ECONOMIC FEASIBILITY STUDY OF RECYCLING EMPTY METALLIC FOOD CONTAINERS IN LEBANESE INDUSTRY

by

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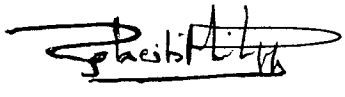

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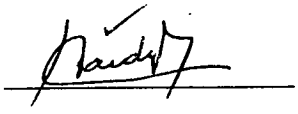

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Chapter I

INTRODUCTION

Limited Resources in nature

Nature has limited resources. Modern society is consuming more and more quantities of these resources in production, manufacturing, marketing, and disposal. Industrial production, one of the many aspects of a growing and developing society, is bound to produce waste and pollution, along with needed goods and services. It is the price society pays for abandoning a quieter and more rural life. Industrial societies (the United States, Russia, or Japan) create a portion of the world's pollution and waste simply because these are the unavoidable by-products of a high level of industrial activity.[1] This is why need is urgent to increase awareness, among consumers of canned food in particular, for the benefits of recycling empty metallic cans.

A resource is useful and valuable in the condition in which it occurs in nature. In its raw or unmodified state, it may be an input into the process of producing something of value (ex. metallic ores, oil), or it may enter consumption processes directly and thus acquire value. (ex: water). Resources are further subdivided into three major categories: *depletable resources, renewable resources,* and *recyclable resources.* Depletable resources have their rate of natural replenishment so low that it does not offer a potential for augmenting the stock in a reasonable time frame; this also is the case of oil and metallic ores. Renewable resources are supplied at a continuous rate, such as solar energy and clean water, and recyclable resources, on the other hand, exist in a form that can be recovered once their current purpose of use is no longer necessary or desirable, such as products like canned food containers, paper from newspapers and magazines, plastic bottles, automobile tires.. [2]

Solid wastes are unrealized resources. They are wastes only because we have not had the foresight to recognize their value. Several terms are erroneously used interchangeably to describe different portions or aspects of the waste stream. These

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[1] Davis, Keith and William C. Frederick, Business and Society: Management, Public Policy, Ethics 5th ed (McGrawHill Book Company: 1984) 13-14.

[2] Tietenberg, Tom, Environmental and Natural Resource Economics. 3rd.ed (Harper Collins Publishers, Inc., 1992) 128

terms are: refuse, garbage, trash, and solid waste stream. However, these words are slightly different in the sense that:[3]

Refuse are things rejected as worthless or of unsignificant value. It is used as a synonym for solid waste.

Garbage is animal or vegetable waste resulting from the handling, storage, preparation, or consumption of food. It decomposes rapidly, often creating offensive odors.

Trash is useless or worthless matter that is unsightly, but does not contain odor-producing food wastes.

Solid Waste Stream is the collective and continual production of all refuse mentioned in the preceding paragraphs.

Environmental Protection

Mass production and large scale manufacturing of metals (mainly aluminum, iron, steel, and tin), uses mineral resources faster than the regeneration cycle of nature. This is likely to threaten the balance of the natural system. The depletion of the world's natural resources such as oil, gaz, coal, mineral ores, and trees had highlighted the need for new or alternative sources of such materials, to find substitutes for them, or to recycle the spent products.[4] "In the space of two decades, environmental protection has grown from a nearly trivial segment of the United States Economy to an industry accounting for nearly one million jobs and over $110 billion in annual sales. Globally, most analysts place the industry at about $200 billion per year, with a growth rate likely to bring it as high as $600 billion by the year 2000".[5]

In nature, nothing is wasted, everything is part of a continuous cycle. More properly wastes should be re-termed "residuals" and placed in an economic context. What are non-productive outputs in any given context may be re-used or become a useful by-product in other or future contexts.[6]

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[3] The McGraw Hill Recycling Handbook (McGraw Hill Book Company 1992) 421

[4] "Recycling," Encyclopedia Britannica: Macropaedia, 1979 ed.

[5] United States Environmental Division, United States Environmental Technology (Washington, 1994) 2-3.

[6] Pearce W. David and R. Kerry Turner, Economics of Natural Resources and the Environment (Harvester Wheatsheaf 1990) 303

According to the World Resources Institute: [7] "From an environmental point of view, preventing waste or the creation of pollutants in the first place is best. When some waste is inevitable, it should be minimized. Next, waste or by-product should be reused or recycled, at the factory level or at the consumer level. Only after all such measures have been exploited should waste treatment and disposal - the traditional end-of-the-pipe approach - be considered". Therefore, recycling, as a solid waste management method, creates 6 times as many jobs as landfilling, and has been preferred over the other two traditional techniques, namely landfilling and incineration, both of which bear harmful side effects on health and environment. In this respect, in landfills, garbage is preserved underground for ages; it is not naturally recycled because of the absence of oxygen in such a place, and therefore does not enter the natural cycle as it should; as an illustration, a newspaper dating back to 1965 has recently been found in a landfill in the United States, still intact and easy to read. As for incineration, the toxic materials that are burnt stay in the atmosphere, thus adding to its pollution, and later they form clouds and fall back on earth in the form of acid rain.

Natural resources and industrial production

Before proceeding, let us first define the word "recycling": It is the collection and marketing of waste materials for use in new products. It also keeps materials out of landfills, helping reduce the pollution. Recycling is as old as life itself, for in nature there is no such thing as an unusable waste. Living organisms use materials from their environment and return those materials, in a different form, to the environment. Thus, materials continually cycle through the ecosystem.[8]

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[7] Kaufman, Donald G. and Cecilia M. Franz, Biosphere 2000: Protecting our Global Environment (1993) 420

[8] Kaufman, and Franz, Biosphere 2000 424-434.

Recycling, or resource recovery, can be viewed as a subsystem within the larger materials balance generated by an economic system. the subsystem could include: 1) The reuse of products in the same form and the same purpose - illustrated by the returnable bottle, 2) The processing of residuals in order to recover and reuse the materials in the same production activity: direct or closed-loop recycling - ex: paper recovered as new paper, used steel cans re-processed as new food cans, 3) The reuse of residuals as inputs into another type of production activity: indirect or open-loop recycling - ex: composting, and, 4) The processing of residuals in order to recover their energy potential - ex: incineration.

Outputs of the resource recovery subsystem are labelled secondary materials as a distinction from primary (virgin) materials (the original natural resources), and from end-use products. [9]

Metallic minerals are classified as ferrous or nonferrous. Ferrous metals contain iron or elements alloyed with iron to make steel. Nonferrous metals contain metallic minerals not commonly alloyed with iron. Proportion in the total world mineral volume is: Aluminum (8.3%), iron (5.6%), magnesium (2.3%), potassium (2.1%); those are abundant metals, accounting for more than 0.1% of the earth's crust by weight. Copper, lead, zinc, tin, tungsten, chromium, gold, silver, platinum, uranium, and mercury consitute less than 0.1% of the earth's crust and are known as scarce metals.[10]

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[9] Pearce W. David and R. Kerry Turner, Economics of Natural Resources and the Environment (Harvester Wheatsheaf, 1990) 303

[10] Kaufman, Donald G. and Cecilia M. Franz, Biosphere 2000: Protecting our Global Environment (1993) 352.

Chapter II

Recycling

Recycling and cheaper raw materials in production

We are living in a "throwaway society", where more products and more excessively elaborate packages are made of more synthetic materials and much of which we use once and throw away. And many of these products are hazardous or toxic substances. It is estimated that 5 billion tons of solid waste are produced each year in the United States; solid waste volume ranges from about 1.35kg to 3.6kg per person per day.[11] Every household in the United Kingdom throws away about 1 ton of garbage a year. This is the equivalent of two trees worth of paper, 210 lb (approximately 95 kgs) of food and beverage cans, $30 worth of clothing, 250 bottles and jars, and 100 lb (approx. 45 kgs) of plastic (see table 1):[12]

Table 1 - Composition of household waste, by weight, in the United Kingdom

Paper and board	30%
Vegetable waste	23%
Dust cinders and misc. debris	21%
Glass	10%
Metals	9%
Plastics	4%
Fabrics	3%

Source: *Save our Earth: Recycling, p.15*

Increasingly, governments in industrialized countries are imposing manufacturers to recycle a specific percentage of their products. In 1990, 13% of the United States municipal solid wastes were recycled. A survey conducted in

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[11] Kaufman, Donald G. and Cecilia M. Franz Biosphere 2000: Protecting our Global Environment (1993) 420

[12] Gordon, Jo Save our Earth: Recycling (Gloucester Press Aladdin Books Ltd. 1992) 15

1991 investigated the materials most commonly included in municipal recycling programs in the United States, and reported its results in table 2 below:[13]

Table 2 - Composition of household waste, by weight, in the United States:

Material	%	Material	%
Newspaper	96.2	Waste oil	46.2
Glass	93.9	High-grade paper	41.3
Aluminium	88.3	Mixed paper	32.2
Plastic bottles	67	Others (batteries)	15.2
Cardboard	60.6	Rigid plastics	11
Scrap metal	52.3	Chip board	6.4
Yard waste	47.3		

Source: *The McGraw Hill Recycling Handbook*, p.20

A perfect example of the efficiency of municipal agencies in this respect is the case of the Boston suburbs, where a municipal agency processes up to 1,500 tons of refuse per day. From this, the facility annually recovers some 25,000 tons of ferrous metals and 40,000 tons of other materials suitable for use in construction. In Europe likewise, and still in 1990, the German government asked the nation's beverage industry to package a certain percentage of its products in reusable bottles and containers by 1991.[14] Following the same principle, graduate business schools in the United States and Europe are adding, to their curricula, courses combining management principles and practice with conditions of environmental protection. According to the Financial Times:[15]

> "The University of Michigan has founded an environment management course combining its Business School with its School of Natural Resources. Furthermore, and still in the United States, groups of business professors are forming partnerships in cooperation with companies providing sponsorship for environment courses and internships, targeted mainly at future business people. Those involved in the greening of US business schools are confident it is an irreversible

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[13] The McGraw Hill Recycling Handbook (McGraw Hill Book Company 1992) 432

[14] Michael Donne, "Strict Controls Force Industry to Adapt" The Financial Times 12 Jun 95

[15] Leyla Boulton, "Campaigners may turn US business schools into citalels of 'green' awareness", The Financial Times 19 July 1995

trend. Similarly, in Switzerland, the Lausanne Institute for Management Development has developped a course on integrating environmental concerns into normal business practice; this course is now compulsory".

This waste of resources does not face only the United States and the industrialized countries, but is rather spread worldwide, where it affects developing and third world countries even more painfully, because these countries lack the adequate financial and technological ability to counter it by establishing healthy landfills, constructing incineration and recycling plants, installing filters in plants, treating sewage water, and composting organic waste for use as fertilizers in an efficient way.

In Lebanon, and according to Dr. Faouzi Adaimi, President of the "Union of Hospitals in Lebanon",[16] 500kg of waste are generated by each person per year, which is equivalent to approximately 1.37kg of waste per person per day.

