals that make up motor oil or gasoline. In some cases, additional polymers can be thermally depolymerised back to monomers to give a reasonably high yield. Examples of these are polystyrene to styrene, and polymethyl methacrylate to methyl methacrylate.

Chemical Recycling

Chemical recycling refers to depolymerisation through condensation, or polymers back to monomers, which are the basic building blocks from which plastics are made. The chemical recycling process can be described as:

Long-chain polymers can be treated chemically and/or thermally to break the chains into segments. When the treatment is done to recreate the chemicals from which the polymers were initially made, we call that feed stock or monomer creation. If the treatment breaks the polymers into an assortment of chemical species, the processor can decide whether to recover specific chemicals for feed stock use, use the assortment of chemical species for fuel, or use some combination of both products (<http://www.plasticsrecycling.com>).

Problems Associated with Plastics Recycling

Plastics are basically non-biodegradable, and therefore can be very useful. The ability of plastics not to easily biodegrade and rust is an advantage for domestic and the industrial users. However, it also poses problems. When a plastic item's usefulness expires, it is disposed of, but takes a long time to biodegrade.

Plastic waste disposal has become a sophisticated process. Although their unique properties make them suitable for particular applications, they cannot be treated the same way when they are disposed of. Their variety, shapes, and sizes, and unlimited quantity when used, and disposed of, creates problems. All the different types of plastics can biodegrade, but it is the period of biodegradability, and the chemical contents that have become a concern. The period of biodegradability for the different types of plastic products varies, but is longer than other recyclable products.

With a little bit of effort, most plastics can be recycled. In developed countries, the collection of plastics for recycling is increasing rapidly, but for a developing country, such as Papua New Guinea, there are barriers that must be considered.

Collection

One problem from the Papua New Guinean perspective is collection. Plastics are bulky, and cumbersome to collect, and society must be willing to dispose of plastics in

designated bins, or sell used plastics to recycling organisations. A lack of motivation and awareness also poses problems. Currently, there are no designated rubbish bins into which plastic waste can be disposed of in most urban areas. All kinds of rubbish are dumped into rubbish trucks from common garbage deposits. This situation will become a problem for current recycling programs when recycling is fully introduced.

Photograph 1: Household Waste Ready to Be Dumped in Landfills and at Dump Sites



Sorting and Separating

Different types of plastic must not be mixed for recycling. They have to be homogeneous in the mechanical recycling process. A small amount of the wrong type of plastic can ruin a melt. For example, polyvinyl chloride (PVC) bottles are difficult to tell apart from PET bottles, but one stray PVC bottle in a melt of PET bottles, can ruin the entire batch. For this reason, buyers of recycled plastics in developed countries always ensure that plastics are sorted before recycling.

Equipment for sorting plastics is being developed, but for the moment most recyclers employ trained personnel who manually identify and sort plastics. However, this is often expensive and time consuming.

Remains of Chemicals

Caution must be taken when using recycled plastics, because of possible traces of poisonous substances, such as cyanide. For example, in most parts of Papua New Guinea, PET 500 mL softdrink bottles are reused as cold water containers, while others are filled with chemicals, such as herbicides or vehicle fuel. Buyers of recycled plastics in developed countries are aware, and cautious, when buying recycled plastics.

Higher Costs

The cost of collecting plastics is relatively high. Plastics are a light substance, but have a larger mass, and the fuel required to transport it from a designated point of disposal to a recycling facility, is the same as transporting twice as much aluminium (for recycling), which has twice as much weight, and occupies less space. This makes the collection of plastics uneconomical when considering the cost of vehicle fuel.

Also, when glass, paper, and cans are recycled, they become similar products which can be reused, and recycled. However, with plastics recycling, there is usually only a single reuse (see <http://www.obviously.com/recycle>). Other materials that can also be recycled include batteries, aluminium (other), steel, motor oil, toxic chemicals (herbicides, other agriculture chemicals, paint), refrigerators, and computer printer cartridges. Most of these materials can be reused after being recycled, if they are disposed of carefully into the designated garbage collection bins, or sold to the respective recycling organisations.

Plastics recycling minimally reduces the amount of natural resources used to make plastics. On the other hand, paper, glass, and metal are continuously recycled, and save far more energy than plastics recycling.

These four problems have to be carefully studied and researched, if plastics recycling is to be successful in Papua New Guinea.