The total amount of municipal solid waste in Beirut is estimated at 1,200 tons per day as in April 1996, according to the Council for Development and Reconstrution. Out of this quantity, the proportion of metals is presented in table 3 below:[17]

Table 3 - Proportion of metals in Lebanese household waste

Metal	Percentage	Quantity
Steel cans	1	12 tons/day
Iron	1	12 tons/day
Aluminum	2.5	30 tons/day
Total	4.5	44 tons/day

Source: CDR (March 1996)

Before proceeding, let us look at the population figures in Beirut and its suburbs, and examine the various waste management techniques applied, as they have been depicted in the UNDP Master Plan for Solid Waste Management, and

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[17] Sleiman Mazen, Head of Solid Waste Department, Council of Development and Reconstruction, personal interview, March 1996.

through various interviews conducted at the Council for Development and Reconstruction with Dr. Mazen Sleiman, Head of the Solid Waste Management Department, and at Sukleen with Mr. Said Najjar, Assistant to the Director at Sukom, a branch of Sukkar Engineering Group. Population figures were estimated for the year 1980, and then inferred for the years 1990, 2000, and 2040, as shown in table 4 below: [18]

Table 4 - Population figures for Lebanese regions

Mohafaza	1980	1990	2000	2040
Beirut	600,000	740,000	930,000	1,140,000
Total	4,691,000	5,625,000	7,065,000	12,700,000

Source: UNDP Master Plan for Solid Waste Management (March 1995)

The corresponding amount of solid waste generated in Beirut have been calculated and reported in table 5 as follows (kg of waste / capita / day):

Table 5 - Solid waste generation rates

	1981	1990	2000
Low	0.7	0.75	0.8
Average	0.8	0.85	0.9
High	0.9	0.95	1

Source: UNDP Master Plan for Solid Waste Management (March 1995)

The Center of Beirut district is under the supervision of SOLIDERE, so the CDR has no responsibility in waste collection and management in this district. The CDR has assigned the other areas of Beirut and its suburbs from Damour south to Dbayeh north, including the region of Baabda (east), to a private collection and management company: SUKLEEN. The agreement between the two parties gave the latter exclusive right for the collection, transportation, and management of the

[18] Project UNDP Leb/77/033 and WHO Leb/BSM/001 with the CDR UNDP Master Plan for Solid Waste Management UNDP, 1995

solid municipal waste generated in Beirut and its suburbs. The CDR does not interfere in the management of the company; two plants owned by the municipality of Beirut have been put at the disposition of Sukleen, including their machines and equipment. The operating costs, including collection and transportation, are undertaken by Sukleen. Over and above, the CDR pays approximately $20 per ton of raw waste to the private company. The deal includes two waste management facilities: the first one located in Qarantina, with a capacity of 500 tons per day of refuse, which is a composting plant, and the other in Amroussieh, used for incineration and electrical power generation. However, the majority of the refuse processed in both plants does not exceed 10% of the total waste stream generated in Beirut and its suburbs. The remaining 90% of waste are dumped in open air, due to the lack of space and of plant capacity, and because the machines and equipment need to be rehabilitated. The Qarantina composting plant was built in 1972-73, and was originally designed to compost 600 tons of waste per day. After the waste collected is deposited in the Qarantina plant, and the combustibles sent from there to the Amroussyeh incinerator, and out of the 90% remaining waste, cast iron is sold to individuals and private companies where they are reprocessed and recycled into construction equipment and piping materials.

The actual capacity of the plant is only 350 tons per day, and even the compost produced in this operation is not or very little used later as fertilizers and thus does result in benefitial applications. In 1991, the government extended L.L.6,000,000 to rebuild the plant, but the project was never executed.[19] The latest government decision concerning the waste dumped in Qarantina and Bourj-Hammoud was taken three months ago (i.e. in March 1996): it consists of opening a new landfill, having all the conditions of landfills in the United States and Europe, to the north of Beirut; the waste dumped in Qarantina and Bourj-Hammoud will be evacuated to this new site. The project designed to move the waste dump away from Bourj-Hammoud to another site outside Beirut has been postponed one month further, till the end of July 1996 (as decided during the Governement

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[19] Bou-Habib Hanna, Ministry of Environment, personal interview, June 1996.

meeting on June 1, 1996). The reason for this delay is that all the political and popular powers present in the different lebanese regions have refused the presence of a waste landfill in the regions of their respective influence, arguing that land prices for parcels situated around such landfill would fall drastically, and that they would not be financially profitable anymore, if they were to be sold.

Still in Lebanon, until two decades ago, the most accepted solid waste management practice was land disposal: in open dumps first, and later in sanitary landfills. Still more recently, the use of alternate methods for solid waste management became pressing issues. The Environmental Protection Act in the United States (EPA) identified waste reduction and recycling as preferred activities to incineration and landfilling.[20] Unfortunately, however, those declarations have not been applied in real life, and waste management techniques in Lebanon are still primitive, chaotic, and do not take into account public health, landscape or environment issues. The most striking illustration of this statement is the huge garbage pile, in Qarantina, which has the same height as the Achrafieh hill, and can be seen from the main road in the Dora region. Area residents know exactly what I am talking about, and they certainly have had to close their car windows while passing by, because of the unbearably bad smell. What is even more serious is that this Qarantina region, where this "garbage mountain" lies, is inhabited by some 20 to 30 families, living among the refuse, and earning money by selling elements of this waste, such as plastic, glass, metals and other materials. They forbid with guns and knives entry to this "no man's land" to visitors, researchers, photographers, journalists, or just those curious to watch this huge pile closely, as if it was a touristic site, in a country known for its tourism and services sector.[21] This pathetic situation shows the importance of the waste problem in Beirut, and the contradiction between promises for quick and permanent solutions and the real applications of such promises. It also highlights the urgency to find and apply a fast, durable and global waste management program in Beirut and its suburbs.

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[20] George Ayoub, Solid Waste Management: An overview, (AUB, 1994).234,249

[21] Said Najjar, Assistant to the Manager, Sukom, personal interview, April 1996.

The Ministry of Environment has been instituted on April 2, 1993, by law No. 216. Its main mission is to conduct a general policy concerning environment issues, and to safeguard it, and to preserve the interests of individuals and society with regard to pollution; one of the duties of the ministry of Environment is to safeguard the urban environment, by controlling solid wastes, sewage water, and air pollution. Dr. Hanna Bou-Habib, responsible for the Cancerogenic materials department in the Lebanese Ministry of Environment, has explained to us the origins and reasons of acid rain falls in Lebanon as follows: Firms and manufacturing plants in European countries lying around the Mediterranean basin are adopting a dual treatment policy regarding air pollution; those plants us a fuel with 0.5% content of sulfuric gas (SO2), which is the norm in all developed countries, in days when the wind direction is westward, into the depth of Europe, in such a way to reduce air pollution to its minimum. On the other hand, and when wind blows eastward, in the direction of the Middle East and Third World countries, those same factories use a fuel containing 2% of sulfuric gas. Then this polluted wind reaches the lebanese coasts, and hits the obstacle of Mount-Lebanon heights, then operates a cyclical reflection and condenses into clouds and falls in the form of acid rain on the Lebanese coast and mountains.

Still on the subject of air pollution, and according to the same source mentioned earlier in the preceding paragraph, a new project is going to be implemented within a few months at the Zouk electricity generation plant, which is now using a fuel with 1.2% sulfuric gas content. The implementation of this project consists of oxydizing further the sulfuric gas generated, thus producing sulfuric acid (H2SO4), a material that is used in batteries and can be sold to batteries manufacturers, thus covering part of the fuel costs.

Israel, one of the most developed countries in the region, has got its share of environmental problems, and strives to find economic solutions to them. Since Israel's climate is similar to Lebanon's, therefore it would be useful to compare the waste management techniques of both countries, and to learn from the more advanced method and technologies used in this neighbouring country. This state faces an increasing solid waste problem as rapid growth in population, industry and

consumption create larger and larger quantities of waste. Each Israeli produces 1.5kg of solid waste per day (1989); this amount is growing by over 2% annually. Because hot climate in Israel contributes to rapid decomposition, unacceptable odors and spontaneous combustion, therefore waste must be treated quickly and properly. Due to the country's small size, landfill sites must compete with other land uses. There are several conditions that must also be taken into consideration; locating landfills far from residential, industrial and defense areas creates additional transportation costs as well as the unavoidable administrative frictions when dealing with local governmental agencies. The disposal methods used in Israel are: a) sanitary landfills, b) recycling, and c) incineration, which is less appealing for general use because of the high moisture content of Israeli waste, and consequently its low caloric value.

a) Sanitary landfills: this is the least expensive method of waste disposal in Israel. 98% of the country's waste is disposed of in this way. Israeli landfills have to fulfill the following requirements: solid waste must be compacted to minimum volume, and completely covered with at least 15cm of earth. Lately, the Israeli ministry of Environment prepared a program expected to provide a solution to the landfill management problem, by reducing the number of landfills from several hundred today (in 1989), to 30 well-maintained landfills within 5 years.

b) Recycling: Long-distance transportation costs and increasing requirement for high environmental standards in landfills are expected to move Israel to recycling technologies. Four studies were undertaken in recent years to investigate the economic, environmental and technological feasibility of recycling in Israel, specifically paper and cardboard, plastic containers, glass and tires. The studies have concluded that the collection and recycling of these materials make economic sense, and more specifically: savings in foreign currency investments for the import of raw materials, reduction in costs of disposal of wastes, increase in the life of existing landfills, and reduction in environmental nuisances.

Table 6 lists the composition of domestic waste in Israel (in 1989):

Table 6 - Composition of Israeli domestic waste (by weight):

Organic materials	50-54%
Paper and cardboard	16-21%
Plastic and synthetic	10-12%
Metals	3-5.5%
Glass	3-5%
Textiles	3-4%
Miscellaneous	0-12%

Source: *The Environment in Israel* (1992)

Theoretically, all components of solid waste can be recycled. Israel's goal was to achieve 25% recycling rate by 1995, and 40% to 50% by the year 2000.