Importance of Recycling Plastics

Despite the problems involved in recycling, it also has advantages in relation to employment opportunities, new products, conserving resources, and reducing waste.

Employment Opportunities

Plastics recycling programs provide many employment opportunities. With the money earned, people can afford better health and education services. Recycling, in this perspective, can be seen as an economic incentive.

Opportunities for New Products

The recycling of plastics provides opportunities for the production of new plastic products. The general rule for recycling of plastics is 'plastics don't mix'. However, this is only applicable, if the intended new product will be the same as the former. Plastics can be mixed to produce a new product, for example, combining PET and PVC plastic bottles to produce plastic streetlight posts. New products can be produced by mixing different types of plastics.

Conservation of Raw Materials and Energy

Plastics recycling reduces the continuous exploitation of natural resources. Consequently, the environment is conserved as a result of recycling.

Reducing Landfill Requirements

The recycling of plastics reduces the amount of waste material that is dumped into landfills, which frees up more land, and reduces negative impacts on the environment.

Photograph 2: Household and Industrial Waste Dumped Indiscriminately at Baruni Dump, outside Port Moresby.



Plastics Recycling and Sustainability

Plastics recycling is important for economic, social, and ecological reasons. The main issue is whether recycling can be economically sustainable. In order for economic, social, and ecological sustainability mechanisms to be studied and tried, there need to be laws and organisations in place, to provide guidance and direction. Existing organisations and their functions, as well as existing litter laws need to be studied, and readjusted, or new laws introduced to encourage sustainability. These laws and the functioning of these organisations have to be realistic and sustainable, over time.

Plastics recycling is a process in which institutional, economic, social, and ecological factors contribute directly or indirectly to its successful operation and accomplishment. The objective of analysing the results of the institutional, economic, social, and ecological components, using a set of indicators, is to promote ecological

sustainability through plastics recycling. This can only be attained if there is institutional, economical, and social sustainability in the recycling process. Each of these components are not isolated, and directly or indirectly affect the existence of the other, the recycling process, and the ecological sustainability of the environment.

Conclusion

There are different types of plastics recycling processes and programs. Some of these have already been introduced into Papua New Guinea, and the problems, as well as the importance of such facilities, need to be carefully assessed. In order for these programs to be successful in the long term, institutional, economical, social, and ecological sustainability have to be encouraged, with the focus on the current situation, as well as the future.

CHAPTER 3: MANUFACTURING AND RECYCLING PLASTICS IN PAPUA NEW GUINEA

Introduction

Plastics are either manufactured in Papua New Guinea or imported from overseas. Companies that are involved in the manufacturing of plastics include WH Industries, Color Pak Limited, KK Kingston, and Pacific Plastics. Color Pak Limited and WH Industries are local manufacturers.

The number of plastics importers in Papua New Guinea increased from about 400 in 2000, to 500 in 2003 (Internal Revenue Commission 2004). These importers included individuals, small businesses, government departments, NGOs, and large corporations. The types and quantities of plastics varied. A total of 15 538 200.08 tonnes of plastics were imported between 2000 and 2003 (*ibid.*). In addition, a total of K37 233 171.86 was spent on the importation of plastics during the same period (see Table 1).

Table 1: Quantity of Plastics Imported into Papua New Guinea, 2000 - 2003

Year	Quantity (tonnes)	Value in Kina
2000	11 533 273.24	20 270 352.46
2001	397 868.20	2 177 759.00
2002	318 627.14	929 692.75
2003	3 288 432.50	13 855 367.65
Total	15 538 200.08	K37 233 171.86

Source: Internal Revenue Commission, 2004.

Color Pak Limited estimates that the company produces 70 million plastic shopping bags, ranging from extra small to extra large, annually, for Port Moresby alone.

Although data were only obtained from Color Pak Limited for a certain type of plastic, it can arguably be estimated that the total quantity of plastics produced by all manufacturers in Papua New Guinea is very large every year. A large range of high density, polyethylene bags, in different colours and prints are produced upon customer request (see Photograph 3).