From a public administration point of view, the storage and collection of solid waste is regulated under specific municipal by-laws for each municipality. The regulations set out the size and type of waste containers required, and the size and the type of construction necessary to house these containers.[22]

Ecological deterioration, an insidious process resulting from mismanagement of resources, eventually affects economic development adversely. Real production costs and imports rise, while land and labor productivity, output, exports, and tax revenues fall.[23]

In this respect, even countries doing most to increase recycling, rates are still relatively low and more needs to be done to encourage people to make use of collection systems. Some recycling figures have been gathered in table 7 as follows:[24]

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[22] State of Israel, Ministry of Environment, The Environment in Israel, National Report to the United Nations Conference of Environment and Development, (New York: United Nations, 1992)

[23] State of the World 1986 (New Delhi: Prentice-Hall of India, 1987)

[24] Jo Gordon, Save our Earth: Recycling (Aladdin Books Ltd., Gloucester Press, 1992)

Table 7 - Recycling as a percentage of waste

Country	Glass (%)	Aluminum cans (%)	Steel cans (%)
France	34	negligible	24
Italy	40	29	n/a
Netherlands	53	negligible	45
Norway	6	80	n/a
Sweden	22	82	n/a
Switzerland	53	26	n/a
United Kindgom	20.4	9.5	9.5
West Germany	39	negligible	45

Source: *Save our Earth: Recycling*, p. 29

Preserving natural resources will benefit individuals as well as institutions. On the macroeconomic level, this is apparent in the ever increasing cost of waste disposal. The cost of disposing of products rises as population density becomes more pronounced and wealth levels support higher levels of waste. As people consume more, their consumption tends to create more wastes. The more they buy, the more paper and packaging are required, most of which becomes refuse. As they travel, they leave a trail of debris such as cans, bottles, and wrappers. It is a fact that real economic output of the United States grew about as much from 1950 to 1980 as it did in the three centuries from 1620 until 1950.[25] Meanwhile the earth's capacity to recycle wastes remained unchanged. Let us go back to the ancient history of mankind, and follow the evolution of waste management. The first simple solutions to waste problems probably involved such expedient methods as covering excrete waste with soil and isolating such disposal waste areas from food preparation and sleeping areas. for most of mankind's history, simple waste management technologies were effective because the wastes were mostly biodegradable and populations were small and relatively isolated. Principal methods used were: a) Isolation in waste piles: the kitchen rubbish piles left centuries ago by the ancient occupants of camps and villages provide today's

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[25] Keith Davis, and William C. Frederick, Business and Society: Management, Public Policy, Ethics. 5th ed (McGrawHill Book Company, 1984) 364.

scholars with an insightful historic record. This simple waste management method continued throughout history and continues yet today, b) Incineration, c) Dilution by disposal in revers, lakes and oceans; the control of water and development of sanitary water systems were also early historical technological achievements, and d) Landfills: the landfill concept was developed early, and today, composting is still an invaluable method for recovering resources for agricultural use.[26]

All through their historical evolution, as people began to settle in permanent communities with higher concentrations of waste producing individuals and activities, the need for waste management became evident; this issue remained an individual responsibility until the 1840s when the western world entered the "Age of Sanitation", and governments increasingly turned their attention to solid wastes, which led to systematic approaches including the "destructor", an incineration system in Nottingham, England, in 1874. America's first municipal incinerator on Governor's Island in New York was built in 1885. Still, environmental concerns were limited beyond the next hill, out at sea and out of sight. Ocean dumping and open space outside of the urban areas continued to be both environmentally acceptable and economical. Only after World War II did fast growing populations, scientific understanding of the environment, and the concept of finite resources lead to a conscious examination of the detrimental nature of land or ocean disposal practices.[27]

The attraction of cities and exodus from rural areas led an increasingly large number of people to live in urban or near-urban environments. This concentration creates waste disposal problems. Since land is becoming scarce, burial is getting increasingly expensive. Consequently, the higher costs of virgin materials and waste disposal have added to the attractiveness of recycling, because by recovering and reintroducing materials into the system, recycling provides an alternative to virgin ores and reduces waste disposal load. Therefore, the applications of recycling grow over time as virgin ores and disposal costs rise. For

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[26] Robert L. Jolley and Rhoda B.M. Wang, ed., Effective and Safe Waste Management (Lewis Publishers, 1993) 3-6

[27] The McGraw Hill Recycling Handbook (McGraw Hill Book Company 1992) 28

example, in 1910, recycled copper accounted for 18% of total production of refined copper in the United States. By 1987, this percentage rose to 41%.[28] Therefore, as recycling becomes more cost competitive, manufacturers rely more heavily on recycled inputs, and they also begin to design their products to facilitate recycling.This way, they are able to use cheaper raw materials from recycled waste containers or by-products. According to Mr. Ziad Abi Chaker[29], once these wastes are melted in special ovens, and reshaped in blocks, they can easily be reused or sold to other manufacturers in the food, furniture, building or any other industry. This way also, import costs will be reduced, new jobs will be created, thus reducing unemployment and inefficiency, and output will rise. As an example, 1 ton of recycled aluminum in the US costs $70, instead of $120 per ton for the virgin aluminum. Likewise, recycled polyethylene (used for plastic bottles of beverages), is at $10 per ton instead of $40 for the virgin material.

The airline industry have lately been adapting their techniques to make them more environmentally friendly. These activities include recycling waste materials, from engine oil to office paper. They are finding that by doing this they can actually save money. For example, the recycling of waste materials can result in significant cost savings.[30]

This study identifies two types of scrap: *new scrap*, which is residual materials generated during production, and *old scrap*, recovered from products used by consumers. Generally speaking, new scrap is always easier and cheaper to process than old scrap, because the materials involved are still at the factory level, thus collection and transportation costs are minimized, whereas scrap generated by consumers depends on their willingness to participate in the recycling process, which is often weak; furthermore, it has to bear the additional costs of collection, selection, sorting, transportation, labor, fuel, etc. As an example of the

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[28] Tom Tietenberg, Environmental and Natural Resource Economics, 3rd. ed. (1992) 191.

[29] Ziad Abi-Chaker, Industrial Engineer, Rutgers University, personal interview, July 1995

[30] Michael Donne, "Strict Controls Force Industry to Adapt," Financial Times 12 Jun 1995

combination between old and new scrap in the recycling process, let us take the aluminum industry: in 1987, 2,096,071 metric tons of aluminum were recovered from scrap of both kinds. Of this, 1,165,071 metric tons came from new scrap, while the rest came from old, including the recycling of some 1,002,561 metric tons of aluminum cans. About 50% of the aluminum used to make aluminum products in the United States is currently being derived from scrap. The overall waste reduction goals in the United States are 25% for conservative states, and 50% for the others (in 1992). Still, the current level of recycling in the United States (1986) is rather low, compared to Japan, where 66% of food and beverage cans are recycled.[31]

Lebanese households interest in recycling refuse metallic containers

The recycling issue in Lebanon, as previously highlighted, involves three interested parties: public authorities, industrialists, and consumers of canned food. On the public side of the problem, recyling would result in reduction in the imports of steel sheets to the country as raw materials, thus helping reduce the deficit in the balance of payments depicted for the year 1994 as follows:[32]while imports (f.o.b) amount to US$(4,484,000), exports (f.o.b) were only US$723,000 for the whole year.

The "Union of Industrialists", on its part, considers that recycling is the best and surest way to manage industrial waste. In fact, a number of factories are already operating on recycling paper, wood, glass, iron, plastic, and rubber in Lebanon.[33]

Consumers, as well as manufacturers, play a role on both the demand and supply side of the market. On the demand side, consumers would find that products depending only virgin raw materials are subject to higher prices than

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[31] Tom Tietenberg Environmental and Natural Resource Economics, 3rd. ed (1992).201-202

[32] United Nations Development Program, Development Cooperation - Lebanon: 1994 Report, (UNDP 1995)

[33] Anwar Berberi, President of the Environment Department at the "Union of Industrials", address, Conference on Environment organized by Notre Dame University, April 28, 1995.

those relying on recycled materials. Consequently, consumers would have a tendency to switch to products made with the cheaper recycled raw materials, as long as quality is not adversely affected.[34]

Lebanese households are generating organic and inorganic solid waste; this waste can further be classified into seven categories, as they appear in following Table 8 below, showing their respective percentage proportion in the waste generated by households: 1) Metals, 2) Organic waste, 3) Paper and cardboard, 4) Plastics, 5) Glass, 6) Textiles, and 7) Miscellaneous:[35]

Table 8 - Percentage of components of household refuse (by weight)

Organic	Paper	Glass	Minerals	Plastic	Others
32-53	19-29	2-8	2-8	1-6	1-12

Source: *The Lebanese Committee for Environmental Activites,* (April 1995)

1)Metals, namely aluminum (beverage cans), steel (food cans), and iron (mostly recycled from yard waste). The emphasis is mostly on aluminum and steel, because they are the most widely used metals in the food and beverage industry:
Aluminum, in the municipal solid waste, comes from used beverage containers, (the most common product made of aluminum), aluminum foil, flexible packaging, appliances, furniture, ... It is the most abundant metal on earth, and is never found in a free state. The refining process uses large amounts of heat and water and is a significant source of air and water pollution. Reusing aluminum metal rather than mining for new aluminum results in tremendous energy savings and reduces water and air pollution.The largest source of aluminum for reuse is cans. They are recycled into new aluminum cans, mostly for beverages.[36]Another important factor affecting the widespread recycling of aluminum is that bundles of aluminum cans have a relatively uniform quality, and can be purified easily, by being exposed to

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[34] Tom Tietenberg Environmental and Natural Resource Economics, 3rd. ed (HarperCollins Publishers 1992) 225

[35] Nach'at Mansour, "The Lebanese Committee for Environmental Activities-BUC", address, Conference on Environment organized by Notre Dame University, April 28, 1995.

high temperature in order to eliminate the contaminants from them. Aluminum old scrap has become an increasingly significant component of total aluminum supplies. Aluminum recycling saves about 95% of the energy that is needed to make new aluminum from ore. In the United States, aluminum cans and packaging constitute 27% of total aluminum production. The magnitude of these energy savings has had a significant influence on the demand for recycled aluminum as cost-conscious producers search for new ways to reduce energy costs.[37] According to Mrs. Brigitte Keyrouz, LIFE project coordinator at UNDP, the beverage industry in Lebanon imports the aluminum cans ready made, designed, and labeled from abroad, therefore there is no manufacturing of aluminum beverage cans in Lebanon. Pepsi-Cola has the sole right to import those cans, whereas local beer and soft drinks are all bottled in glass containers. Then, the empty aluminum containers are sold to manufacturers in the construction industry, where the metal is melted and reprocessed to produce doors, windows, and other fixtures. One of the reasons for the high rate of aluminum recycling and much lower rate of plastics recycling is the differential difficulty with which a high quality product can be produced from scrap. Whereas bundles of aluminum cans have a relatively uniform quality, waste plastics tend to be highly contaminated with nonplastic substances and the plastics manufacturing process has little tolerance for impurities. Remaining contaminants in metals can frequently be eliminated by high-temperature combustion, but plastics are destroyed by high temperatures.[38]

Steel is an alloy of iron and coal. Steel is a ferrous metal, therefore magnetic, as opposed to aluminum, a nonferrous metal. During the separation of waste, steel cans are separated from the rest of the stream using magnets, whereas aluminum materials are separated manually. Steel is a form of commercial iron characterized by its malleability, and by the fact that it has a lower carbon content than cast iron, which is relatively brittle. The steel can is often called the "tin" can, a misnomer.