Photograph 3: The Different Sized Plastic Shopping Bags Used in Shops and Supermarkets in PNG



Quantity of Plastics Disposed of in Landfills and Dump Sites

There are no official records of how much plastic is disposed of in landfills and dump sites. According to the PNG Coastal Clean Campaign Chairman, Mr. Jamie Maxtone-Graham, there was a total of 249 312 kilograms (249 tonnes) of plastics collected in just one clean up in the coastal towns of Alotau, Buka, Kimbe, and Port Moresby (*Post-Courier*, 15 November 2002). Other similar collection scenarios are Indonesia (217 kg), Netherlands (404.1 kg), Saudi Arabia (248 kg), Micronesia (41 kg), Singapore (63 991 kg), Australia (69 kg), and Netherlands (404 kg), over the same period. In comparison, the carelessly disposed of plastics in Papua New Guinea was a hundred times more than that in most other countries.

Many of the things that we use today in homes, streets, supermarkets, and local markets are arguably plastics, or have a part, or component made of plastic. The Department of Environment and Conservation identified shopping bags as a major environmental hazard, but was unsuccessful in its attempt to introduce legislation to stop the importation, and manufacturing of plastics. Draft legislation was passed in March 2005, without much feedback. The status on the progress of the draft legislation is currently unknown.

Recycling Plastics

The two companies that are involved in the recycling of plastics in Papua New Guinea are Color Pak Limited, and PNG Recyclers Limited, which is a subsidiary of Sims Metals Australia.

Color Pak Limited has been operating in PNG for 11 years, and has a recycling facility in Lae, Morobe Province (*Post-Courier*, 9 April 2003; *The National*, 8 April 2003). According to Color Pak Limited, 98 percent of all waste plastics are recycled to reduce the amount of packaging in landfills. A large portion is exported, while a small portion is reintroduced into the manufacturing process.

On the other hand, PNG Recyclers mainly purchase plastics, sorting them out, and exporting them with other products, metals (copper, aluminium, iron), and paper to Australia for recycling.

They focus more on recycling other materials such as copper, aluminium, and iron. According to the management of PNG Recyclers, the purchasing of waste plastics from the public in the National Capital District for recycling depends on the world market prices. When the world market prices for recycled plastics are high, the organisation is able to buy plastics from the general public. However, when world market prices drop, the organisation temporarily halts the buying of used plastics.

PNG Recyclers stated that most people in Papua New Guinea are not aware of the recycling programs that currently exist and so are not cooperative. The majority of the people living in the National Capital District do not know that PNG Recyclers buy used plastics. Currently, PNG Recyclers has an agreement with Coca Cola Amatil (PNG) Ltd to purchase all used Coca Cola 500 mL PET bottles, and Mount Franklin mineral water PET bottles from the public, for recycling purposes. This agreement was made known to the public through a number of advertisements that appeared in the *Post-Courier* and *The National* newspapers between November and December 2005.

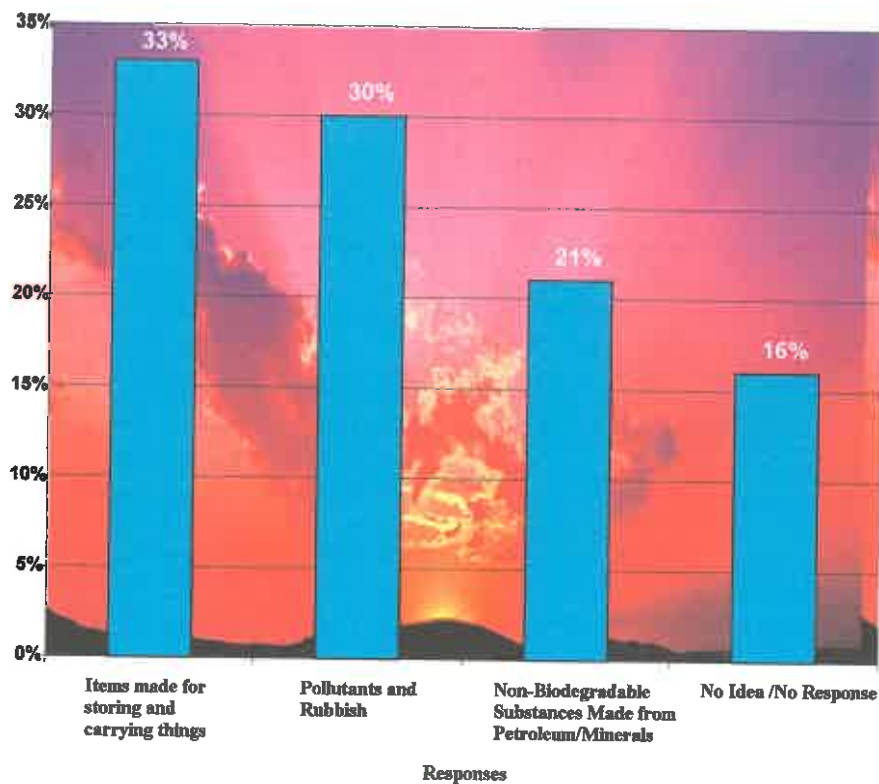
Although Color Pak Limited states that it recycles 98 percent of all packaging wastes that it produces, the exact quantity, and how it recovers all these wastes are not known. There are no garbage sorting mechanisms in the urban garbage collection processes. In addition, it is a challenging task for any plastics recycler to consistently purchase waste plastics, when the purchasing and exporting of plastics is dependent on the fluctuating world market pricing. Consequently, it is difficult to determine, or verify, how much recycling of plastics is done or can be done in Papua New Guinea.

Peoples' Opinions of Plastics

A survey was randomly conducted in Gerehu, Rainbow, Hohola, Tokarara, Down Town Port Moresby, and in Hanuabada Village, in 2004, to gauge people's opinions of plastics. About 33 percent of the people stated that plastics were used for storing, and carrying things. Some 30 percent of the respondents stated that plastics were pollutants and rubbish, 11 percent had no idea what plastics were, and five percent gave no response.

The survey revealed that 16 percent of the sample population in Port Moresby did not know what plastics were, while 21 percent stated that plastics were non-biodegradable substances derived from petroleum or minerals.

According to the findings, approximately 80 percent of the respondents did not know what plastics were. The respondents who stated that plastics were used for carrying things, did not give additional details. The same applied to those who stated that plastics created rubbish, and the rest who admitted that they did not know what plastics were.

Figure 3: Peoples' Opinions of Plastics

The Government's Position on Plastics

Media reports continue to expose the intentions of various levels of government to ban plastics. The Minister for Environment and Conservation, Hon. William Duma, released a press statement banning the importation, manufacture, sale, and use of plastic shopping bags in Papua New Guinea (*Post-Courier*, Friday 31 December 2004). The nationwide ban invoked by the Minister under the *Environment Act* 2000, created much debate, and controversy. This was a direct environmental approach that did not consider other factors.

The state of the environment is important to humanity and other living creatures, and factors such as the economic, social, institutional, legal, and organisational issues and the environment have to be considered.

Papua New Guinea is a developing nation and needs sustainability in its social, economic, institutional, and ecological approach towards development and globalisation. The decision made by the Minister for Environment and Conservation to ban plastic shopping bags needs to be carefully assessed because the factors mentioned here are directly or indirectly linked.

The department did not thoroughly research the issue, by taking into consideration the social, economic, institutional, and ecological factors, before deciding to impose a ban.

The following questions should have been considered before imposing a ban:

- Are plastic shopping bags the only type of plastics product polluting the environment?
- Why were other used plastics such as empty rice bags, biscuit packets, fast food plastic containers, ice-block packets, and 500 mL softdrink PET bottles not included in the ban?
- What are the general waste management alternatives?
- Are legislation and remedies in place to effect the banning of plastic shopping bags?
- Who will enforce this legislation?
- What are the available alternatives to replace plastic shopping bags?
- Is there a company to provide alternatives for plastic shopping bags?

The decision by the Department of Environment and Conservation also did not consider those people who would be directly or indirectly affected. Employees of plastics manufacturing and distributing companies would lose their jobs, while people in the informal sector who sell plastic shopping bags would have to seek alternative ways to earn a living. Moreover, the public and the private sectors would have to be given a reasonable time to adjust to these changes.

The ban on plastic shopping bags caught the general public and the private sector by surprise. Plastics recycling is socially, economically, institutionally, and ecologically sustainable in Papua New Guinea. The government should commission a socioeconomic and environmental impact study of plastics waste management, if it is serious about banning plastic shopping bags.

Conclusion

A large quantity of plastics is produced locally and imported from overseas. However, from surveys conducted in Port Moresby, some 75 percent of the sample population do not know what plastics are. The government has taken a bold step in attempting to ban plastic shopping bags. This raises the question, 'Can plastics recycling be institutionally, economically, socially, and ecologically sustainable in Papua New Guinea?'