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[36] Kaufman, Donald G. and Cecilia M. Franz Biosphere 2000: Protecting our Global Environment (1993) p.422

[37] Tom Tietenberg Environmental and Natural Resource Economics, 3rd. ed (HarperCollins Publishers 1992).208

[38] Tom Tietenberg Environmental and Natural Resource Economics, 3rd. ed (HarperCollins Publishers 1992)..208

Actually there is very little tin in these cans; the base metal is steel, and what little tin is used forms a thin coating on the inside of the can to stabilize the flavours of its food contents. The detinning process, during recycling steel cans, is a very important stage of this process. A large magnet is used, often in conveyor form, to separate the steel cans from other materials.[39] Steel is mostly used as containers for soup and vegetables. However, lately, the world tin market short-term prospects do not look bright. Tin consumption in 1993, at 225,000 tons, was close to levels of a decade earlier, while demand for metals such as aluminum, zinc, copper and nickel have risen to two-to-five-fold. Tin consumption is estimated to have risen by a modest 1 to 2% last year (1994) after a 1.3% rise in 1993. Tinplate, 90% of which is used in packaging, now accounts for less than a 1/4 of the world tin consumption, compared with 40% in the 1960's.

In Lebanon, food cans (soup, canned vegetables, pork and beans, pickles, jam,...) are made of steel. Steel cans constitute, as already mentioned, approximately 1% of the total waste stream generated in Beirut and its suburbs.

2)Organic: food waste. This waste, through dynamic composture, is turned into agricultural fertilizers.

3) Paper and cardboard: One of the most frequently recycled materials, paper can be made into a variety of products: newsprint, paper bags, record jackets, game boards, egg cartons, ...

4) Plastics (PET, polystyrene, LDPE, PVC, ...): they are entirely recyclable, but have a shorter shelf life than metallic or glass containers.

5) Glass: container glass (clear, green, amber), other glass: it can have several applications after it has been smashed into small pieces: a) Filter for sewage water in the garden; b) Prevention of soil erosion when it is stocked against walls, c) Foundation for buildings; and d) Recycling into new glass containers.[40]

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[39] Recycling in America (1992) 229

[40] Ziad Abi Chaker Food Engineer, Rutgers University, USA, personal interview, July 1995

6. Textiles: cotton, wool ...

7. Miscellaneous: wood, ceramics, tires, white products (old applicances)...

The collection and sorting of these wastes is a rather complicated and costly process. Thus, the contribution of consumers and individuals is very important in reducing the time and money required to go through it. Unfortunately, this active participation has not yet been attained, even in the United States, where it has reached only 40% of the american population. This lack of participation could be due to the fact that consumers do not fully realize the cost of waste disposal, because they do not pay for it immediately and separately, but it is rather disguised in the form of taxes, insurance fees, urbanization and maintenance costs, and other charges imposed on them by the municipality. Whereas, if they have to separate waste and deliver it to specialized centers, they would feel the cost involved directly in this operation. This is what brings the need to find ways to manage waste collection and sorting with as small cost as possible. The efforts developed above would still be insufficient to solve the resource waste problem if the citizens themselves do not consciously and willingly get involved in this process, to the best of their interest. This is why the authorities would have to provide environmental education to their people. Such an education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems and motivated to work toward their solution. There are two types of environmental education: a) Formal, by adding environment courses to the curricula in schools, colleges, and universities, and by giving these courses on-site, such as taking students to a recycling center and explaining the process to them; and b) Informal, which is the task of zoos, nature centers, museums, aquariums, wildlife refuges, and of National and international environmental organizations that sponsor research and provide information.[41] (ex: Friends of Nature in Lebanon).

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[41] Kaufman, Donald G. and Cecilia M. Franz Biosphere 2000: Protecting our Global Environment (1993) 600

The World Book Encyclopedia determines three ways to collect and sort recyclable materials: a) Buy-back centers, b) Drop-off centers, and c) Curbside collection programs:

a) Buy-back centers: They are located in municipalities or urban centers. Individuals who separate their waste into the above mentioned 6 categories and bring them to one of these centers are paid in return in the form of either cash or coupons of tax reduction on their personal income tax, as additional incentive for supplying a recyclable product that someone else wants.

b- Drop-off centers: They open longer hours than the buy-back centers. The wastes do not have to be separated and sorted by individuals, but there is no payment in return.

c- Curbside collection programs: Residents of a community separate their materials and put them on curbs by their homes. Trucks pick up the materials and bring them to a central place. From there, they are sent to manufacturers who convert them back into usable products.[42] Another option to this solution is the commingled collection approach, whereby all waste materials are kept mixed, and thrown altogether in containers placed near households. This kind of commingled collection is considered to maximize participant convenience and minimize the presence of bulky containers at home. Such bins could either be placed permanently at the back or sides of buildings in a practical and easthetic way, or else they could be given to residents in individual apartments.

Once the solid wastes are collected, they have to be selected and sorted, and separated into the different 6 categories mentioned earlier. This can be done with a single machine recently invented, the Materials Recovery Facility (MRF). The sorted metallic wastes are then processed on site, and then they are sold to other manufacturers, along with the wastes that have been sorted and separated, but not recycled. What remains at the end of the process is mainly wood, textiles, ceramics, and other materials, consituting only 10% of the original garbage.[43] A

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[42] The World Book Encyclopedia, 1991 ed. 186-187

[43] Ziad Abi Chaker Food Engineer, Rutgers University, USA, personal interview, July 1995.

good illustration would be the case of an Australian couple who used only one garbage bin for an entire year, filling it with waste that could not be either composted or recycled.[44]

[44] Sydney Morning Herald, March 1995.

Chapter III
Economic Feasibility of Recycling

Modern society can be divided, regarding recycling issues, into three main sectors: the public sector, the industrialists, and consumers at large. All three bodies will be benefiting from recycling food cans. The benefits of recycling include: a) preserving natural resources, b) producing cheaper raw materials, c) reducing imports, d) diverting from landfill space, and e) creating jobs.

The purpose of this study consists of creating, in the mind of Lebanese consumers of canned food, a sense of responsibility toward the environmental crisis. Our society is suffering nowadays from this problem, therefore this awareness and responsibility sense would help Lebanese citizens realize the magnitude of the environmental problem. It would also prepare them for immediate action on the part of the three sectors of the economy mentioned above, namely: the public sector, the industrialists, and the consumers as well. The subject is further narrowed down to the level of a single industry, recycling of empty steel cans, and a single product line, the canned food business in Beirut and its suburbs. The study includes the following two objectives: 1) to assess the level of awareness of consumers of canned food in Lebanon and their readiness to participate in a recycling effort, and 2) to conduct a study comparing the revenues generated by the recycling business, with the costs incurred during operation; based on the results found in the preceding steps, the study suggests to come up with the proposal of a "recycling business", a new industry in Lebanon.

Determination of consumer awareness of recycling

In issues concerning general welfare, and societal questions, most people are influenced by three factors: region of residence, age, educational level, and level of income, or socio-economic level. Narrowing down the study to young educated respondents, two variables are kept constant: age and educational level. The analysis is made on the basis of the two remaining variables: region, and socio-economic level. Based on the results obtained in the survey, we would know the extent of awareness towards recycling issues among the respondents, thus we would be able to anticipate their expected response to a recycling program requiring their active participation. In a further step, these results will help in choosing the target audience for launching a promotional campaign aimed at involving consumers in a recycling program. Thus, the first messages of such a campaign would be addressed to the portion of the public which is the most sensitive to recycling. Then after securing its participation in such a program, the efforts could be moved to more uncertain and less conscious population.

The practical results of this survey would be the first steps in any comprehensive recycling program, englobing the whole community.

The overall goals and objectives of this project should meet the community's specific needs which are: minimizing landfill requirements, being economically efficient, and reducing waste volume. The short-term profitability and success of the proposed recycling business does not depend directly on consumer participation in sorting and separating steel food containers from their other waste. The "Sukleen" company has monopoly over collecting waste in Beirut and its suburbs for the next five years, as agreed upon with the CDR and the municipality of Beirut Therefore, the materials mentioned earlier in the paragraph will be bought directly from this company. The ultimate success of recycling programs depends, in large part, on public participation. Incentives for this participation must be created and maintained. A small portion of the public, motivated by a sincere environmental ethic, will participate in recycling programs no matter what; on the other hand, another small segment will be unwilling to participate regardless of the types and levels of publicity. The majority of the population, however, can be affected by responsible information and promotional programs.[45] In the future, however, there will be growing trends towards more active and conscious participation of the public in waste separation, because this will save time and costs on the part of the entity concerned with waste management. This is why I feel it is adequate to start today initiating consumers and orienting them in the direction of participation in the recycling efforts. One of the basic tools needed to operate efficiently is to obtain a clear idea of where people stand regarding recycling, and whether they are knowledgeable, concerned, and willing to participate in recycling efforts. This is done through specific questions asked during the survey. All subsequent orientation and information efforts will be directed towards planting interest in this major environmental issue among them. However, people will not be eager to participate unless they are fully conscious of the benefits gained; every individual should understand that by contributing in the recycling program, he/she will gain a cleaner and healthier environment, cheaper products of equivalent quality, more job opportunities and the inner satisfaction of contributing to the general welfare. The purpose of the survey is therefore to highlight some of those benefits, hoping they will reach and convince the largest proportion of people possible.

Investigation of economic feasibility

In this study I will evaluate the economic gain from recycling, and whether its operation will be worth the costs and investments. The figures are discounted to their

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[45] The McGraw Hill Recycling Handbook (McGraw Hill Book Company 1992) 225

present value, and I will try to prove, using numbers, that this plant will be economically profitable, in addition to its environmental interest. Otherwise, and without the profitability condition, any commercial or economic entity would not be viable. As it will be highlighted, such a business requires a very important capital. The reasons for this are numerous, and mainly: the large investment required for land and buildings, and the high cost of the special machinery and equipment. These important costs are compared with the revenues generated by only one source, namely the sale of recycled steel cans to local and foreign manufacturers. An important issue is the difficulty of entering a market already supplied by imported steel sheets at competitive prices (ranging between $800 and $1200 per ton). Another difficulty lies in having to convince customers (i.e. manufacturers in the food industry), as well as consumers at large, of new ideas and concepts that will create a revolution in habits and beliefs deeply rooted and hard to change or modify.Those factors will be further detailed in explaining the methodology part of this study.

Chapter IV
Methodology

In a preliminary part of this research, an attempt is made to overview the historical and technical evolution of waste management techniques, and especially recycling interests. The present situation of waste management in industrial countries as well as in developing regions is also described, through literature review of books, articles, researches and policies concerning this subject.

The methodological procedures, consist of: a) conducting an awareness and participation survey, b) and preparing a benefit-cost analysis. Then, proposing an operational framework for recycling plant for used steel cans would come as a suggested illustration of the possibilities on hand, based on the results obtained in the preceding steps.

Survey

Planning is the most important step in the statistical part. It begins with the identification of the sample that will achieve the goals of the study. This is followed by the construction of an instrument that would answer specific expectations and depict the present attitude of consumers in Beirut and its suburbs toward recycling. With the help of the gathered data, a substantive analysis is conducted to show the level of awareness, among those consumers mentioned above, and to anticipate their degree of participation in a global program of action for a wider application of recycling.