Photograph 4: People Employed in a Plastics Manufacturing Plant



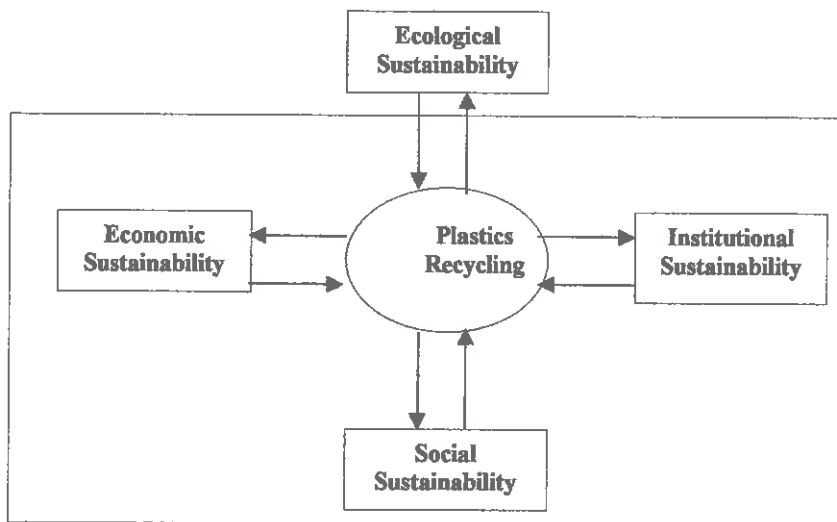
Source: Color Pak product catalogue.

CHAPTER 4: THE INSTITUTIONAL, ECONOMIC, SOCIAL, AND ECOLOGICAL SUSTAINABILITY OF PLASTICS RECYCLING

Introduction

As already discussed, all sustainability factors are not distinct from each other, and recycling is an important component of sustainability (see Figure 4).

Figure 4: Relationship of Institutional, Economic, Social, and Ecological Sustainability



There is no definite answer as to whether recycling can be institutionally, economically, socially, and ecologically sustainable in Papua New Guinea. Currently, there is a plastics recycling facility in Lae, which has plastics recycling programs in place. Companies that are regulated under the *Environment Act 2000* must provide their waste management plans, while each province is to look after its own municipal waste management program.

There is a lack of institutional direction, monitoring, and support from the Department of Environment and Conservation, the relevant government agencies, and municipal authorities, because of the lack of trained personnel, and insufficient financial support from the national government. Under s. 39 of the *Environment Act 2000*, the Department of Environment and Conservation can bypass municipal authorities. However, it is impeded by the lack of resources.

A firm legal and predetermined organisational structure in the public and private sectors is needed in order for the plastics recycling program to become sustainable in Papua New Guinea. The objective of the structure would be to establish and monitor legislation, and to devise alternatives, as and when required.

Institutional Sustainability

Currently, there is Color Pak Limited's plastics recycling facility in Lae, and a number of other plastics recycling programs such as PNG Recyclers. However, to date, the government has failed to formulate legislation and by-laws, through the Department of Environment and Conservation, to support, regulate, and monitor these programs. Municipal authorities, such as the National Capital District Commission, have not set up by-laws specifically for plastics. The *National Capital District Environmental Protection Law 1986*, and the *National Capital District Litter Law 1999* do not specifically include anything on plastics. Plastics come under the category of 'general litter', under *Prohibited Acts No. 5*, of the *NCD Environmental Protection Law 1986*. It should be removed from the 'general litter' category and dealt with as a separate issue.

The government has not enacted laws, or codes of practices to specifically regulate plastics recycling processes. Although recycling companies may have their own codes of practice, it is important that the government is kept informed on the issue of plastics recycling.

The introduction, implementation, and monitoring of a solid legal framework by the government is the foundation for sustainability in any area, including plastics recycling. Other factors for sustainability such as economic, social, and ecological sustainability depend on the setting up of a solid legal framework. Other institutional key players, such as the private sector, must conform to the legal standards and requirements that are introduced, in order to make recycling a successful program.