The questionnaire is designed to depict the level of awareness, among consumers of canned food in Beirut and its suburbs, toward the subject of recycling, and more precisely recycling used steel food cans. The survey also measures the consumers' degree of readiness to participate in recycling efforts, if they were undertaken by a private or public party. Hypotheses are chosen, then independent and dependent variables proposed, taking into consideration the fact that environmental matters are very critical. The fact is that they deal with general welfare, and the ecosystem balance, and because very large investments are required to find and apply adequate solutions to this major problem. Therefore, the scope of this issue is beyond the individual private level, and certain givens exist and have to be respected and acted upon:

First of all, it is important to note that environmental issues have been developed in universities, at the academic level as well as on the ecological level. Scholars have adopted the struggle for a better environment, a healthier world and a more balanced economy. For this reason, the survey has been directed to university students, who are expected to be well informed of the latest trends and are ready to

accept new concepts and ideas, if such concepts are proven to be beneficial to their community. Also, their level of instruction enables them to understand and participate with full awareness in recycling efforts, because they are open to innovations and have no or little prejudices. Moreover, young educated persons are considered to be "opinion leaders"; they are the ones who set an example in their families, and subsequently in their communities. Therefore, when they are aware of a major concern, they become the main source of information and guidance to their surroundings.

In addition, university students, generally, have more free time than working adults; therefore, they would be more available, and would be able to devote more time to listen and understand and get involved in issues which are not direct priorities of living. On the other hand, adults and especially those responsible for their families, are immersed in their daily problems, and therefore they are not easily open to concerns which are rather abstract and far away from them.

The choice of middle class respondents concerns people of medium socio-economical level. Since the ultimate goal of this survey is to touch the population and awake its concern for recycling issues, therefore only households have been considered. Also, the respondents have been asked about their recycling behaviour at home, and at university and at work as well. It is assumed that the other parts of the economy, i.e. the services and the industry (hotels, restaurants, beaches, hospitals...) could apply the separation of waste as a procedural decision. In this case, the personnel of those institutions would follow the directions given to them by management automatically, and continuously. This is why I feel that efforts should be concentrated on households and individual consumers, instead of institutions, since convincing is harder and more time consuming than imposing a procedure to a community. Because middle classes constitute the majority of the Lebanese population (According to the Development Cooperation 1994), therefore by reaching them, a large portion of the work would be accomplished. This category can be interested in environmental problems more easily than the other portions of the population, which are the lower and upper classes. The rationale behind this assumption is that poor families have enough to deal with for making a living and securing the bare necessities of life so they do not care about environmental and waste reduction problems. At the extreme, the upper classes of society usually do not have time nor the interest to deal with such "trivial" matters as waste and garbage.

Consequently, the following hypotheses were derived: a) educated young people are aware and willing to participate in the recycling effort, b) consumers of low to middle-level income are touched directly by the waste management problem and eager to find solutions to it, and c) inhabitants of urban regions are involved in the waste problems and willing to contribute to recycling.

In constructing an instrument to measure, especially when it comes to a questionnaire, the task is to use the appropriate semantics which corresponds to the intended content that can be read, easily understood and having a meaningful relation to the subject in particular. This is why precise and concrete questions are however difficult to formulate. Through their concreteness recognizable features are evoked giving real information about the subject's attitude. The propositions are put into questions and statements which have reference into the individual's everyday life and beliefs.

In true experiments, we study the relationship between two types of variables - independent variables and dependent variables. Independent variables are the causes and responsible for the manipulation of the dependent variables. The dependent variables measure the effect of the independent variables combination with the subject under study. The independent variables considered were: age, gender, level of income, level of instruction, and place of living. In issues concerning society as a whole, a person is influenced by his or her community, and by the level of income, as well as by age, educational background, and gender. Since this survey has limited its sample to university students, the three latter variables are kept the same. People are affected by their community, with whom they share tastes, values and beliefs, and also by their level of income that will decide upon their priorities and limited possibilities.

The dependent variable or phenomenon under study is the level of awareness among university student of the environmental issues. The sample chosen is designed to represent the young educated generation living in Beirut and its suburbs. As discussed and analyzed, this portion of the population (the young educated people) is the first target to new concepts and to the introduction of new commitments such as waste separation at home, university, and work. It is expected that when this target has assimilated the goals and purpose of this program, then it would endorse it as its own responsibility, with the dynamism and enthusiasm of youth. Later on, and as a natural result of this conviction, the young educated people will hopefully communicate those acquired beliefs and principles to their families and to their communities. This is why this study has used the targed mentioned above as the door to enter to the whole society regarding recycling issues, and especially to the inhabitants of Beirut.

The sample consists of 110 randomly determined university students. They are divided evenly among two universities: the Lebanese University (including different branches), and Notre Dame University (55 students from each). All respondents have an equivalent level of instruction, and approximately the same age. The only variables kept different are: place of residence, and income level.

The Lebanese University is public university, owned by the Lebanese government, having its major branches located within Beirut, whereas Notre Dame

University is a private university located in Zouk Mikael, outside Beirut and its suburbs. This selection therefore served two purposes: there is a majority of NDU students living outside Beirut, while Lebanese University students are mostly concenctrated in the capital. The reason is that other regions can have access to different branches of the national public university, scattered in all Lebanese regions. The other purpose of the selection is to differentiate between two distinct levels of income: low- to middle- level income, and high-level income. It has been assumed that NDU students in general have a higher income level that LU students. This justifies the choice of the two insitutions to consitute the sample.

The questionnaire used in this research consists of items assessing the variety of regional, educational and financial variables. The goal is to learn what the respondent knows about recycling, and what he/she thinks about this issue. The questionnaire is divided into two sections. The first section includes closed-ended questions with several alternative answers formulated by the researcher. The second section consists of open-ended questions, whereby the respondent is asked to rate the benefits of recycling as he/she sees them, and then to state the motives that would push him/her personnally to participate in a recycling effort. Answers obtained in this section are classified in respectively five and three chosen criteria, as follows: in question 9 of the questionnaire, respondents are asked to rate, according to priority, the four benefits of recycling as they see them; the researcher has in mind the following benefits, although they are not communicated to the respondents: preserving natural resources, cheaper raw materials, diverting from landfill space, and creating jobs. However, it appeares from the answers collected that consumers have an additional concern about recycling, which is the health aspect, whereby this waste management technique would reduce the volume of microbes and disease-generating waste. Therefore, this item has been added to the four previously mentioned benefits of recycling. The questionnaire is written in Arabic; it has been pretested and questions revised to increase their appropriateness for the sample.The questionnaire is presented to randomly picked students of the Lebanese University (from different branches), and of Notre Dame University, to fill it up. The researcher has explained to them that it is a university research. Due to the concern with the protection of the rights of the participants, no name is required. This made the respondents feel safe that it is anonymous. On the whole, the procedure went on quite smoothly.

The answers collected by this survey are classified into proportions and percentages. Those figures determine the approximate number of persons willing to participate by sorting and depositing the metallic, glass, and plastic containers intended for recycling. Thus, depending on the information obtained, the efforts will be directed

adequately toward the selection of the most suitable method of collection for the materials in question.

Benefit-Cost Analysis

The risk of most concern to the recycling business is monetary loss. This risk can be caused by five factors: 1) technology, 2) waste stream, 3) markets, 4) legal and regulatory, and 5) force majeure.

1. Technology: Risks include completing the construction of the recycling facility on time and within a specified cost, and technical problems affecting the ability to complete the facility as designed. Documents of procurement or bid should require guarantees that the facility will be completed by a certain date, for a certain cost, with specified preformance and/or design criteria.

2. Waste stream: The assurance of an adequate and reliable supply of waste of the proper composition and quality. Methods of waste stream control include agreement with the city municipality to obtain franchise to collect waste.[46] This is exactly what the Sukleen company has accomplished, by signing an agreement with the CDR, granting the private party exclusive monopoly over waste collection in Beirut and its suburbs for the next 5 years.[47]

3. Markets: In recycling programs, securing markets to purchase recovered material is critical. In Lebanon, there is only one supplier of steel cans to the local food manufacturers: it is the "Light Metal" plant, located in Choueifat. This plant imports steel in sheets from abroad, processes them into different shapes, thicknesses and sizes depending on the demand, sticks labels on them, and then sells them to the different food manufacturers in Lebanon.[48] Therefore, local demand for steel sheets is restricted to one major party, and it would be easy to satisfy it by offering competitive prices and facilities of transportation, especially taking into consideration that no freight, insurance, and remote transportation costs are involved. As for the regional and foreign markets, the principles and guidelines governing export of any materials and products would apply to this case.

4. Legal and regulatory, such as tax law, environmental protection legislations (air or water), antitrust challenges, and others.

5. Force majeure: Unanticipated occurences such as wars, sabotage, and natural disasters.

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[46] The McGrawHill Recycling Handbook (McGrawHill Book Company, 1992)

[47] Said Najjar, Assistant to the Manager, Sukom, personal interview, April 1996

[48] Walid Salhab, Administrative Manager, Light Metal plant, personal interview, March 96

The Benefit-Cost analysis is a detailed study listing the costs incurred by the daily operations of the business, added to the fixed costs of land, building and heavy equipment, as against the revenues generated by the sale of recycled steel sheets, and grants or donations if the case applies. The numbers and estimations presented below in the study are taken from real-life businesses, and from current market prices and current wages and salaries in Lebanon. From daily operations, annual figures for Year I are derived. According to the UNDP Master Plan for Solid Waste Management (March 1995) presented earlier in this paper (see Table 4), the waste generation volume in Lebanon is assumed to grow at a rate of 2.6% per annum. Therefore, a growth rate of 2.6% is applied to estimate the Cost and Revenues figures for the next five years. The study is conducted using a computer spreadsheet program (MS-Excel for Windows version 7.0). The details of all costs and revenues for Year I are listed below:

ANNUAL REVENUES

- Sale of recycled steel sheets: The quantity generated daily being 15 tons; in order to be competitive and to stand on the market, the price of 1 ton of recycled steel should not exceed US$500, since this is the price currently transacted in Lebanon, as it was given to us by the Administrative Manager of "Light Metal" plant, located in Choueifat, Mr. Walid Salhab. ("Light Metal" is the only company in Lebanon that supplies the manufacturers of canned food in the Lebanese market with cans of different sizes and consistencies, different shapes and textures. This company imports steel from abroad in the form of sheets, and processes them into various forms, according to the demand of their customers; then, labels are prepared and sticked on the cans before selling them in their final shape to be filled by food ingredients). Therefore, we have chosen the minimum price actually in the market, to be on the safe side for the analysis (i.e. $500): 15 tons * $500 * 365 = US$2,737,500.

- Grants and Donations intended to cover part or all of the fixed costs of the business mentioned above (land, building, heavy equipment): The parties involved in this part would be either Non-Governmental Organizations (Ford Foundation, Friends of Nature, United Nations Environment Program ...), or local public authorities. In general, health, nutrition and environmental issues, like all necessities, consitute financial burdens for the public authorities, and they are not economically profitable. Thus, the governments use funds supplied by other profitable sectors of the economy, in order to subsidize those mentioned above. In the case discussed here, the public entity involved would be the Lebanese Ministry of Environment. This Ministry, however, has got more that its share of financial burdens; it employs 138 regular employees, and 16 contractual experts; however, since the performance of the 138 employees is rather poor, the ministry is in need of more members of the qualifies

experts and personnel, and of laboratory equipment, and it already suffers from a shortage of funds. Therefore, it would be very improbable, at the time being, to expect any financial assistance from the Lebanese Ministry of Environment.[49] As for the NGO's mentioned above, a letter has been sent to the UNEP regional office in Nairobi, Kenya (see Appendix B in this paper), requesting information in the form of figures and numbers about: a) the estimated cost of heavy recycling equipment and furnaces, and b) the possibility of UNEP subsidizing part or all of the fixed costs involved in part a) above; however, no answer has been received yet, at the date or writing this paper.

ANNUAL COSTS

Operating Costs:

a) Cost of used steel cans @ $35 per ton of waste cans
b) Construction Services, including:
   - rental of buildings for offices, machines and equipment, incoming and outgoing storage, and parking areas,
   - building services (electricity, fuel, maintenance and services)
c) Transportation: 2 trucks are used, each with a capacity of 10 to 15 tons estimated at $150 per load
d) Labor wages, including workers, technicians, and drivers
e) Personnel salaries, including operators, accounting, marketing and administrative staff
f) Operation and Maintenance Costs, amounting to 10% of the Initial Investment
g) Governmental Taxes: 8% of the Annual Revenues
h) Unforeseen expenses: since the costs cannot be determined exactly due to the lack of real-life recycling businesses in Lebanon, those expenses have been inflated, to cover all probable events, to the proportion of 15% of the Annual Revenues
i) Depreciation: for long-term major equipment, depreciation for the first 5 years of existence are estimated at 6% of the Initial Investment.

The Total Operating Costs are deducted from the Annual Revenues at the end of Year I, thus giving the Net Income. Then, the Cash Flow for Year I is computed by adding Net Income to the Depreciation figure, and discounted to the present by applying the PVIF factor with a discount rate of 10%, the current industry rate.

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[49] Hanna Bou-Habib, Lebanese Ministry of Environment, personal interview, June 1996

At the end of the fifth year, the Cash Flow figures are summed up and deducted from the Initial Investment, computed below:

Initial Investment:

Cost of Equipment:	$1,000,000
Cost of Scrap Handler:	50,000
Total Initial Investment	$1,050,000

If the result of the subtraction (Sum of Cash Flows discounted to the present - Initial Investment) turns out to be positive, this means that the project is financially feasible.

Structure

The recycling business proposed in this paper is designed to recycle empty food containers made of steel, to form steel sheets out of the recycled metal, and then to sell those sheets to food manufacturers.

The company is divided administratively into two parts: the processing plant, including machinery, workers and engineers,and the administrative body, consisting of offices, computers and office equipment, added to the administrative personnel and services. The processing plant is located at the entrance of the company, after the guards control office staffed with three members working different shifts 24 hours a day. Incoming used steel cans are received and checked. The heavy recycling equipment and furnaces are located inside the building; ten workers are employed to operate and maintain them, under the direct supervision of two mechanical and/or environmental engineers. The role of those engineers is critical in following all stages of the recyling process: cleaning the cans from paper, labels and detinning them, then refining them to take away all kinds of debris and impurities, and finally mixing them into alloys of different densities and forming sheets of various sizes and thicknesses. The administrative building is located close to the plant, housing the administrative offices and services for the whole complex. At the entrance, the reception area welcomes visitors and contains a central telephone line serving the whole building. The accounting department handles the financial accounts and operations of the company, and is staffed with two full-time employees. The marketing department plans and executes promotional campaigns, prepares ads for newspapers, magazines, television and radio, and follows up the consumer behaviour, tastes and attitudes through marketing research; it is composed of two employees as well. The overall administration of the company is supervised and followed up by the administrative director, assisted by a secretary.

CHAPTER V

Results

Results of the Survey

The sample under study is composed of young educated persons of both sexes, picked up randomly from two universities: the Lebanese University (different branches), and Notre Dame University. 56.4% of the repsondents live in Beirut, whereas 43.6% live outside the capital; 55% are male students and 45% female students. 80% of the population tested have levels of income in the range below L.L.3,000,000 per month for the whole household, while the remaining 20% have a monthly income of L.L.3,000,000 and more.

The first hypothesis tested is: Young educated persons show a high degree of interest in environmental issues, and are willing to participate in recyling efforts.

Out of the 110 subjects asked about their interest in environmental issues (question 1: level of concern in environmental problems), only one failed to answer the question; 58.7% of the valid responses showed continuous interest, and 31% of the others were periodically interested; 10% of the overall respondents were little or not interested at all. These dispositions were further investigated, in question 10 (actual separation of trash every day), in order to depict the real potential of participation of respondents and their practical contribution to a recycling program;. Positive responses were given by 79% of the population, and 13.3% of the others were hesitant or not ready yet to get involved, whereas 8.3% of the rest had negative attitudes and refused to cooperate. Upon further explanation of the detailed actions expected from consumers in case containers were put at their disposition at the entrance of buildings, universities, and offices, with detailed instructions about waste separation (Question 11: Trash separation if bins are placed at home, university, or work), the results are reported in table 9 below:

Table 9 - Willingness to separate steel cans and deposit in bins

Question 11	Home separat.	Univ. separat.	Work separat.
Yes	95.4%	92%	93%
No	4.6%	8%	7%

From the previous analysis, it appears that when the concept is first rather remote and abstract for the respondents, the degree of participation is moderate (58.7%). Then, as the recycling effort required becomes clearer and more specific, the degree of awareness and interest gradually increases, until it reaches close to 100% contribution, as depicted in table 9 above.

Moving to the opinion of respondents regarding the different waste management methods (question 2: rating of the different waste management methods by decreasing performance), it can be seen that 63.2% of the population considered recycling to be the most suitable method; the second best method appears to be composting, as chosen by 53% of the respondents, and then incineration comes third (45% of the answers). Landfilling is seen by 44% to be the fourth method, ending with throwing in the street corners, which was regarded as the worst method by 85% of the population. All in all, the great majority of the population investigated (97.3%) does not agree with the present waste management method in Beirut (question 5: opinion about the actual waste management method);

When the respondents were asked to rate themselves as to their level of knowledge of recycling, 27.7% rated themselves as well informed, against 34.7% as not informed at all; an important proportion was moderately informed (37.6%). Further, when asked about their personal concern in recycling, the population seemed almost equally divided between deep concern (37.6%), and not concerned at all (34.3%), with 26.3% of them hesitant or in-between. However, their positive attitude increases to reach 65% when they are directly asked about their readiness to participate, whereas the negative attitude falls to 14%.

According to the survey results, paper recycling is the most popular in Beirut, since approximately two-thirds of the population is aware of it taking place, against

43.6% for both glass and plastic recycling. (question 8: knowledge of refuse materials currently recycled in Beirut)

Then, the respondents were asked, in an open-ended question (question 9: listing the benefits of recycling in general), to list their priorities concerning the benefits of recycling as they can feel them; the researcher was able to group them, according to the different answers collected, into five categories that are recapitulated as follows: 1) preservation of natural resources, 2) cheaper raw materials, 3) diverting from landfill space, 4) creation of jobs, and 5) health concerns; 41% of the respondents considered that the best achievement of recycling would be to divert waste from landfills, thus saving scarce and precious land sites to more profitable uses. The second most important accomplishment of recycling, as seen by 39% of the population, is the production of cheaper raw materials, since in Lebanon all sorts of raw materials are imported, and thus carry high costs. Third, recycling is bound to create job opportunities in plants, transportation services, and offices; this advantage was rated by 35.3% of the population.

The second hypothesis stated was: Inhabitants of urban areas are more concerned and ready to participate in recycling, than inhabitants outside Beirut.

Results of the answers given by inhabitants of both regions to question 1 are given in table 10 below (numbers are given as the valid percentages):

Table 10 - Comparison between degrees of interest in environmental issues

Question 1	Continuous	Periodic	Random	Rarely
Beirut	51.6	35.5	6.5	6.5
Town	68.1	25.5	4.3	2.1

According to the results in table 10 above, 87% of Beirut inhabitants are positively interested in environmental questions, against 93.6% of inhabitants outside Beirut. When asked about their personal contribution to the recycling (question 10), results came also very close between the two categories of respondents (77% and 81%

respectively). As to their actual potential to separate trash in homes, universities, and offices (question 11), results showed no discrimination between the two regions, and participation was ranging between 91% and 95% of inhabitants of both regions.

The results of question 2, asking about their preferred method of waste management, are listed in table 11 below:

Table 11 - Comparison of best waste management method

Question 2	Landfilling	Incineration	Composting	Recycling
Beirut	14.8	1.6	18	63.9
Town	20	-	17.8	62.2

Both categories of respondents agree on recycling as the best method; they also agree on composting as the second best method.

Table 12 lists the results of question 3 (Degree of information, concern and participation in recycling efforts), as answered by inhabitants of Beirut, as well as those living outside the capital:

Table 12 - Comparison of information, concern and participation in recycling

Question 3	Informed	Concerned	Participation
Beirut	27.3	47.2	61.1
Town	28.3	30.4	69.6

Both regions have equivalent level of knowledge about recycling (around 28% of the sample); however, Beirut inhabitants are more concerned about this problem (47.2% against 30.4%), the reason being that they have to encounter trash every day and on a continuous and important basis, whereas rural inhabitants are kept distant somehow from important quantities of waste, relatively to urban population. However, the discrepancy in concern is not reflected in the readiness to participate in recycling efforts, as depicted in the following: 61.1% of Beirut inhabitants are willing to participate, as opposed to 69.6% of rural inhabitants. Therefore, this apparent contradiction can be washed away by the fact that participation in recycling efforts is directly related to the knowledge of the environmental problem, instead of being a

function of any physical encounter with the trash. As depicted in the above table, the degree of information and knowledge of the recycling problem is approximately equivalent for both groups of people. Consequently, the percentage participation in recycling efforts is slightly higher outside Beirut, depicting the small superiority of those inhabitants in their information level over Beirut inhabitants.

The benefits of recycling, (question 9), as seen by inhabitants of both regions, are listed in table 13 below:

Table 13 - Benefits of recycling as considered by population of Beirut and out of it

Question 9	Nat. Resources	Cheap.raw mat.	Landfill sites	Jobs	Health
Town	51.6	35.5	6.5	6.5	6.7
Beirut	36.8	26.3	34.2	-	2.6

Inhabitants of Beirut rate diverting from landfills as their first priority; this is well understood, since they are living in an overcrowded city, where land is precious because it is scarce; on the other hand, inhabitants outside Beirut rate the preservation of natural resources first in the list of benefits.

As a conclusion to the second hypothesis, it appears the following: keeping in mind that the sample under consideration is still limited to university students and to regions surrounding the capital, the difference between those regions does not affect the attitude and opinions of the population toward recycling significantly enough to justify the second hypothesis of this study. Therefore, this hypothesis turns out to be irrelevant in the circumstances and for the population taken under study. Consequently, the young educated generation is not affected by the place of residence when it comes to environmental concerns and to active participation in recycling efforts to prevent more damage and waste of resources. It is in fact aware of the problem, and has an attitude of responsibility and willingness to help solve the problem, provided it gets clear explanations and justification of the actions required from it.