Laws that Promote a Recycle-Based Society

The government should start with the *Environment Act 2000* to formulate a basic framework of laws that will promote a recycle-based society. After the laws have been introduced, they need to be implemented and monitored by the national government, its departments, and relevant stakeholders, to promote an effective recycling program. Such laws might include:

- specific and general plastics waste management alternatives and requirements, with remedies targeting the general public;
- general workplace, health, and safety standards, and code of practice for local recyclers to abide by, with alternatives for breaches; and
- economic incentives and disincentives for plastics producers, importers, recyclers, and the general public.

A good recycling program that is backed by strong institutional support from the government and the private sector is the foundation for economic, social, and ecological sustainability. Professor Hosoda, when interviewed about Japan's approach to establishing a recycle-based society, stated that laws targeting the people and organisations should not be too open because this will cause it to lose significance. On the other hand, it is impossible to impose laws that are too rigid (Kondo 2003).

Can Plastics Recycling Be Institutionally Sustainable?

At present, plastics recycling in Papua New Guinea is not institutionally sustainable in the long term. However, there are ways to implement a successful program. There is a need for research into plastics recycling in the country to provide a general approach that could assist in setting up a framework for institutional cooperation and sustainability.

This research should be carried out by a team of specialists. Drafting and implementation of policies by relevant institutions, based on the outcomes of the research, would lead to the introduction of new environmental, economic, and social laws, and by-laws, and the effective implementation and monitoring of these laws (see Figure 5).

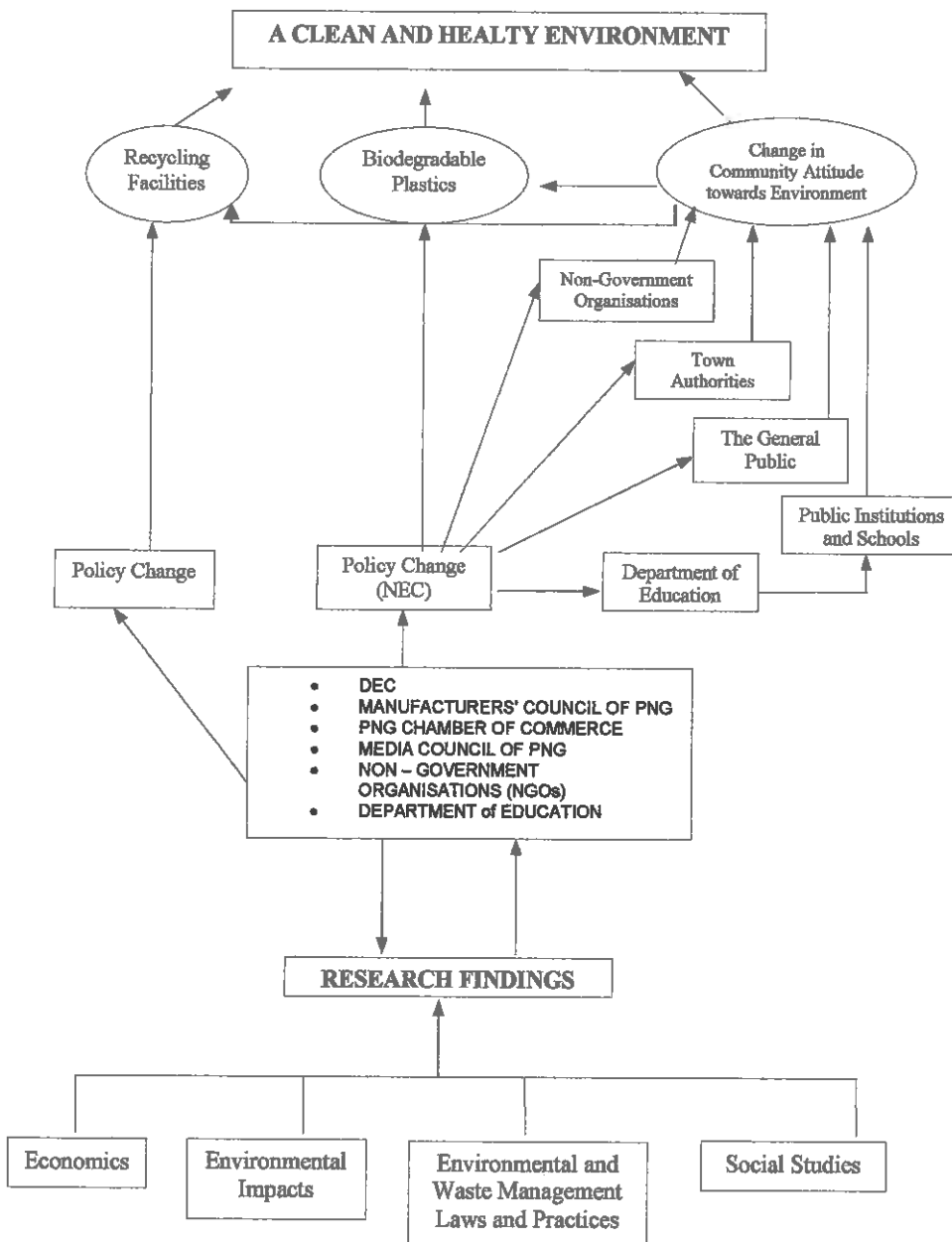
Laws are a major factor in establishing codes of conduct. The task is to create a combination of laws that will bring about changes in recycling behaviour.