The third hypothesis developed below states that: Respondents of low- to middle- level income are more aware and ready to participate in recycling efforts than people of high income levels.

We can deduce, based on the answers collected in the survey, that on the whole, all respondents have shown interest and readiness to participate in recycling, as depicted by questions 1 and 10 of the questionnaire. The participation proportions range between 50% and 65% of the sample in all its categories alike, going from respondents with a monthly income of less than L.L.1,500,000, to respondents with monthly income of more than L.L.8,000,000. When it comes to question 11 concerned with practical daily separation of trash in homes, universities, and offices, the picture somewhat changes; while people with monthly income of less than L.L.3,000,000 (group A in table 14 below) show a 95% to 100% willingness to separates their waste at home, university or work, the contribution of respondents with monthly income of more than L.L.3,000,000 (group B in table 14 below), falls below this level, and as low as 78% in some instances. The detailed results are listed in the table 14 as follows:

Table 14 - Comparison of daily separation of trash between Group A and Group B

Question 11	Home separat.	Univers. separat.	Work separat.
Group A	97	92.5	93
Group B	82	87	86

The same split in responses occurs when respondents are asked about their motivations for participating in recycling (question 12). Group A members are pushed by human and patriotic motivations such as the general welfare, the love of their country and their pride in it, or the well-being and cleanliness of society as a whole, especially roads and touristic sites; group B, on the other hand, stresses on environmental motivations, like pollution control, ecosystem balance, and other global considerations. Very few people (almost 4%) have mentioned economic motivations and profit gaining from recycling.

On the whole, we can deduce that the young educated population of Beirut and its suburbs *feels* the importance of the environmental problem, and *senses* the necessity of doing something to contribute personally to find an adequate solution to it. What

they need is further explanation and presentation of the present situation with the aid of numbers and statistics. They also need to be specifically guided and followed up in the fulfillment of their role, by being told explicitly what they are expected to accomplish in order to do it. If they are presented with clear and detailed instructions, logical sequence and adequate follow-up of their contribution, and if they are shown the physical results of recycling steel cans, including the financial and economic benefits of it, they would eventually be eager to contribute at least periodically, and at best continuously by separating steel cans from their trash. As it is very well understood, media communication is the most effective tool to reach people in modern society, and to introduce ideas and concepts. It is also able to convince any audience of the benefits of recycling, and to give the public instructions to follow daily in order to separate their trash and thus to contribute to the general welfare and in environmental protection. Respondents have rated the most powerful media instruments, among the five following channels presented to them by the researcher (Question 4: Rating of the most effective media channels by decreasing effectiveness): 1) television, 2) radio, 3) newspapers, 4) magazines, and 5) lectures. The answers have been recorded as follows: Television is the most effective media, since 61.7% of the respondents have rated it as their primary source of information. TV is followed by radio, chosen by 24.3% of the population as their second choice; then newspapers come third, as indicated by the 37.8% of the sample, magazines is fourth place, and finally lectures are rated as the fifth media of communication by 40.4% of the population. These results would help the marketing department to organize, with the assistance of advertising agencies, in distributing and organizing their promotional messages and appeals adequately among the various communication channels mentioned above. Their goal would be to cover the maximum number possible of people, and to be the most effective possible in delivering the messages and the ads. This young educated population would be moved by specific arguments meeting their deep motivations and beliefs. As it appears in the answers collected in the survey, the young educated generation under study attaches the biggest value to the land aspect of the question: 41% of the respondents have considered that the most important benefit of recycling is to divert from landfill, thus saving the sites used presently for waste dumping, for alternative, more beneficial and economic functions. Next in preference, comes the reduction in raw materials cost (27.7%). This is easily understandable in Lebanon, a

country that imports all the raw materials necessary for all kinds of production and manufacturing, and the population under study is well aware of the high costs of imports and the resulting deficit in Lebanon's external balance of payments. Therefore, any promotional campaign would best focus of the quality of recycled steel, which is the same as steel produced from virgin ores, but at lower prices and greater accessibility to local producers. The third accomplishment of recycling is the creation of jobs, since unemployment and the lack of adequate jobs is one of the greatest problems facing the young generation in Lebanon nowadays, a generation composed of people who are going to graduate soon and join the workforce in the near future. Therefore, 35.3% out of the sample population considered job creation to be the third benefit of recycling in the hierarchy, out of the five benefits listed above, and which we are going to recapitulate once more quickly by the following: 1) conservation of natural resources, 2) cheaper raw materials, 3) diverting from landfills, 4) creation of jobs, and 5) health aspects. Conservation of natural resources and the respect of public health have been mentioned also, however less frequently than the three aspects mentioned above. Therefore the three main arguments that should be used by any promotional campaign for recycling are, in order, the following: diverting from landfill space, cheaper raw materials, and the creation of jobs for the recycling industry. The most successful messages have been found to be the ones insisting on human and patriotic feelings, such as the encouragement to act as a good loyal citizen in order to keep Lebanon clean, healthy, touristically appealing, and culturally developed. By these words, I am only citing the opinions and sayings of respondents, as they were given in the survey. Next in the hierarchy of preference, comes environmental arguments, that would stress on the pure ecological aspect of recycling, namely nature's preservation, the ecosystem balance, and the resources regeneration rythm. The previous assertments are also taken from the answers of respondents to the survey.

A few points remain to highlight before concluding the section about the results of the survey. Table 15 below shows the evolution of the respondents' answers given on their level of information, then their concern, up to their readiness to participate in recycling efforts:

Table 15 - Evolution of Attitude from Information to Participation

Question 3	Information	Concern	Participation
Positive	27.7%	39.4%	65%
Negative	72.3%	60.6%	35%

It appears clearly that, while a small proportion of the respondents (27.8%) are well-informed of environmental issues, their concern about such issues rise to nearly 40% of the total population. Even further, the figures increase to 65% of them who are ready to participate in recycling efforts, even though they have no or very little information about the problem. This shows favourable dispositions among the young generation, a sign of hope that it can be mobilized to the maximum extent of participation, provided there exists a good reliable leadership, applying a sound strategy of action in order to evolve things to the best.

Another thing worth mentioning is the fact that the motivations mentioned by the respondents are in majority dealing with values and human well-being. The young educated persons are not impressed by the society of consumption and by materialistic interests. This is depicted in table 16 below:

Table 16 - Motivations of the Respondents for Participation

Question 12	Environmental	Human	Env/Human	Economic
Motivations	15.2%	40.2%	27.2%	1%

40.2% of the respondents have stressed on human and patriotic motives, and it is the highest proportion in the list of motivations suggested by them. Less than 1% of them are driven by economic and materialistic benefits, and consider that these elements play a role in their enrollment in the recycling efforts. They tend, instead, to respect human values, and to humanize their environment, socially, politically, and even physically.

The last finding of the preceding survey worth mentioning shows that there are no discrepancies between genders concerning recycling issues. Both men and women alike have the same level of knowledge, concern and degree of participation.

As it appears in Table 17 below, the business under study has a positive return on investment, since the difference between the cumulative present value of cash flows over the next five years, and the initial investment, is a positive figure of US$7,103,090. Therefore, the recycling business is economically feasible.

Since waste is collected solely by Sukleen, therefore the steel cans will have to be bought from Sukleen, at a price agreed upon so that it preserves benefits of both parties. So, the best location of the recycling business would be very close to Sukleen. This way, transportation costs will be reduced to their minimum, and the operations will save time and gain in efficiency. In the present situation, the supply of used steel cans from Sukleen seems to be the best alternative. The reason is that the recycling business proposed in this study, during its founding and growing phase, could not benefit from the favorable conditions economies of scale and mass production. On the other hand, Sukleen, being already established and operational in an efficient way, since 1993, is able to operate efficiently and with minimum cost. In a later stage, we could anticipate an optimal level of consumer participation in the recycling efforts, and consequently much larger volumes of used steel cans entering the plant. Then, alternatives could be reviewed and analyzed, according to their efficiency, profitability, and benefit to the environment and to society.

Table 17 - NPV Analysis of Proposed Recycling Profitability

NET PRESENT VALUE	
Initial Investment	1,050,000
Present Value of Cash Flows	6,010,729
Net Present Value	**4,960,729**

Chapter VI

Conclusion

Recapitulation of findings

The overall findings of this study can be recapitulated as follows: university students of both genders, and coming from various socio-economic and regional backgrounds, can and should be addressed for the introduction of the recycling concept into the Lebanese market. They have little information of the subject, but are ready to participate in a recycling effort organized by a responsible and reliable source, be it a government agency or a private enterprise.

As for the economic feasibility of such a project, it has been depicted, using figures and tables, that recycling is beneficial not only on the environmental level, but also economically and financially. On the economic level, recycling steel cans will reduce imports, thus decreasing the loss in the Balance of Payments. Financially, it offers prospects for good opportunities to investors and businessmen interested in profit and growth.

Viewed from a social perspective, recycling offers job opportunities and reduces unemployment, contributes in cleaning the streets and the Lebanese sites, and creates a sense of consciousness in Lebanese people toward the environment.

All these benefits are added to the primary and essential effects of recycling in preserving natural resources and helping restore the ecosystem and the balance of nature.

It appears to us, after the research and investigations conducted throughout this study, that only one company handles the collection of commingled waste in Beirut and its suburbs: the Sukleen company. Trucks belonging to this company collect the commingled waste from Beirut and its suburbs, and bring this waste to the composting plant in Qarantina. Then, they are separated into: organic waste (composed of paper, tissue, food waste ...), combustible waste, metals, glass, and plastic components. All this separation is done on the site of Sukleen in Qarantina, and the separated materials, which are neither organic nor combustible, are ready to be sold; used steel cans are part of these materials; as already mentioned, the price of steel cans is set at US$75 per ton. Therefore, the supply of steel cans for our business concern is located in one central place: the Sukleen composting plant in Qarantina. Cans bought from there are

then brought to the recycling plant under study. (I would like to anticipate and recommend that the plant would best be located in an area adjoining the Sukleen plant, so as to reduce the transportation costs to their minimum). Once on site, the steel cans are pushed by a front-end loader onto the in-feed conveyor, and taken to be cleaned from contaminants, labels and paints. A magnetic separator can be used also for further ascertaining that aluminum cans have not entered in the steel stream by mistake, and to assure product purity. After the whole process is over, the recycled steel is shaped in sheets, up to the demand of customers in the food and beverage industry.