The inclusion of the Department of Education will be a tremendous boost because it will play a lead role in nurturing environmental and social responsibility in children, through introduced curriculum changes that target human behaviour. The education system will be very effective in introducing these changes to children at an early age.

Changes in attitudes, especially in relation to rubbish disposal, can also be implemented by non-government organisations, and the various urban authorities, by way of mass public awareness using the print and electronic media. In addition, urban authorities can enforce a change in the public's waste management practices by implementing regulations such as on-the-spot fines for people who litter in public places.

The research program should involve a wider sector of the community (Disendorf and Hamilton 1997). The introduction of a pilot project in a selected province would constitute the initial stage for implementation. An assessment would be made on the project's successes and failures, and the information derived would be used to make further adjustments in order for the project to be more effective

Figure 5: A Framework for Institutional Cooperation and Sustainability



As there is a recycling facility in Lae, it would be the ideal centre to trial a pilot project. The research should identify the use of various sustainability indicators, over space and time, for it to be effective (see Box 2).

To give the plastics recycling approach a boost, the government should also seek advice and assistance from countries that have an established recycling program. Bilateral and multilateral trade agreements could also be signed to export some of Papua New Guinea's plastics waste.

Economic Sustainability

Economic sustainability is seen as meeting the needs of current consumption patterns without compromising future consumption patterns. Recycling can be economically sustainable in a number of ways.

Economic sustainability can be achieved through human development, and the promotion, and enhancement of technical skills and knowledge through direct employment. The process of recycling requires technical skills and knowledge. Through recycling, a person can develop skills and knowledge, which will lead to integral human development.

Photograph 5: Skilled Labour in the Plastics Manufacturing Industry



Also, the plastics recycling program can provide employment opportunities for those in the informal sector. Local people could be engaged as local plastics buyers who would buy and resell plastics directly to the plastics recycling companies. Unemployed youths, and other disadvantaged people could earn money by collecting and reselling used or disposed of plastics.

Monies earned through plastics recycling would help to improve their standard of living, and this would be the main indicator that will ascertain whether sustainable economic development has been achieved. However, in order to promote economic sustainability, various incentives need to be introduced.

Economic Incentives

Any proposed incentives should implement concepts that encourage or promote the activities of plastics recycling programs. For example, the allowing of a 'grace period' on taxes for smallholder plastic buying firms that are specifically established to deal with plastics recycling. Tax credit schemes and levies could also be introduced as incentive mechanisms to support and promote the establishment and implementation of recycling programs.

Economic Disincentives

Economic disincentives through policies can also help the recycling process. This approach could be used as an income-generating avenue for the government. Plastics manufacturers could be heavily taxed per output, to keep their production at a minimal amount. This will apply to plastics manufacturers who are not involved in recycling programs. There could also be a quota on locally produced plastics and imported plastics.

The lack of economic incentives and disincentives has a major impact on whether a plastics recycling program would be sustainable.

Social Sustainability through Community Support

Social sustainability can be met through public awareness and wider community support. A successful sustainable plastics recycling program depends on the cooperation of the public. For example, people must change their attitudes and behaviour by disposing of their rubbish in the designated bins. In Lae, designated garbage bins for plastics have been placed in shops, and at various locations. However, one of the problems that the plastics recycler faces is the careless disposing of betel-nut slime into these bins.

Social sustainability also depends on enforcement from institutions such as the Department of Environment and Conservation, Department of Education, non-government organisations, and municipal authorities. The government and the private sector will also need to effectively implement economic incentives and disincentives.