The recycling business under study will manage the used steel cans throughout an entire process summarized as follows: buying used cans from the waste stream, then cleaning, shredding, melting and de-tinning them, shaping and finally selling the final products in the form of steel sheets. Steel cans are sorted, then shredded to facilitate the removal of food and paper contamination and then melted down. De-tinned steel is sent to a steel mill to be made into a new product. When scrap metals are collected for recycling, they are generally crushed, shredded, melted and refined, and poured into sheets. Metal can be re-melted, re-fined, and reprocessed indefinitely without losing their required characteristics, and most scrap metal is recycled into products similar to the ones originally made from virgin materials. Metals recycling is one of the most efficient ways to conserve nonrenewable natural resources.[50]

Consumers in the Lebanese market, in particular, have a precise and simple role to accomplish: separate their trash daily, avoid throwing anything by the windows and on the streets, and above all, feel their responsibility and take this matter seriously, otherwise they will be the biggest losers.

The study proposed in this paper is a very limited and small part of an overall environmental program that could, and should, be implemented in Lebanon as soon as possible, starting with children's education in schools. And in case it proves, as suggested, that it is a profitable business to producers, job hunters and the import-export balance of the country, then it would be the first step, leading the way to other recycling ventures concerning all other kinds of waste, because "In nature, nothing is created, nothing is lost; everything is part of a continuous cycle" (Lavoisier)

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[50] *Recycling in America*

Concluding with a rather optimistic note, it is true that the environmental problem in Lebanon is not as tragic as it appears, because there is no primary industry in our country, generating huge quantities of waste from ores re-fining and manufacturing. Lebanese industrialists import semi-manufactured materials, and process them into finished products, thus generating only a limited amount of solid waste and industrial pollution. Therefore, the problem of waste management would not be too hard to solve within few months, provided, though, that the political interests and considerations are set aside and experts are left free to perform according to their professional knowledge and conscience, and in a way to serve the general welfare of the whole society.

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APPENDIX A

Questionnaire

|__|__|__|

التاريخ: _____

صديقتي ، صديقي ،

في إطار مشروع مُتكامل يُعالج قضايا النفايات الصلبة في مدينة بيروت وضواحيها ، يقوم عدد من طلاّب كلّيّة إدارة الأعمال في جامعة سيّدة اللويزة باستقصاء هدفه التعرُّف على مدى معرفة السكّان بطرق مُعالَجة النفايات المنزلية ، والمُستوعَبات المعدنية منها بشكل خاص ، ومدى استعدادهم للمُشارَكة في مُعالجة هذه القضايا ، الهدف هو القيام بعمل مُشترَك لإيجاد حلّ لتراكُم هذه النفايات ومُعالجتها بشكل يُخفّف من الهدر في المواد الأولية ، ويُحافظ على النظافة العامة ويحدّ من عدد ومساحة مكبّات النفايات المُلوِّثة والمُضِرَّة بالصحة العامة وبالبيئة .

لذلك ،

نرجو منك المُساهمة في إنجاح هذه المهمّة بالإجابة على أسئلة هذه الاستمارة .

ولك شكرنا ، وشكر الذين نخدمهم معاً .

نادين جبور

١. هل تثير مشاكل البيئة اهتمامك ؟

|__| اهتمام عميق ومتواصل

|__| بصورة مرحلية

|__| سطحياً

|__| نادراً

|__| كلاّ، على الإطلاق

٢. أذكر بحسب الأولوية من ١ الى ٦، الطرق الأنسب لمُعالجة النفايات الصلبة (١=الطريقة الأنسب، ٦=الطريقة الأضعف)

|__| وضعها في مكبّ للنفايات (Landfilling)

|__| حرقها (Incineration)

|__| تحويلها الى أسمدة (Composting)

|__| إعادة تصنيعها (Recycling)

|__| وضعها على زاوية الشارع

|__| غيره : _____

٣. كيف تُقيِّم معلوماتك الشخصية حول إعادة التصنيع:

|_١_|_٢_|_٣_|_٤_|_٥_|

كثير الاطّلاع لا معرفة بالموضوع

|_١_|_٢_|_٣_|_٤_|_٥_|

معني شخصياً غير معني شخصياً

|_١_|_٢_|_٣_|_٤_|_٥_|

مُستعد للمشاركة غير مستعد للمُشاركة

٤. أذكر ،بحسب الأولوية من ١ الى ٦، مصادر المعلومات حول مشاكل البيئة:

|__| من الصحف |__| من المجلاّت

|__| من شاشة التلفزيون |__| من مُحاضرات

|__| من الإذاعة |__| غيره: _____

٥. النفايات الصلبة في بيروت وضواحيها تُعالَج بإرسالها الى مكبّات على الشاطئ؛ ما رأيك بهذه المُعالجة؟

|__| موافِق

|__| غير موافِق

٦. هل أنت مُطَّلِع على إعادة تصنيع علَب الموادّ الغذائية في مدينة بيروت؟

|__| نعم |__| لا

٧. ما هو موقفك من هذه المُعالجَة؟

|_١_|_٢_|_٣_|_٤_|_٥_|

معني شخصياً غير معني شخصياً

|_١_|_٢_|_٣_|_٤_|_٥_|

مُستعد للمشاركة غير مستعد للمُشاركة

٨. حسب معلوماتك ، ما هي المواد التي يُعاد تصنيعها في بيروت حالياً:

|__| مُعلّبات ومشروبات غازية

|__| بلاستيك

|__| زجاج

|__| ورق وكارتون

|__| لا معلومات

٩. إذكر ، بحسب الأولويّة ، أهمّ الدوافع وراء إعادة التصنيع (١=الأكثر أهمية):

١- _____

٢- _____

٣- _____

٤- _____

١٠. كيف تستطيع أن تُنظِّم عمليّة فرز العلب والقناني الزجاجية ، البلاستيكية والمعدنية عن باقي النفايات ، ووضعها في براميل مُجهَّزة لهذه الغاية عند مدخل منزلك ، أو جامعتك ، أو عملك؟

|__| بصورة متواصلة ودقيقة دائماً

|__| بصورة مرحلية وإجمالاً

|__| بشكل مُتقطِّع

|__| نادراً

|__| كلاّ ، على الإطلاق

١١. إذا وُضِعت براميل خاصة بالعلب والقناني الزجاجية والبلاستيكية والمعدنية عند مدخل منزلك ، أو جامعتك ، أو عملك ، هل أنت مُستعد لفصل هذه المواد عن بقية النفايات ، ولوضعها في تلك البراميل؟

	نعم	كلا
في البيت		
في الجامعة		
في العمل		

١٢. إذا كان جوابك إيجابياً ، فما هي الدوافع في عملك هذا؟

_____

_____

_____

_____

١٣. مكان الإقامة:

|__| بيروت وضواحيها

|__| خارج بيروت وضواحيها

١٤. المدخول الشهري للعائلة:

|__| أقل من ١،٥٠٠،٠٠٠

|__| بين ١،٥٠٠،٠٠٠ و ٣ ملايين

|__| بين ٣ ملايين و ٥ ملايين

|__| بين ٥ ملايين و ٨ ملايين

|__| أكثر من ٨ ملايين

١٥. الجنس:

|__| ذكر |__| أنثى

شكراً

APPENDIX B

Letter to the UNEP

June 13, 1996

Fax: (+961) 9-938127
Tel: (+961) 9-831480

Ms. Linda Spencer
Acting Director
United Nations Environment Programme (UNEP)
Infoterra, PAC
P.O. Box 30552, Nairobi
Fax: (+254) 2-624269 / 226949

Dear Madam:

I am an MBA student at Notre Dame University - Louaizeh, Lebanon, preparing a thesis project, under the title: "**The Economic Feasibility of Recycling Metallic Food Containers in Lebanon".**
The purpose of this study is to propose the structure and operation of a recycling business designed to recycle the used steel food containers into new food cans. The plant is located in Beirut, and its capacity is 20,000kgs of steel cans daily.
One of the objectives of the project is to conduct a Benefit/Cost analysis for this recycling business, in order to highlight the economic profitability and feasibility of the company, by comparing the revenues generated with the costs incurred.
I would be grateful if you could provide me with the following information at your earliest convenience, because this is a new industry in Lebanon, so we do not have any precise reference on it:
1. The **Fixed Cost** of the equipment needed for crushing, shredding, detinning, melting the metal, and forming steel sheets out of the steel cans entered in the process. Also, an estimate of the annual operating costs incurred by the normal performance of this equipment
2. In case the project was a real-life business, would you consider **subsidizing such recycling projects** organized by private companies, either in the form of grants and/or long-term loans, or in offering discounted prices and/or facility of payment for the equipment mentioned above.
Thanking you in advance for your time and help,
Sincerely,

Nadine Jabbour

c.c.: Dr. Philippe Zgheib, Research Director
Dr. Hratch Hadjetian, Dean, Faculty of Business Administration

APPENDIX C

Benefit-Cost Analysis

Cost Benefit Analysis - Year 1		
Description	U.S.D	
Sales		2,737,500
Purchase of used steel cans	191,625	
Construction Services	150,000	
Transportation (2 Trucks)	73,000	
Labors	23,100	
Personnel	52,200	
Operation & Maintenance	105,000	
Governmental Taxes	219,000	
Unforeseen	410,625	
Depreciation	63,000	
Total Operating Cost		1,287,550
Net Income		1,449,950
Cash flow *		1,512,950
PV of CF **		1,375,272

Cost Benefit Analysis - Year 2		
Description	U.S.D	
Sales		2,808,675
Purchase of used steel cans	196,607	
Construction Services	153,900	
Transportation (2 Trucks)	74,898	
Labors	23,701	
Personnel	53,557	
Operation & Maintenance	107,730	
Governmental Taxes	224,694	
Unforeseen	421,301	
Depreciation	64,638	
Total Operating Cost		1,321,026
Net Income		1,487,649
Cash Flow		1,552,287
PV of CF		1,282,189

* Cash Flows = Net Income + Depreciation

** I = 10% current industry rate

Cost Benefit Analysis - Year 3

Description	U.S.D	
Sales		2,881,701
Purchase of used steel cans	201,719	
Construction Services	157,901	
Transportation (2 Trucks)	76,845	
Labors	24,317	
Personnel	54,950	
Operation & Maintenance	110,531	
Governmental Taxes	230,536	
Unforeseen	432,255	
Depreciation	66,319	
Total Operating Cost		1,355,373
Net Income		1,526,328
Cash Flow		1,592,646
PV of CF		1,196,077

Cost Benefit Analysis - Year 4

Description	U.S.D	
Sales		2,956,625
Purchase of used steel cans	206,964	
Construction Services	162,007	
Transportation (2 Trucks)	78,843	
Labors	24,949	
Personnel	56,378	
Operation & Maintenance	113,405	
Governmental Taxes	236,530	
Unforeseen	443,494	
Depreciation	68,043	
Total Operating Cost		1,390,613
Net Income		1,566,012
Cash Flow		1,634,055
PV of CF		1,116,060

Cost Benefit Analysis - Year 5

Description	U.S.D	
Sales		3,033,497
Purchase of used steel cans	212,345	
Construction Services	166,219	
Transportation (2 Trucks)	80,893	
Labors	25,598	
Personnel	57,844	
Operation & Maintenance	116,353	
Governmental Taxes	242,680	
Unforeseen	455,025	
Depreciation	69,812	
Total Operating Cost		1,426,769
Net Income		1,606,728
Cash Flow		1,676,540
PV of CF		1,041,132